**KONGU ENGINEERING COLLEGE** 

(Autonomous Institution Affiliated to Anna University, Chennai)

PERUNDURAI ERODE – 638 060

# TAMILNADU INDIA



# **REGULATIONS, CURRICULUM & SYLLABI – 2022**

(CHOICE BASED CREDIT SYSTEM AND OUTCOME BASED EDUCATION)

# BACHELOR OF ENGINEERING DEGREE IN

# **MECHANICAL ENGINEERING**

**DEPARTMENT OF MECHANICAL ENGINEERING** 



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#### KONGU ENGINEERING COLLEGE, PERUNDURAI, ERODE – 638 060 (Autonomous)

#### **INSTITUTE VISION**

To be a centre of excellence for development and dissemination of knowledge in Applied Sciences, Technology, Engineering and Management for the Nation and beyond.

#### **INSTITUTE MISSION**

We are committed to value based Education, Research and Consultancy in Engineering and Management and to bring out technically competent, ethically strong and quality professionals to keep our Nation ahead in the competitive knowledge intensive world.

#### **QUALITY POLICY**

We are committed to

- Provide value based quality education for the development of students as competent and responsible citizens.
- Contribute to the nation and beyond through research and development
- Continuously improve our services

#### DEPARTMENT OF MECHANICAL ENGINEERING

#### **DEPARTMENT VISION**

To be a centre of excellence for development and dissemination of knowledge in Mechanical Engineering for the Nation and beyond.

#### **DEPARTMENT MISSION**

Department of Mechanical Engineering is committed to:

- MS1: Establish itself as an excellent academic centre through expert pedagogical methods and modern laboratories to produce world class mechanical engineers.
- MS2: Disseminate knowledge through seminar, conferences and continuing education programs.
- MS3: Make tie-ups with industries, research centres and renowned institutions to synergize the benefit.
- MS4: Contribute towards the upliftment of the society.

#### **PROGRAM EDUCATIONAL OBJECTIVES (PEOs)**

Graduates of Mechanical Engineering will be able to:

- PEO1: Practice Mechanical Engineering in the general stems of design, manufacture, service and allied engineering sectors.
- PEO2: Habituate continuous learning and carryout research and development in science, engineering and technology that support career growth.
- PEO3: Exhibit ethical code of conduct in a professional manner to solve real-time multidisciplinary engineering problems.
- PEO4: Demonstrate managerial and leadership capabilities that support economic development of firms as well as society.

#### MAPPING OF MISSION STATEMENTS (MS) WITH PEOS

MS\PEO	PEO1	PEO2	PEO3	PEO4
MS1	3	3	3	3
MS2	2	3	2	1
MS3	2	3	2	2
MS4	1	1	2	3

1 – Slight, 2 – Moderate, 3 – Substantial

	PROGRAM OUTCOMES (POs)
Graduate	es of Mechanical Engineering will be able to:
PO1	<b>Engineering knowledge:</b> Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	<b>Problem analysis:</b> Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	<b>Design/development of solutions:</b> Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4	<b>Conduct investigations of complex problems:</b> Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	<b>Modern tool usage:</b> Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6	<b>The engineer and society:</b> Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	<b>Environment and sustainability:</b> Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	<b>Ethics:</b> Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	<b>Individual and team work:</b> Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	<b>Communication:</b> Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	<b>Project management and finance:</b> Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	<b>Life-long learning:</b> Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

	PROGRAM SPECIFIC OUTCOMES (PSOs)							
Gradua	tes of Mechanical Engineering will be able to:							
PSO1	<b>Modern tool usage:</b> use the techniques, skills and modern engineering tools necessary for engineering practice.							
PSO2	<b>Domain Knowledge:</b> work professionally in thermal, manufacturing and mechanical system areas including the design and realization of such systems with the use of computational tools.							

PEO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
PEO1	3	3	3	2	2	2	2	1	1	2	2	2	2	3
PEO2	3	3	3	3	3	3	2	1	1	2	2	2	3	3
PEO3	3	3	3	2	2	1	2	3	1	2	1	2	3	3
PEO4	2	1	2	1	2	3	1	2	3	3	3	2	2	3

# MAPPING OF PEOs WITH POs AND PSOs

1 – Slight, 2 – Moderate, 3 – Substantial

#### KONGU ENGINEERING COLLEGE, PERUNDURAI, ERODE – 638060

#### (Autonomous)

#### **REGULATIONS 2022**

#### CHOICE BASED CREDIT SYSTEM AND OUTCOME BASED EDUCATION

# BACHELOR OF ENGINEERING (BE) / BACHELOR OF TECHNOLOGY (BTech) DEGREE PROGRAMMES

# These regulations are applicable to all candidates admitted into BE/BTech Degree programmes from the academic year 2022 – 2023 onwards.

#### 1. DEFINITIONS AND NOMENCLATURE

In these Regulations, unless otherwise specified:

- i. "University" means ANNA UNIVERSITY, Chennai.
- ii. "College" means KONGU ENGINEERING COLLEGE.
- iii. "Programme" means Bachelor of Engineering (BE) / Bachelor of Technology (BTech) Degree programme
- iv. "Branch" means specialization or discipline of BE/BTech Degree programme, like Civil Engineering, Information Technology, etc.
- v. "Course" means a Theory / Theory cum Practical / Practical course that is normally studied in a semester like Mathematics, Physics etc.
- vi. "Credit" means a numerical value allocated to each course to describe the candidate's workload required per week.
- vii. "Grade" means the letter grade assigned to each course based on the marks range specified.
- viii. "Grade point" means a numerical value (0 to 10) allocated based on the grade assigned to each course.
- ix. "Principal" means Chairman, Academic Council of the College.
- x. "Controller of Examinations (COE)" means authorized person who is responsible for all examination related activities of the College.
- xi. "Head of the Department (HOD)" means Head of the Department concerned.

## 2. PROGRAMMES AND BRANCHES OF STUDY

The following programmes and branches of study approved by Anna University, Chennai and All India Council for Technical Education, New Delhi are offered by the College.

Programme	Branch				
	Civil Engineering				
	Mechanical Engineering				
	Electronics and Communication Engineering				
	Computer Science and Engineering				
BE	Electrical and Electronics Engineering				
	Electronics and Instrumentation Engineering				
	Mechatronics Engineering				
	Automobile Engineering				
	Computer Science and Design				
	Chemical Engineering				
	Information Technology				
BTech	Food Technology				
	Artificial Intelligence and Data Science				
	Artificial Intelligence and Machine Learning				

## 3. ADMISSION REQUIREMENTS

#### 3.1 First Semester Admission

The candidates seeking admission to the first semester of the eight semester BE / BTech Degree Programme:

Should have passed the Higher Secondary Examination (10 + 2) in the academic stream with Mathematics, Physics and Chemistry as three of the four subjects of study under Part-III subjects of the study conducted by the Government of Tamil Nadu or any examination of any other University or authority accepted by the Anna University, Chennai as equivalent thereto.

#### (OR)

Should have passed the Higher Secondary Examination of Vocational stream (Vocational groups in Engineering / Technology) as prescribed by the Government of Tamil Nadu.

They should also satisfy other eligibility conditions as prescribed by the Anna University, Chennai and Directorate of Technical Education, Chennai from time to time.

#### 3.2 Lateral Entry Admission

The candidates who hold a Diploma in Engineering / Technology awarded by the State Board of Technical Education, Tamilnadu or its equivalent are eligible to apply for Lateral entry admission to the third semester of BE / BTech.

The candidates who hold a BSc degree in Science(10+2+3 stream) with mathematics as one of the subjects at the BSc level from a recognised University are eligible to apply for Lateral entry admission to the third semester of BE / BTech. Such candidates shall undergo two additional Engineering course(s) in the third and fourth semesters as prescribed by the College.

They should also satisfy other eligibility conditions prescribed by the Anna University, Chennai and Directorate of Technical Education, Chennai from time to time.

# 4. STRUCTURE OF PROGRAMMES

#### 4.1 Categorisation of Courses

The BE / BTech programme shall have a curriculum with syllabi comprising of theory, theory cum practical, practical courses in each semester, professional skills training/industrial training, project work, internship, etc that have been approved by the respective Board of Studies and Academic Council of the College. All the programmes have well defined Programme Outcomes (PO), Programme Specific Outcomes (PSO) and Programme Educational Objectives (PEOs) as per Outcome Based Education (OBE). The content of each course is designed based on the Course Outcomes (CO). The courses shall be categorized as follows:

- i. Humanities and Social Sciences (HS) including Management Courses, English Communication Skills, Universal Human Values and Yoga & Values for Holistic Development.
- ii. Basic Science (BS) Courses
- iii. Engineering Science (ES) Courses
- iv. Professional Core (PC) Courses
- v. Professional Elective (PE) Courses
- vi. Open Elective (OE) Courses
- vii. Employability Enhancement Courses (EC) like Project work, Professional Skills/Industrial Training, Comprehensive Test & Viva, Entrepreneurships/Start ups and Internship / In-plant Training in Industry or elsewhere
- viii. Audit Courses (AC)
- ix. Mandatory Courses (MC) like Student Induction Program and Environmental Science.
- x. Honours Degree Courses (HC)

# 4.2 Credit Assignment and Honours Degree

## 4.2.1. Credit Assignment

Each course is assigned certain number of credits as follows:

Contact period per week	Credits
1 Lecture / Tutorial Period	1
2 Practical Periods	1
2 Project Work Periods	1
40 Training / Internship Periods	1

The minimum number of credits to complete the BE/BTech programme is 168.

## 4.2.2 Honours Degree

If a candidate earns 18 to 20 additional credits in an emerging area, then he/she can be awarded with Honours degree mentioning that emerging area as his/her specialization. The respective board of studies shall recommend the specializations for honours degree and appropriate additional courses to be studied by the candidate which shall get approval from Academic Council of the institution. A candidate shall have not less than 7.5 CGPA and no history of arrears to opt for the honours degree and has to maintain the same during the entire programme.

SNo	Specializations for Honours degree in emerging areas	To be offered as Honours, Only for the following branches mentioned against the specialization
1.	Construction Technology	BE – Civil Engineering
2.	Smart Cities	BE – Civil Engineering
3.	Smart Manufacturing *	BE – Mechanical Engineering
4.	Computational Product Design *	BE – Mechanical Engineering
5.	Intelligent Autonomous Systems *	BE – Mechatronics Engineering
6.	E-Mobility *	BE – Automobile Engineering
7.	Artificial Intelligence and Machine Learning	BE – Electronics and Communication Engineering
8.	System on Chip Design *	BE – Electronics and Communication Engineering
9.	Electric Vehicles	BE – Electrical and Electronics Engineering
10.	Microgrid Technologies	BE – Electrical and Electronics Engineering
11.	Intelligent Sensors Technology *	BE – Electronics and Instrumentation Engineering
12.	Smart Industrial Automation *	BE – Electronics and Instrumentation Engineering
13.	Data Science	BE – Computer Science and Engineering
14.	Cyber Security	BE – Computer Science and Engineering
15.	Data Science	BTech – Information Technology
16.	Cyber Security	BTech – Information Technology
17.	Petroleum and Petrochemical Engineering *	BTech – Chemical Engineering
18.	Waste Technology *	BTech – Chemical Engineering
19.	Food Processing and Management *	BTech – Food Technology
20.	Virtual and Augumented Reality	BE- Computer Science and Design
21.	Data Science	BE- Computer Science and Design
22.	Internet of Things (IoT)	BTech – Artificial Intelligence and Data Science
23.	Blockchain	BTech – Artificial Intelligence and Data Science
24.	Internet of Things (IoT)	BTech – Artificial Intelligence and Machine Learning
25.	Blockchain	BTech – Artificial Intelligence and Machine Learning

Various specializations for various branches recommended by the respective boards of studies are given below:

\*Title by KEC

The courses specified under Honours degree in the emerging area may include theory, theory cum practical, practical, project work, etc. under the particular specialization. A candidate can choose and study these specified courses from fourth semester onwards and he/she shall successfully complete the courses within the stipulated time vide clause 5. Total number of credits earned in each semester may vary from candidate to candidate based on the courses chosen. The registration, assessment & evaluation pattern and classification of grades of these courses shall be the same as that of the courses in the regular curriculum of the programme of the candidate vide clause 6, clause 7 and clause 15 respectively. A candidate can earn Honours degree in only one specialization during the entire duration of the programme.

## 4.3 Employability Enhancement Courses

A candidate shall be offered with the employability enhancement courses like project

work, internship, professional skills training/industrial training, comprehensive test & viva, and entrepreneurships/start ups during the programme to gain/exhibit the knowledge/skills.

# 4.3.1 Professional Skills Training/ Indsutrial Training/Entrepreneurships/Start Ups/ Inplant Training

A candidate may be offered with appropriate training courses imparting programming skills, communication skills, problem solving skills, aptitude skills etc. It is offered in two phases as phase I in fourth semester and phase II in fifth semester including vacation periods and each phase can carry two credits.

#### (OR)

A candidate may be allowed to go for training at research organizations or industries for a required number of hours in fifth semester vacation period. Such candidate can earn two credits for this training course in place of Professional Skills Training course II in fifth semester. He/She shall attend Professional Skills Training Phase I in fourth semester and can earn two credits.

#### (OR)

A candidate may be allowed to set up a start up and working part-time for the start ups by applying his/her innovations and can become a student entrepreneur during BE/BTech programme. Candidates can set up their start up from fifth semester onwards either inside or outside of the college. Such student entrepreneurs may earn 2 credits in place of Professional Skills Training II. The area in which the candidate wants to initiate a start up may be interdisciplinary or multidisciplinary. The progress of the startup shall be evaluated by a panel of members constituted by the Principal through periodic reviews.

#### 4.3.2 Comprehensive Test and Viva

The overall knowledge of the candidate in various courses he/she studied shall be evaluated by (i) conducting comprehensive tests with multiple choice questions generally with pattern similar to GATE and/or (ii) viva-voce examination conducted by a panel of experts assigned by the Head of the department. The members can examine the knowledge of the candidate by asking questions from various domains and the marks will be assigned based on their answers. This course shall carry two credits.

#### **4.3.3** Full Time Project through Internships

The curriculum enables a candidate to go for full time project through internship during a part of seventh semester and/or entire final semester and can earn credits vide clause 7.6 and clause 7.11.

A candidate is permitted to go for full time projects through internship in seventh semester with the following condition: The candidate shall complete a part of the seventh semester courses with a total credit of about 50% of the total credits of seventh semester including Project Work-II Phase-I in the first two months from the commencement of the seventh semester under fast track mode. The balance credits required to complete the seventh semester shall be earned by the candidate through either approved One/Two Credit Courses /Online courses / Self Study Courses or Add/Drop courses as per clause 4.4 and clause 4.5 respectively.

A candidate is permitted to go for full time projects through internship during eighth semester. Such candidate shall earn the minimum number of credits required to complete eighth semester other than project through either approved One / Two Credit Courses /Online courses / Self Study Courses or Add/Drop courses as per clause 4.4 and clause 4.5 respectively.

Assessment procedure is to be followed as specified in the guidelines approved by the Academic Council.

**4.3.4** A student shall go for in-plant training for duration of two weeks during the entire programme. It is mandatory for all the students.

# 4.4 One / Two Credit Courses / Online Courses / Self Study Courses

The candidates may optionally undergo One / Two Credit Courses / Online Courses / Self Study Courses as elective courses.

- **4.4.1 One / Two Credit Courses:** One / Two credit courses shall be offered by the college with the prior approval from respective Board of Studies. A candidate can earn a maximum of six credits through one / two credit courses during the entire duration of the programme.
- **4.4.2 Online Courses:** Candidates may be permitted to earn credits for online courses, offered by NPTEL / SWAYAM / a University / Other Agencies, approved by respective Board of Studies.
- **4.4.3** Self Study Courses: The Department may offer an elective course as a self study course. The syllabus of the course shall be approved by the respective Board of Studies. However, mode of assessment for a self study course will be the same as that used for other courses. The candidates shall study such courses on their own under the guidance of member of the faculty following due approval procedure. Self study course is limited to one per semester.
- **4.4.4** The elective courses in the final year may be exempted if a candidate earns the required credits vide clause 4.4.1, 4.4.2 and 4.4.3 by registering the required number of courses in advance.
- **4.4.5** A candidate can earn a maximum of 30 credits through all one / two credit courses, online courses and self study courses.

# 4.5 Flexibility to Add or Drop Courses

- **4.5.1** A candidate has to earn the total number of credits specified in the curriculum of the respective programme of study in order to be eligible to obtain the degree. However, if the candidate wishes, then the candidate is permitted to earn more than the total number of credits prescribed in the curriculum of the candidate's programme.
- **4.5.2** From the first to seventh semesters the candidates have the option of registering for additional elective/Honours courses or dropping of already registered additional elective/Honours courses within two weeks from the start of the semester. Add / Drop is only an option given to the candidates.
- **4.6** Maximum number of credits the candidate can enroll in a particular semester cannot exceed 30 credits.
- **4.7** The blend of different courses shall be so designed that the candidate at the end of the programme would have been trained not only in his / her relevant professional field but also would have developed to become a socially conscious human being.
- **4.8** The medium of instruction, examinations and project report shall be English.

# 5. DURATION OF THE PROGRAMME

- **5.1** A candidate is normally expected to complete the BE / BTech Degree programme in 8 consecutive semesters/4 Years (6 semesters/3 Years for lateral entry candidate), but in any case not more than 14 semesters/7 Years (12 semesters/6 Years for lateral entry candidate).
- **5.2** Each semester shall consist of a minimum of 90 working days including continuous assessment test period. The Head of the Department shall ensure that every teacher imparts instruction as per the number of periods specified in the syllabus for the course being taught.
- **5.3** The total duration for completion of the programme reckoned from the commencement of the first semester to which the candidate was admitted shall not exceed the maximum duration specified in clause 5.1 irrespective of the period of break of study (vide clause 11) or prevention (vide clause 9) in order that the candidate may be eligible for the award of the degree (vide clause 16). Extension beyond the prescribed period shall not be permitted.

# 6. COURSE REGISTRATION FOR THE EXAMINATION

- **6.1** Registration for the end semester examination is mandatory for courses in the current semester as well as for the arrear courses failing which the candidate will not be permitted to move on to the higher semester. This will not be applicable for the courses which do not have an end semester examination.
- **6.2** The candidates who need to reappear for the courses which have only continuous assessment shall enroll for the same in the subsequent semester, when offered next, and repeat the course. In this case, the candidate shall attend the classes, satisfy the attendance requirements (vide clause 8) and earn continuous assessment marks. This will be considered as an attempt for the purpose of classification.
- **6.3** If a candidate is prevented from writing end semester examination of a course due to lack of attendance, the candidate has to attend the classes, when offered next, and fulfill the attendance requirements as per clause 8 and earn continuous assessment marks. If the course, in which the candidate has a lack of attendance, is an elective, the candidate may register for the same or any other elective course in the subsequent semesters and that will be considered as an attempt for the purpose of classification.
- 6.4 A candidate shall register for the chosen courses as well as arrear courses (if any vide clause 6.2 and 6.3) from the list of courses specified under Honours degree.

# 7. ASSESSMENT AND EXAMINATION PROCEDURE FOR AWARDING MARKS

**7.1** The BE/BTech programmes consist of Theory Courses, Theory cum Practical courses, Practical courses, Comprehensive Test and Viva, Project Work, Industrial Training /Professional Skills Training, Internship/In-plant Training and Entrepreneurships/ Start ups. Performance in each course of study shall be evaluated based on (i) Continuous Assessments (CA) throughout the semester and (ii) End Semester Examination (ESE) at the end of the semester except for the courses which are evaluated based on continuous assessment only. Each course shall be evaluated for a maximum of 100 marks as shown below:

Sl. No.	Category of Course	Continuous Assessment Marks	End Semester Examination Marks
1.	Theory	40	60
2.	Theory cum Practical (The distribution of marks shall be decided based on the credit weightage assigned to theory and practical components.)	50	50
3.	Practical	60	40
4.	Professional Skills Training / Comprehensive Test & Viva / Entrepreneurships / Start ups / Project Work I / Mandatory Course/Industrial Training/ Universal Human Values / Yoga and Values for Holistic Development	100	
5.	Project Work II Phase I / Project Work II Phase II / Internships	50	50
6.	One / Two credit Course	The distribution of marks shall be	
7.	All other Courses	decided based on the credit weightage assigned	

**7.2** Examiners for setting end semester examination question papers for theory courses, theory cum practical courses and practical courses and evaluating end semester examination answer scripts, project works, internships and entrepreneurships/start ups shall be appointed by the Controller of Examinations after obtaining approval from the Principal.

# 7.3 Theory Courses

For all theory courses out of 100 marks, the continuous assessment shall be 40 marks and the end semester examination shall be for 60 marks. However, the end semester examinations shall be conducted for 100 marks and the marks obtained shall be reduced to 60. The continuous assessment tests shall be conducted as per the schedule laid down in the academic schedule. The total of the continuous assessment marks and the end semester examination marks shall be rounded off to the nearest integer.

7.3.1	The assessment pattern for awarding continuous assessment marks shall be as
	follows:

Sl. No.	Туре	Max. Marks	Remarks
1	Test - I	20	
1.	Test - II	20	Average of best 2 tests
	Test - III	20	(20 marks)
2.	Tutorial: (Tutorial/Problem Solving (or) Simulation (or) Simulation & Mini Project (or) Mini Project (or) Case Studies (or) Any other relevant to the course )	15	Type of assessment is to be chosen based on the nature of the course and to be approved by Principal
3.	Others: Assignment / Paper Presentation in Conference / Seminar / Comprehension / Activity based learning / Class notes	05	To be assessed by the Course Teacher based on any one type.
	Total	40	Rounded off to the one decimal place

However, the assessment pattern for awarding the continuous assessment marks may be changed based on the nature of the course and is to be approved by the Principal.

- **7.3.2** A reassessment test or tutorial covering the respective test or tutorial portions may be conducted for those candidates who were absent with valid reasons (Sports or any other reason approved by the Principal).
- **7.3.3** The end semester examination for theory courses shall be for a duration of three hours and shall be conducted between November and January during odd semesters and between April and June during even semesters of every year.

## 7.4 Theory cum Practical Courses

For courses involving theory and practical components, the evaluation pattern as per the clause 7.1 shall be followed. Depending on the nature of the course, the end semester examination shall be conducted for theory and the practical components. The apportionment of continuous assessment and end semester examination marks shall be decided based on the credit weightage assigned to theory and practical components approved by Principal.

## 7.5 Practical Courses

For all practical courses out of 100 marks, the continuous assessment shall be for 60 marks and the end semester examination shall be for 40 marks. Every exercise / experiment shall be evaluated based on the candidate's performance during the practical class and the candidates' records shall be maintained.

- **7.5.1** The assessment pattern for awarding continuous assessment marks for each course shall be decided by the course coordinator based on rubrics of that particular course, and shall be based on rubrics for each experiment.
- **7.5.2** The end semester examination shall be conducted for a maximum of 100 marks for duration of 3 hours and reduced to 40 marks. The appointment of examiners and the schedule shall be decided by chairman of Board of Study of the relevant board.

## 7.6 Project Work II Phase I / Project Work II Phase II

- **7.6.1** Project work shall be assigned to a single candidate or to a group of candidates not exceeding 4 candidates in a group. The project work is mandatory for all the candidates.
- **7.6.2** The Head of the Department shall constitute review committee for project work. There shall be two assessments by the review committee during the semester. The candidate shall make presentation on the progress made by him/her before the committee.
- **7.6.3** The continuous assessment and end semester examination marks for Project Work II Phase I /Project Work II Phase II and the Viva-Voce Examination shall be distributed as below.

Continuous Assessment (Max. 50 Marks)						End Semester Examination (Max. 50 Marks)			
Zeroth Review		Review I (Max 20 Marks)		Review II (Max. 30 Marks)		Report Evaluation (Max. 20 Marks)	Viva - V (Max. 30)	√oce Marks)	
Rv. Com	Super visor	Review Committee (excluding supervisor )	Super visor	Review Committee (excluding supervisor)	Super visor	Ext. Exr.	Super visor	Exr.1	Exr.2
0	0	10	10	15	15	20	10	10	10

- **7.6.4** The Project Report prepared according to approved guidelines and duly signed by the Supervisor shall be submitted to Head of the Department. The candidate(s) must submit the project report within the specified date as per the academic schedule of the semester. If the project report is not submitted within the specified date then the candidate is deemed to have failed in the Project Work and redo it in the subsequent semester.
- **7.6.5** If a candidate fails to secure 50% of the continuous assessment marks in the project work, he / she shall not be permitted to submit the report for that particular semester and shall have to redo it in the subsequent semester and satisfy attendance requirements.
- **7.6.6** The end semester examination of the project work shall be evaluated based on the project report submitted by the candidate in the respective semester and viva-voce examination by a committee consisting of two examiners and supervisor of the project work.
- **7.6.7** If a candidate fails to secure 50 % of the end semester examination marks in the project work, he / she shall be required to resubmit the project report within 30 days from the date of declaration of the results and a fresh viva-voce examination shall be conducted as per clause 7.6.6.

**7.6.8** A copy of the approved project report after the successful completion of viva-voce examination shall be kept in the department library.

## 7.7 Project Work I / Industrial Training

The evaluation method shall be same as that of the Project Work II as per clause 7.6 excluding 7.6.3, 7.6.5, 7.6.6 and 7.6.7. The marks distribution is given below.

			C	ontinuous Asse (Max. 100 Ma	ssment irks)				
					Review III (Max. 50 Marks)				
Zeroth Review		Review I (Max 20 M	larks)	Review II Max 30 Marks)	)	Report Evaluation (Max. 20 Marks)	Viva - Voce (Max. 30 Marks)		
Review	Super	Review	Super	Review	Super	Review	Super	Review	
Commi ttee	visor	Committee (excluding supervisor)	visor	Committee (excluding supervisor)	visor	Committee	visor	Committee	
0	0	10	10	15	15	20	10	20	

If a candidate fails to secure 50 % of the continuous assessment marks in this course, he / she shall be required to resubmit the project report within 30 days from the date of declaration of the results and a fresh viva-voce examination shall be conducted.

## 7.8 Professional Skills Training

Phase I training shall be conducted for minimum of 80 hours in 3<sup>rd</sup> semester vacation and during 4<sup>th</sup> semester. Phase II training shall be conducted for minimum of 80 hours in 4<sup>th</sup> semester vacation and during 5<sup>th</sup> semester. The evaluation procedure shall be approved by the board of the offering department and Principal.

## 7.9 Comprehensive Test and Viva

A candidate can earn 2 credits by successfully completing this course. The evaluation procedures shall be approved by the Principal.

## 7.10 Entrepreneurships/ Start ups

A start up/business model may be started by a candidate individually or by a group of maximum of three candidates during the programme vide clause 4.3.1. The head of the department concerned shall assign a faculty member as a mentor for each start up.

A review committee shall be formed by the Principal for reviewing the progress of the Start ups / Business models, innovativeness, etc. The review committee can recommend the appropriate grades for academic performance for the candidate(s) involved in the start ups. This course shall carry a maximum of two credits in fifth semester and shall be evaluated through continuous assessments for a maximum of 100 marks vide clause 7.1. A report about the start ups is to be submitted to the review committee for evaluation for each start up and the marks will be given to Controller of Examinations after getting approval from Principal.

# 7.11 In-Plant Training

Each candidate shall go for In-Plant training for a duration of minimum of two weeks during the entire programme of study and submit a brief report about the training undergone and a certificate issued from the organization concerned.

## 7.12 One / Two Credit Courses

For all one/ two credit courses out of 100 marks, the continuous assessment shall be 50 marks and the model examination shall be for 50 marks. Minimum of two continuous assessments tests shall be conducted during the one / two credit course duration by the offering department concerned. Model examination shall be conducted at the end of the

#### 7.13 Online Course

The Board of Studies will provide methodology for the evaluation of the online courses. The Board can decide whether to evaluate the online courses through continuous assessment and end semester examination or through end semester examination only. In case of credits earned through online mode from NPTEL / SWAYAM / a University / Other Agencies approved by Chairman, Academic Council, the credits may be transferred and grades shall be assigned accordingly.

#### 7.14 Self Study Course

The member of faculty approved by the Head of the Department shall be responsible for periodic monitoring and evaluation of the course. The course shall be evaluated through continuous assessment and end semester examination. The evaluation methodology shall be the same as that of a theory course.

#### 7.15 Audit Course

A candidate may be permitted to register for specific course not listed in his/her programme curriculum and without undergoing the rigors of getting a 'good' grade, as an Audit course, subject to the following conditions.

The candidate can register only one Audit course in a semester starting from second semester subject to a maximum of two courses during the entire programme of study. Such courses shall be indicated as 'Audit' during the time of registration itself. Only courses currently offered for credit to the candidates of other branches can be audited.

A course appearing in the curriculum of a candidate cannot be considered as an audit course. However, if a candidate has already met the Professional Elective and Open Elective credit requirements as stipulated in the curriculum, then, a Professional Elective or an Open Elective course listed in the curriculum and not taken by the candidate for credit can be considered as an audit course.

Candidates registering for an audit course shall meet all the assessment and examination requirements (vide clause 7.3) applicable for a credit candidate of that course. Only if the candidate obtains a performance grade, the course will be listed in the semester Grade Sheet and in the Consolidated Grade Sheet along with the grade SC (Successfully Completed). Performance grade will not be shown for the audit course.

Since an audit course has no grade points assigned, it will not be counted for the purpose of GPA and CGPA calculations.

## 7.16 Mandatory Courses

A candidate joined in first semester shall attend and complete a mandatory course namely Student Induction Program of duration three weeks at the beginning of first semester. The candidates studying in second year shall attend and complete another one mandatory course namely Environmental Science. No credits shall be given for mandatory courses and shall be evaluated through continuous assessment tests only vide clause 7.1 for a maximum of 100 marks each. Upon the successful completion, these courses will be listed in the semester grade sheet and in the consolidated grade sheet with the grade "SC" (Successfully Completed). Since no grade points are assigned, these courses will not be counted for the purpose of GPA and CGPA calculations.

# 7.17 Universal Human Values (UHV) and Yoga and Values for Holistic Development (YVHD)

Courses YVHD shall be offered to all first year candidates of all BE/ BTech programmes to impart knowledge on yoga and human values. Course UHV shall be offered to all the second year BE/ BTech students. These courses shall carry a maximum of 100 marks each and shall be evaluated through continuous assessment tests only vide clause 7.1. The candidate(s) can earn 2 credits for UHV and 1 credit for YVHD by successfully completing these courses. Two continuous assessment tests will be conducted and the average marks will be taken for the calculation of grades.

# 8. REQUIREMENTS FOR COMPLETION OF A SEMESTER

- **8.1** A candidate who has fulfilled the following conditions shall be deemed to have satisfied the requirements for completion of a semester and permitted to appear for the examinations of that semester.
  - **8.1.1** Ideally, every candidate is expected to attend all classes and secure 100 % attendance. However, a candidate shall secure not less than 80 % (after rounding off to the nearest integer) of the overall attendance taking into account the total number of working days in a semester.
  - **8.1.2** A candidate who could not satisfy the attendance requirements as per clause 8.1.1 due to medical reasons (hospitalization / accident / specific illness) but has secured not less than 70 % in the current semester may be permitted to appear for the current semester examinations with the approval of the Principal on payment of a condonation fee as may be fixed by the authorities from time to time. The medical certificate needs to be submitted along with the leave application. A candidate can avail this provision only twice during the entire duration of the degree programme.

A candidate who could not satisfy the attendance requirements as per clause 8.1.1 due to his/her entrepreneurships/ start ups activities, but has secured not less than 60 % in the current semester can be permitted to appear for the current semester examinations with the recommendation of review committee and approval from the Principal.

- **8.1.3** In addition to clause 8.1.1 or 8.1.2, a candidate shall secure not less than 60 % attendance in each course.
- **8.1.4** A candidate shall be deemed to have completed the requirements of study of any semester only if he/she has satisfied the attendance requirements (vide clause 8.1.1 to 8.1.3) and has registered for examination by paying the prescribed fee.
- **8.1.5** Candidate's progress is satisfactory.
- **8.1.6** Candidate's conduct is satisfactory and he/she was not involved in any indisciplined activities in the current semester.
- **8.2.** The candidates who do not complete the semester as per clauses from 8.1.1 to 8.1.6 except 8.1.3 shall not be permitted to appear for the examinations at the end of the semester and not be permitted to go to the next semester. They have to repeat the incomplete semester in next academic year.
- **8.3** The candidates who satisfy the clause 8.1.1 or 8.1.2 but do not complete the course as per clause 8.1.3 shall not be permitted to appear for the end semester examination of that course alone. They have to repeat the incomplete course in the subsequent semester when it is offered next.

#### 9. **REQUIREMENTS FOR APPEARING FOR END SEMESTER EXAMINATION**

- **9.1** A candidate shall normally be permitted to appear for end semester examination of the current semester if he/she has satisfied the semester completion requirements as per clause 8, and has registered for examination in all courses of that semester. Registration is mandatory for current semester examinations as well as for arrear examinations failing which the candidate shall not be permitted to move on to the higher semester.
- **9.2** When a candidate is deputed for a National / International Sports event during End Semester examination period, supplementary examination shall be conducted for such a candidate on return after participating in the event within a reasonable period of time. Such appearance shall be considered as first appearance.
- **9.3** A candidate who has already appeared for a course in a semester and passed the examination is not entitled to reappear in the same course for improvement of letter grades / marks.

## 10. PROVISION FOR WITHDRAWAL FROM EXAMINATIONS

- **10.1** A candidate may, for valid reasons, be granted permission to withdraw from appearing for the examination in any regular course or all regular courses registered in a particular semester. Application for withdrawal is permitted only once during the entire duration of the degree programme.
- **10.2** The withdrawal application shall be valid only if the candidate is otherwise eligible to write the examination (vide clause 9) and has applied to the Principal for permission prior to the last examination of that semester after duly recommended by the Head of the Department.
- **10.3** The withdrawal shall not be considered as an appearance for deciding the eligibility of a candidate for First Class with Distinction/First Class.
- **10.4** If a candidate withdraws a course or courses from writing end semester examinations, he/she shall register the same in the subsequent semester and write the end semester examinations. A final semester candidate who has withdrawn shall be permitted to appear for supplementary examination to be conducted within reasonable time as per clause 14.
- **10.5** The final semester candidate who has withdrawn from appearing for project viva-voce for genuine reasons shall be permitted to appear for supplementary viva-voce examination within reasonable time with proper application to Controller of Examinations and on payment of prescribed fee.

# 11. PROVISION FOR BREAK OF STUDY

- **11.1** A candidate is normally permitted to avail the authorised break of study under valid reasons (such as accident or hospitalization due to prolonged ill health or any other valid reasons) and to rejoin the programme in a later semester. He/She shall apply in advance to the Principal, through the Head of the Department, stating the reasons therefore, in any case, not later than the last date for registering for that semester examination. A candidate is permitted to avail the authorised break of study only once during the entire period of study for a maximum period of one year. However, in extraordinary situation the candidate may apply for additional break of study not exceeding another one year by paying prescribed fee for the break of study.
- **11.2** The candidates permitted to rejoin the programme after break of study / prevention due to lack of attendance shall be governed by the rules and regulations in force at the time of rejoining.
- **11.3** The candidates rejoining in new Regulations shall apply to the Principal in the prescribed format through Head of the Department at the beginning of the readmitted semester itself for prescribing additional/equivalent courses, if any, from any semester of the regulations in-force, so as to bridge the curriculum in-force and the old curriculum.
- **11.4** The total period of completion of the programme reckoned from the commencement of the semester to which the candidate was admitted shall not exceed the maximum period specified in clause 5 irrespective of the period of break of study in order to qualify for the award of the degree.
- **11.5** If any candidate is prevented for want of required attendance, the period of prevention shall not be considered as authorized break of study.
- 11.6 If a candidate has not reported to the college for a period of two consecutive semesters without any intimation, the name of the candidate shall be deleted permanently from the college enrollment. Such candidates are not entitled to seek readmission under any circumstances.

# **12. PASSING REQUIREMENTS**

- **12.1** A candidate who secures not less than 50 % of total marks (continuous assessment and end semester examination put together) prescribed for the course with a minimum of 45 % of the marks prescribed for the end semester examination in all category of courses vide clause 7.1 except for the courses which are evaluated based on continuous assessment only shall be declared to have successfully passed the course in the examination.
- **12.2** A candidate who secures not less than 50 % in continuous assessment marks prescribed for the courses which are evaluated based on continuous assessment only shall be declared to have successfully passed the course. If a candidate secures less than 50% in the continuous assessment marks, he / she shall have to re-enroll for the same in the subsequent semester and satisfy the attendance requirements.
- **12.3** For a candidate who does not satisfy the clause 12.1, the continuous assessment marks secured by the candidate in the first attempt shall be retained and considered valid for subsequent attempts. However, from the fourth attempt onwards the marks scored in the end semester examinations alone shall be considered, in which case the candidate shall

secure minimum 50 % marks in the end semester examinations to satisfy the passing requirements.

# **13. REVALUATION OF ANSWER SCRIPTS**

A candidate shall apply for a photocopy of his / her semester examination answer script within a reasonable time from the declaration of results, on payment of a prescribed fee by submitting the proper application to the Controller of Examinations. The answer script shall be pursued and justified jointly by a faculty member who has handled the course and the course coordinator and recommended for revaluation. Based on the recommendation, the candidate can register for revaluation through proper application to the Controller of Examinations. The Controller of Examinations will arrange for revaluation and the results will be intimated to the candidate concerned. Revaluation is permitted only for Theory courses and Theory cum Practical courses where end semester examination is involved.

# 14. SUPPLEMENTARY EXAMINATION

If a candidate fails to clear all courses in the final semester after the announcement of final end semester examination results, he/she shall be allowed to take up supplementary examinations to be conducted within a reasonable time for the courses of final semester alone, so that he/she gets a chance to complete the programme.

# **15. AWARD OF LETTER GRADES:**

For all the passed candidates, the relative grading principle is applied to assign the letter grades.

Marks / Examination Status	Letter Grade	Grade Point
	O (Outstanding)	10
	A+ (Excellent)	9
Based on the relative	A (Very Good)	8
grading	B+ (Good)	7
	B (Average)	6
	C (Satisfactory)	5
Less than 50	U (Reappearance)	0
Successfully Completed	SC	0
Withdrawal	W	-
Absent	AB	-
Shortage of Attendance in a course	SA	-

The Grade Point Average (GPA) is calculated using the formula:

$$GPA = \frac{\sum [(course credits) \times (grade points)] \text{ for all courses in the specific semester}}{\sum (grade points)}$$

 $\Sigma$ (course credits) for all courses in the specific semester

The Cumulative Grade Point Average (CGPA) is calculated from first semester (third semester for lateral entry candidates) to final semester using the formula

CGPA=  $\frac{\sum [(\text{course credits}) \times (\text{grade points})] \text{ for all courses in all the semesters so far}}{\sum (\text{course credits}) \text{ for all courses in all the semesters so far}}$ 

The GPA and CGPA are computed only for the candidates with a pass in all the courses.

The GPA and CGPA indicate the academic performance of a candidate at the end of a semester and at the end of successive semesters respectively.

A grade sheet for each semester shall be issued containing Grade obtained in each course, GPA and CGPA.

A duplicate copy, if required can be obtained on payment of a prescribed fee and satisfying other procedure requirements.

Withholding of Grades: The grades of a candidate may be withheld if he/she has not cleared his/her dues or if there is a disciplinary case pending against him/her or for any other reason.

# 16. ELIGIBILITY FOR THE AWARD OF DEGREE

A candidate shall be declared to be eligible for the award of the BE / BTech Degree provided the candidate has

- i. Successfully completed all the courses under the different categories, as specified in the regulations.
- ii. Successfully gained the required number of total credits as specified in the curriculum corresponding to the candidate's programme within the stipulated time (vide clause 5).
- iii. Successfully passed any additional courses prescribed by the respective Board of Studies whenever readmitted under regulations other than R-2022 (vide clause 11.3)
- iv. No disciplinary action pending against him / her.

# 17. CLASSIFICATION OF THE DEGREE AWARDED

## **17.1** First Class with Distinction:

- **17.1.1.** A candidate who qualifies for the award of the degree (vide clause 16) and who satisfies the following conditions shall be declared to have passed the examination in First class with Distinction:
  - Should have passed the examination in all the courses of all the eight semesters (six semesters for lateral entry candidates) in the **First Appearance** within eight consecutive semesters (six consecutive semesters for lateral entry candidates) excluding the authorized break of study (vide clause 11) after the commencement of his / her study.
  - Withdrawal from examination (vide clause 10) shall not be considered as an appearance.
  - Should have secured a CGPA of not less than 8.50

(OR)

- 17.1.2 A candidate who joins from other institutions on transfer or a candidate who gets readmitted and has to move from one regulations to another regulations and who qualifies for the award of the degree (vide clause 16) and satisfies the following conditions shall be declared to have passed the examination in First class with Distinction:
  - Should have passed the examination in all the courses of all the eight semesters (six semesters for lateral entry candidates) in the **First Appearance** within eight consecutive semesters (six consecutive semesters

for lateral entry candidates) excluding the authorized break of study (vide clause 11) after the commencement of his / her study.

- Submission of equivalent course list approved by the respective Board of studies.
- Withdrawal from examination (vide clause 10) shall not be considered as an appearance.
- Should have secured a CGPA of not less than 9.00

## 17.2 First Class:

A candidate who qualifies for the award of the degree (vide clause 16) and who satisfies the following conditions shall be declared to have passed the examination in First class:

- Should have passed the examination in all the courses of all eight semesters (six semesters for lateral entry candidates) within ten consecutive semesters (eight consecutive semesters for lateral entry candidates) excluding authorized break of study (vide clause 11) after the commencement of his / her study.
- Withdrawal from the examination (vide clause 10) shall not be considered as an appearance.
- Should have secured a CGPA of not less than 6.50

## 17.3 Second Class:

All other candidates (not covered in clauses 17.1 and 17.2) who qualify for the award of the degree (vide clause 16) shall be declared to have passed the examination in Second Class.

**17.4** A candidate who is absent for end semester examination in a course / project work after having registered for the same shall be considered to have appeared for that examination for the purpose of classification.

## 17.5 Honors Degree:

A candidate who qualifies for the award of the degree (vide clause 16) and who satisfies the following conditions shall be declared to have earned the BE/BTech degree with Honours (vide clause 16 and clause 4.2.2):

- Should have passed the examination in all the courses of all the eight semesters (six semesters for lateral entry candidates) in the **First Appearance** within eight consecutive semesters (six consecutive semesters for lateral entry candidates) excluding the authorized break of study (vide clause 11) after the commencement of his / her study.
- Withdrawal from examination (vide clause 10) shall not be considered as an appearance.
- Should have secured a CGPA of not less than 7.50

# **18. MALPRACTICES IN TESTS AND EXAMINATIONS**

If a candidate indulges in malpractice in any of the tests or end semester examinations, he/she shall be liable for punitive action as per the examination rules prescribed by the college from time to time.

## **19. AMENDMENTS**

Notwithstanding anything contained in this manual, the Kongu Engineering College through the Academic council of the College, reserves the right to modify/amend without notice, the Regulations, Curricula, Syllabi, Scheme of Examinations, procedures, requirements, and rules pertaining to its BE / BTech programme.

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#### CURRICULUM BREAKDOWN STRUCTURE – R2022

Summary of Credit Distribution

		Sinbulio												
Category				Seme	ester				Total number of credits	Currie (% of t credits	culum Content otal number of of the program)			
	I	Ш	III	IV	v	VI	VII	VIII						
HS	4/5	4	2/1			2	3		15		9.09			
BS	8	8		4					20		11.9			
ES	8/10	8/7	8						24/25	14.2/14.8				
PC	3/0	3	12	15	17	8	0/3		58	34.5				
PE					3	3	9/6	3	18/15	8.9				
OE					4	4	3	3	14		8.3			
EC				2	2	6/7	5/6	4	21		12.5			
МС	0		0						0		0.0			
Semester wise Total	23	23/22	22/21	21	26	23/24	20/21	10	168		100.00			
									•					
				С	ategor	у					Abbreviation			
Lecture hours p	er week									L				
Tutorial hours p	er week										т			
Practical, Project	Practical, Project work, Internship, Professional Skill Training, Industrial Training hours per week										Р			
Credits											С			

	CATEGORISATION OF COURSES												
HU	HUMANITIES AND SOCIAL SCIENCE INCLUDING MANAGEMENT (HS)												
S. No.	Course CodeCourse NameLTPCSer												
1.	22EGT11	Communication Skills – I	3	0	0	3	I						
2.	22TAM01	Heritage of Tamils	1	0	0	1	I						
3.	22VEC11	Yoga and Values for Holistic Development	1	0	1	1	I						
4.	22EGT21	Communication Skills – II	3	0	0	3	П						
5.	22TAM02	Tamils and Technology	1	0	0	1	П						
6.	22EGL31	Communication Skills Development Laboratory	0	0	2	1	111						
7.	22GET31	Universal Human Values	2	0	0	2	VI						
8.	22GCT71	Engineering Economics and Management	3	0	0	3	VII						
	Т	otal Credits to be earned				15							

	BASIC SCIENCE (BS)											
S. No.	Course Code	Course Name	L	т	Ρ	С	Sem					
1.	22MAC11	Matrices and Ordinary Differential Equations	3	1*	2*	4	Ι					
2.	22PHT12	Physics for Mechanical Engineering	3	0	0	3	I					
3.	22PHL12	Physics Laboratory for Mechanical Engineering	0	0	2	1	Ι					
4.	22MAC21	Multivariable Calculus and Complex Analysis	3	1*	2*	4	П					
5.	22CYT22	Chemistry for Mechanical Engineering	3	0	0	3	П					
6.	22CYL22	Chemistry Laboratory for Mechanical Systems	0	0	2	1	II					
7.	22MAT41	Numerical Methods for Engineers	3	1	0	4	IV					
	Total Credits to be earned     20											

	ENGINEERING SCIENCE (ES)											
S. No.	Course Code	Course Name	L	т	Р	С	Sem					
1.	22MET11	Engineering Drawing	2	1	0	3	I					
2.	22CSC11	Problem Solving and Programming in C	3	0	2	4	I					
3.	22MEL11	Engineering Practices Laboratory	0	0	2	1	I					
4.	22CSC21	Fundamentals of Data Structures	3	0	2	4	П					
5.	22EET14	Electrical and Electronics Engineering	3	0	0	3	П					
6.	22EEL14	Electrical and Electronics Engineering Laboratory	0	0	2	1	П					
7.	22ITC31	Introduction to Python	3	0	2	4	Ш					
8.	22MEC31	Fluid Mechanics and Hydraulic Machines	3	0	2	4	111					
	Т	otal Credits to be earned				24						

	PROFESSIONAL CORE (PC)										
S. No.	Course Code	Course Name	L	т	Р	С	Sem	Domain/ Stream			
1.	22MET12	Engineering Mechanics	3	0	0	3	I	Design			
2.	22MET21	Engineering Materials and Metallurgy	3	0	0	3	П	Material Science			
3.	22MET31	Manufacturing Technology	3	0	0	3		Mfg.			
4.	22MET32	Engineering Thermodynamics	3	1	0	4		Thermal			
5.	22MET33	Strength of Materials	3	0	0	3		Design			
6.	22MEL31	Manufacturing Technology and Material Property Testing Laboratory	0	0	2	1		Mfg.			
7.	22MEL32	Machine Drawing and AutoCAD Laboratory	0	0	2	1		Design			
8.	22MET41	Thermal Engineering	3	0	0	3	IV	Thermal			
9.	22MET42	Machining and Measurements	3	0	0	3	IV	Mfg.			
10.	22MET43	CAD/CAM/CIM for Automation	3	0	0	3	IV	Mfg.			
11.	22MET44	Kinematics of Machinery	3	0	0	3	IV	Design			
12.	22MEL41	Thermal Engineering and Renewable Energy Laboratory	0	0	2	1	IV	Thermal			
13.	22MEL42	Machining and Measurements Laboratory	0	0	2	1	IV	Mfg.			
14.	22MEL43	Solid Modeling Laboratory	0	0	2	1	IV	Design			
15.	22MEC51	Heat and Mass Transfer	3	0	2	4	V	Thermal			
16.	22MEC52	Dynamics of Machinery	3	0	2	4	V	Design			

17.	22MET51	Operations Research	3	1	0	4	V	Mfg.
18.	22MET52	Artificial Intelligence in Mechanical Systems	3	0	0	3	V	Mfg.
19.	22MEL51	CAM and Robotics Laboratory	0	0	2	1	V	Mfg.
20.	22MEL52	Surface and Sheet Metal Design Laboratory	0	0	2	1	V	Design
21.	22MET61	Design of Machine Elements	3	1	0	4	VI	Design
22.	22MET62	Finite Element Analysis	3	0	0	3	VI	Design
23.	22MEL61	Simulation Laboratory	0	0	2	1	VI	Design
	Т	otal Credits to be earned				58		

		LIST OF PROFESSIONAL ELE	СТІ	/ES (	PEs)					
S. No.	Course Code	Course Name	L	т	Ρ	С	Domain/ Stream			
		Semester – V								
		Professional Elective – I								
1.	22MEE01	Fluid Power System	3	0	0	3	Design			
2.	22MEE02	Piping Design	3	0	0	3	Design			
3.	22MEE03	Unconventional Machining Processes	3	0	0	3	Mfg.			
4.	22MEE04	Design for Manufacture and Assembly	3	0	0	3	Mfg.			
5.	22MEE05	Automobile Engineering	3	0	0	3	Thermal			
6.	22MEE06	Fuels and Combustion Technology	3	0	0	3	Thermal			
7.	22MEE07	Industrial Engineering	3	0	0	3	Ind. Engg.			
8.	22MEE08	Production Planning and Control	3	0	0	3	Ind. Engg.			
		Semester – VI								
	Professional Elective – II									
9.	22MEE09	Design of Transmission Systems	3	0	0	3	Design			
10.	22MEE10	Vibration and Noise Control	3	0	0	3	Design			
11.	22MEE11	Intelligent Manufacturing Systems	3	0	0	3	Mfg.			
12.	22MEE12	Manufacturing Information System	3	0	0	3	Mfg.			
13.	22MEE13	Alternative Energy Systems and Applications	3	0	0	3	Thermal			
14.	22MEE14	Instrumentation in Thermal Engineering	3	0	0	3	Thermal			
15.	22MEE15	Digitalization in Supply Chain Management	3	0	0	3	Ind. Engg.			
16.	22MEE16	Lean Six Sigma	3	0	0	3	Ind. Engg.			
		Semester – VII	•		•					
		Professional Elective – II	I							
17.	22GEE01	Fundamentals of Research	3	0	0	3	General			
18.	22MEE17	Mechanics of Composite Materials	3	0	0	3	Design			
19.	22MEE18	Design of Jigs, Fixtures and Press Tools	3	0	0	3	Design			
20.	22MEE19	CNC Technology	3	0	0	3	Mfg.			
21.	22MEE20	Precision Engineering	3	0	0	3	Mfg.			
22.	22MEE21	Computational Fluid Dynamics	3	0	0	3	Thermal			
23.	22MEE22	Gas Dynamics and Jet Propulsion	3	0	0	3	Thermal			
24.	22MEE23	Project Management	3	0	0	3	Ind. Engg.			

25.	22GEE02	Total Quality Management	3	0	0	3	Ind. Engg.
	1	Professional Elective – I	/			I	1
26.	22MEE24	Industrial Tribology	3	0	0	3	Design
27.	22MEE25	Advanced Mechanics of Materials	3	0	0	3	Design
28.	22MEE26	Additive Manufacturing	3	0	0	3	Mfg.
29.	22MEE27	Welding Technology	3	0	0	3	Mfg.
30.	22MEE28	Power Plant Engineering	3	0	0	3	Thermal
31.	22MEE29	Design of Heat Exchangers	3	0	0	3	Thermal
32.	22MEE30	Quality Control and Reliability Engineering	3	0	0	3	Ind. Engg.
33.	22MEE31	Multi - Variate Artificial Intelligence Data Analysis	3	0	0	3	Ind. Engg.
34.	22MEE32	Hybrid Vehicle Technology	3	0	0	3	Thermal
		Professional Elective – V	/				-
35.	22MEE33	Introduction to Aircraft Systems	3	0	0	3	Design
36.	22MEE34	Mechatronics and IoT	3	0	0	3	Design
37.	22MEE35	Modeling and Analysis of Manufacturing Systems	3	0	0	3	Mfg.
38.	22MEE36	Micro Electro Mechanical Systems	3	0	0	3	Mfg.
39.	22MEE37	Refrigeration and Air Conditioning	3	0	0	3	Thermal
40.	22MEE38	Energy Auditing and Management	3	0	0	3	Thermal
41.	22MEE39	Maintenance Engineering	3	0	0	3	Ind. Engg.
42.	22MEE40	Industrial Safety Engineering	3	0	0	3	Ind. Engg.
		Semester – VIII					
	T	Elective – VI	1			1	T
43.	22MEE41	Introduction to Aircraft Structures	3	0	0	3	Design
44.	22MEE42	Product Design and Optimization	3	0	0	3	Design
45.	22MEE43	Nanotechnology for Mechanical Engineers	3	0	0	3	Mfg.
46.	22MEE44	Non Destructive Evaluation Techniques	3	0	0	3	Mfg.
47.	22MEE45	Turbomachines	3	0	0	3	Thermal
48.	22MEE46	Energy Conservation in HVAC System	3	0	0	3	Thermal
49.	22MEE47	Industrial Marketing	3	0	0	3	Ind. Engg.
50.	22MEE48	Decision Support Systems	3	0	0	3	Ind. Engg.
		Total Credits to be earned				18	

\* Domain: Mfg - Manufacturing, Ind. Engg. - Industrial Engineering

	EMPLOYABILITY ENHANCEMENT COURSES (EC)											
S. No.	Course Code	Course Name	L	т	Ρ	С	Sem					
1.	22GCL41/ 22GCl41	Professional Skills Training I / Industrial Training I				2	IV					
2.	22GCL51/ 22GCl51	Professional Skills Training II / Industrial Training II				2	V					
3.	22MEP61	Project Work I	0	0	8	4	VI					
4.	22GEP61	Comprehensive Test and Viva				2	VI					
5.	22MEP71	Project Work II Phase I	0	0	10	5	VII					
6.	22MEP81	Project Work II Phase II	0	0	8	4	VIII					
	Т	otal Credits to be earned				19						

	MANDATORY COURSES (EC)										
S. No.	Course Code	Course Name	L	т	Р	С	Sem				
1.	22MNT11	Student Induction Program				0	I				
2.	22MNT31	Environmental Science	2	0	0	0					
	Т			00							

C	OPEN ELECTIVE COURSES OFFERED TO OTHER DEPARTMENTS (OE)									
S. No.	Course Code	Course Name	L	т	Ρ	С	Sem			
1.	22MEX01	Renewable Energy Sources	3	0	2	4	V			
2.	22MEX02	Design of Experiments	3	0	2	4	VI			
3.	22MEO01	Fundamentals of Ergonomics	3	0	0	3	VII			
4.	22MEO02	Principles of Management and Industrial Psychology	3	0	0	3	VII			
5.	22MEO03	Waste Heat Recovery System and Storage	3	0	0	3	VII			
6.	22MEO04	Safety Measures for Engineers	3	0	0	3	VIII			
7.	22MEO05	Energy Conservation in Thermal Equipments	3	0	0	3	VIII			
8.	22MEO06	Climate Change and New Energy Technology	3	0	0	3	VIII			

OPEN ELECTIVE COURSES OFFERED BY OTHER DEPARTMENTS (OE)									
S. No.	Course Code	Course Name	L	т	Р	С	OFFERED BY		
		SEMESTER V							
1.	22CEX01	Remote Sensing and its Applications	3	0	2	4	CIVIL		
2.	22MEX01	Renewable Energy Sources	3	0	2	4	MECH		
3.	22MTO01	Design of Mechatronics Systems	3	1	0	4	MTS		
4.	22MTX01	Data Acquisition and Virtual Instrumentation	3	0	2	4	MTS		
5.	22MTX02	Factory Automation	3	0	2	4	MTS		
6.	22AUX01	Automotive Engineering	3	0	2	4	AUTO		
7.	22ECX01	Basics of Electronics in Automation Appliances	3	0	2	4	ECE		
8.	22ECX02	Image Processing	3	0	2	4	ECE		
9.	22EEO01	Solar and Wind Energy Systems	3	1	0	4	EEE		
10.	22EEO02	Electrical Wiring and Lighting	3	1	0	4	EEE		
11.	22EEO03	Programmable Logic Controller and SCADA	3	1	0	4	EEE		
12.	22EEO04	Analog and Digital Electronics	3	1	0	4	EEE		
13.	22EEO05	Power Electronics and Drives	3	1	0	4	EEE		
14.	22EEO06	Sensors and Actuators	3	1	0	4	EEE		
15.	22EIO01	Measurements and Instrumentation	3	1	0	4	EIE		
16.	22EIO02	Biomedical Instrumentation and Applications	3	1	0	4	EIE		
17.	22EIO03	Industrial Automation	3	1	0	4	EIE		
18.	22CSX01	Fundamentals of Databases	3	0	2	4	CSE		
19.	22CSX02	Data science for Engineers	3	0	2	4	CSE		
20.	22CSX03	Enterprise Application Development Using Java	3	0	2	4	CSE		
21.	22CSO01	Computational science for Engineers	3	1	0	4	CSE		
22.	22CSO02	Formal Languages and Automata Theory	3	1	0	4	CSE		
23.	22ITO01	Artificial Intelligence	3	1	0	4	IT		
24.	22ITX01	Next Generation Databases	3	0	2	4	IT		
25.	22GEX02	NCC Studies (Air Wing) - 1	3	0	2	4	IT		
26.	22CDO01	Fundamentals of User Experience	3	1	0	4	CSD		
27.	22ADO01	Data Warehousing and Data Mining	3	1	0	4	AIDS		

28.								
	22ALO01	Business Intelligence	3	1	0	4	AIML	
29.	22CHO01	Industrial Enzymology	3	1	0	4	CHEM	
30.	22CHO02	Waste to Energy Conversion	3	1	0	4	CHEM	
31.	22CHO03	Applied Nanotechnology	3	1	0	4	CHEM	
32.	22FTX01	Baking Technology	3	0	2	4	FT	
33.	22FTO01	Food Processing Technology	3	1	0	4	FT	
34.	22MAO01	Mathematical Foundations for Machine Learning	3	1	0	4	MATHS	
35.	22MAO02	Numerical Computing	3	1	0	4	MATHS	
36.	22MAO03	Stochastic Processes and Queuing Theory	3	1	0	4	MATHS	
37.	22MAO04	Statistics for Engineers	3	1	0	4	MATHS	
38.	22PHO01	Thin Film Technology	3	1	0	4	PHYSICS	
39.	22PHO02	High Energy Storage Devices	3	1	0	4	PHYSICS	
40.	22PHO03	Structural and Optical Characterization of Materials	3	1	0	4	PHYSICS	
41.	22CYO01	Instrumental Methods of Analysis	3	1	0	4	CHEMISTRY	
42.	22CYO02	Chemistry Concepts for Competitive Examinations	3	1	0	4	CHEMISTRY	
43.	22CYO03	Organic Chemistry for Industry	3	1	0	4	CHEMISTRY	
		SEMESTER VI						
44.	22CEO01	Disaster Management	3	1	0	4	CIVIL	
			ſ	0	2	Λ	MECH	
45.	22MEX02	Design of Experiments	0	0	2	4		
45. 46.	22MEX02 22MTO02	Design of Experiments Robotics	3	1	0	4	MTS	
45. 46. 47.	22MEX02 22MTO02 22MTO03	Design of Experiments Robotics 3D Printing and Design	3	1	0	4 4 4	MTS MTS	
45. 46. 47. 48.	22MEX02 22MTO02 22MTO03 22AUO01	Design of Experiments Robotics 3D Printing and Design Automotive Electronics	3 3 3	0 1 1 1	2 0 0 0	4 4 4 4	MTS MTS ECE	
45. 46. 47. 48. 49.	22MEX02 22MTO02 22MTO03 22AUO01 22ECX03	Design of Experiments Robotics 3D Printing and Design Automotive Electronics PCB Design and Fabrication	3 3 3 3 3	0 1 1 1 0	2 0 0 0 2	4 4 4 4 4	MTS MTS ECE ECE	
45. 46. 47. 48. 49. 50.	22MEX02 22MTO02 22MTO03 22AUO01 22ECX03 22EEO07	Design of Experiments Robotics 3D Printing and Design Automotive Electronics PCB Design and Fabrication Energy Conservation and Management	3 3 3 3 3	0 1 1 1 0 1	2 0 0 2 0	4 4 4 4 4 4	MTS MTS ECE ECE EEE	
<ul> <li>45.</li> <li>46.</li> <li>47.</li> <li>48.</li> <li>49.</li> <li>50.</li> <li>51.</li> </ul>	22MEX02 22MTO02 22MTO03 22AUO01 22ECX03 22EEO07 22EEO08	Design of Experiments Robotics 3D Printing and Design Automotive Electronics PCB Design and Fabrication Energy Conservation and Management Microprocessors and Microcontrollers Interfacing	3 3 3 3 3 3 3	0 1 1 1 0 1 1	2 0 0 2 0 0	4 4 4 4 4 4 4	MTS MTS ECE ECE EEE EEE	
<ul> <li>45.</li> <li>46.</li> <li>47.</li> <li>48.</li> <li>49.</li> <li>50.</li> <li>51.</li> <li>52.</li> </ul>	22MEX02 22MTO02 22MTO03 22AUO01 22ECX03 22EEO07 22EEO08 22EEO09	Design of Experiments Robotics 3D Printing and Design Automotive Electronics PCB Design and Fabrication Energy Conservation and Management Microprocessors and Microcontrollers Interfacing Electrical Safety	3 3 3 3 3 3 3 3	0 1 1 1 0 1 1 1	2 0 0 2 0 0 0 0	4 4 4 4 4 4 4 4	MTS MTS ECE ECE EEE EEE EEE	
<ul> <li>45.</li> <li>46.</li> <li>47.</li> <li>48.</li> <li>49.</li> <li>50.</li> <li>51.</li> <li>52.</li> <li>53.</li> </ul>	22MEX02 22MTO02 22MTO03 22AUO01 22ECX03 22EEO07 22EEO08 22EEO09 22EEO10	Design of Experiments Robotics 3D Printing and Design Automotive Electronics PCB Design and Fabrication Energy Conservation and Management Microprocessors and Microcontrollers Interfacing Electrical Safety VLSI System Design	3 3 3 3 3 3 3 3 3 3	1 1 1 1 1 1 1 1	2 0 0 2 0 0 0 0 0	4 4 4 4 4 4 4 4 4	MTS MTS ECE ECE EEE EEE EEE EEE	
<ul> <li>45.</li> <li>46.</li> <li>47.</li> <li>48.</li> <li>49.</li> <li>50.</li> <li>51.</li> <li>52.</li> <li>53.</li> <li>54.</li> </ul>	22MEX02 22MTO02 22MTO03 22AUO01 22ECX03 22EEO07 22EEO08 22EEO09 22EEO10 22EEO11	Design of Experiments Robotics 3D Printing and Design Automotive Electronics PCB Design and Fabrication Energy Conservation and Management Microprocessors and Microcontrollers Interfacing Electrical Safety VLSI System Design Automation for Industrial Applications	3 3 3 3 3 3 3 3 3 3 3 3	1 1 1 1 1 1 1 1 1	2 0 0 2 0 0 0 0 0 0 0	4 4 4 4 4 4 4 4 4 4	MTS MTS ECE ECE EEE EEE EEE EEE EEE	
<ul> <li>45.</li> <li>46.</li> <li>47.</li> <li>48.</li> <li>49.</li> <li>50.</li> <li>51.</li> <li>52.</li> <li>53.</li> <li>54.</li> <li>55.</li> </ul>	22MEX02 22MTO02 22MTO03 22AUO01 22ECX03 22EEO07 22EEO08 22EEO09 22EEO10 22EEO11 22EEO11	Design of Experiments Robotics 3D Printing and Design Automotive Electronics PCB Design and Fabrication Energy Conservation and Management Microprocessors and Microcontrollers Interfacing Electrical Safety VLSI System Design Automation for Industrial Applications PLC Programming with High Level Languages	3 3 3 3 3 3 3 3 3 3 3 3 3	0       1       1       1       0       1       1       1       1       1       1       1       1       1	2 0 0 2 0 0 0 0 0 0 0 0	4 4 4 4 4 4 4 4 4 4 4	MTS MTS ECE ECE EEE EEE EEE EEE EEE EIE	
<ul> <li>45.</li> <li>46.</li> <li>47.</li> <li>48.</li> <li>49.</li> <li>50.</li> <li>51.</li> <li>52.</li> <li>53.</li> <li>54.</li> <li>55.</li> <li>56.</li> </ul>	22MEX02 22MTO02 22MTO03 22AUO01 22ECX03 22EEO07 22EEO08 22EEO09 22EEO10 22EEO11 22EEO11 22EEO14 22EIO04	Design of ExperimentsRobotics3D Printing and DesignAutomotive ElectronicsPCB Design and FabricationEnergy Conservation and ManagementMicroprocessors and Microcontrollers InterfacingElectrical SafetyVLSI System DesignAutomation for Industrial ApplicationsPLC Programming with High Level LanguagesVirtual Instrumentation	3 3 3 3 3 3 3 3 3 3 3 3 3 3	1       1       1       1       1       1       1       1       1       1       1       1       1       1       1	2 0 0 2 0 0 0 0 0 0 0 0 0	4 4 4 4 4 4 4 4 4 4 4 4 4	MTS MTS ECE ECE EEE EEE EEE EEE EEE EIE EIE	
<ul> <li>45.</li> <li>46.</li> <li>47.</li> <li>48.</li> <li>49.</li> <li>50.</li> <li>51.</li> <li>52.</li> <li>53.</li> <li>54.</li> <li>55.</li> <li>56.</li> <li>57.</li> </ul>	22MEX02 22MTO02 22MTO03 22AUO01 22ECX03 22EEO07 22EEO08 22EEO09 22EEO10 22EEO11 22EEO11 22EIO04 22EIO05 22CSX04	Design of ExperimentsRobotics3D Printing and DesignAutomotive ElectronicsPCB Design and FabricationEnergy Conservation and ManagementMicroprocessors and Microcontrollers InterfacingElectrical SafetyVLSI System DesignAutomation for Industrial ApplicationsPLC Programming with High Level LanguagesVirtual InstrumentationFoundations of Machine Learning	3 3 3 3 3 3 3 3 3 3 3 3 3 3 3	0       1       1       1       0       1       1       1       1       1       1       1       1       1       1       1       0	2 0 0 2 0 0 0 0 0 0 0 0 0 2	4 4 4 4 4 4 4 4 4 4 4 4 4	MTS MTS ECE ECE EEE EEE EEE EEE EEE EIE EIE EIE	

59.	22ITX02	Advanced Java Programming	3	0	2	4	IT	
60.	22ITO02	Internet of Things	3	1	0	4	IT	
61.	22ITO03	Fundamentals of Software Development	3	1	0	4	IT	
62.	22ITO04	Mobile Application Development	3	1	0	4	IT	
63.	22CDX01	Fundamentals of User Interactive Design	3	0	2	4	CSD	
64.	22ADX01	Data Visualization	3	0	2	4	AIDS	
65.	22ALX01	Data Exploration and Visualization Techniques	3	0	2	4	AIML	
66.	22CHO04	Air Pollution Monitoring and Control	3	1	0	4	CHEM	
67.	22CHO05	Paints and Coatings	3	1	0	4	CHEM	
68.	22CHO06	Powder Technology	3	1	0	4	CHEM	
	22FTX02	Processing of milk and milk products	3	0	2	4	FT	
	22FTX03	Processing of Fruits and Vegetables	3	0	2	4	FT	
69.	22MAO05	Graph Theory and its Applications	3	1	0	4	MATHS	
70.	22MAX01	Data Analytics using R Programming	3	0	2	4	MATHS	
71.	22MAO06	Operations Research	3	1	0	4	MATHS	
72.	22MAO07	Number Theory and Cryptography	3	1	0	4	MATHS	
73.	22PHO04	Synthesis, Characterization and Biological Applications of Nanomaterials	3	1	0	4	PHYSICS	
74.	22PHO05	Techniques of Crystal Growth	3	1	0	4	PHYSICS	
75.	22CYO04	Corrosion Science and Engineering	3	1	0	4	CHEMISTRY	
76.	22CYO05	Chemistry of Cosmetics in Daily Life	3	1	0	4	CHEMISTRY	
77.	22CYO06	Nanocomposite Materials	3	1	0	4	CHEMISTRY	
		SEMESTER VII						
78.	22CEO02	Introduction to Smart Cities	3	0	0	3	CIVIL	
79.	22CEO03	Environmental Health and Safety	3	0	0	3	CIVIL	
80.	22MEO01	Fundamentals of Ergonomics	3	0	0	3	MECH	
81.	22MEO02	Principles of Management and Industrial Psychology	3	0	0	3	MECH	
82.	22MEO03	Waste Heat Recovery System and Storage	3	0	0	3	MECH	
83.	22MTO04	Drone System Technology	3	0	0	3	MTS	
84.	22AUO02	Vehicle Maintenance	3	0	0	3	AUTO	
85.	22ECO01	Wearable Devices	3	0	0	3	ECE	
86.	22ECX04	Electronic Hardware and Troubleshooting	2	0	2	3	ECE	

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87.	22EEO12	Electric Vehicle	3	0	0	3	EEE	
88.	22EEO13	E-Waste Management	3	0	0	3	EEE	
89.	22EEO14	Embedded System Design	3	0	0	3	EEE	
90.	22EEO15	Energy Storage Systems and Controllers	3	0	0	3	EEE	
91.	22EEO16	AI Techniques for Engineering Applications	3	0	0	3	EEE	
92.	22EIO06	Introduction to Distributed Control Systems	3	0	0	3	EIE	
93.	22EIO07	Instrumentation in Aircraft Navigation and Control	3	0	0	3	EIE	
94.	22EIO08	Industry 4.0 with Industrial IoT	3	0	0	3	EIE	
95.	22EIO09	Industrial Data Communication	3	0	0	3	EIE	
96.	22EIO10	Wireless Instrumentation	3	0	0	3	EIE	
97.	22EIO11	Instrumentation Techniques in Agriculture	3	0	0	3	EIE	
98.	22CSO03	Nature Inspired optimization techniques	3	0	0	3	CSE	
99.	22ITO05	Fundamentals of Cloud Computing	3	0	0	3	IT	
100.	22CDO02	Introduction to Mobile Game Design	3	0	0	3	CSD	
101.	22CDO03	Introduction to Graphics Design	3	0	0	3	CSD	
102.	22ADO02	Neural Networks and Deep Learning	3	0	0	3	AIDS	
103.	22ALO02	Industrial Machine Learning	3	0	0	3	AIML	
104.	22CHO07	Hydrogen Energy	3	0	0	3	CHEM	
105.	22CHO08	Rubber Technology	3	0	0	3	CHEM	
106.	22FTO02	Principles of Food safety	3	0	0	3	FT	
107.	22FTO03	Fundamentals of Food Packaging and Storage	3	0	0	3	FT	
108.	22MAO08	Non-Linear Optimization	3	0	0	3	MATHS	
109.	22MAO09	Optimization for Engineers	3	0	0	3	MATHS	
110.	22CYO07	Waste and Hazardous Waste Management	3	0	0	3	CHEMISTRY	
111.	22CYO08	Chemistry in Every day Life	3	0	0	3	CHEMISTRY	
		SEMESTER VIII						
112.	22CEO04	Infrastructure Planning and Management	3	0	0	3	CIVIL	
113.	22CEO05	Environmental Laws and Policy	3	0	0	3	CIVIL	
114.	22MEO04	Safety Measures for Engineers	3	0	0	3	MECH	
115.	22MEO05	Energy Conservation in Thermal Equipments	3	0	0	3	MECH	
116.	22MEO06	Climate Change and New Energy Technology	3	0	0	3	MECH	

117.	22MTO05	Micro and Nano Electromechanical Systems	3	0	0	3	MTS
118.	22AUO03	Public Transport Management	3	0	0	3	ECE
119.	22AUO04	Autonomous Vehicles	3	0	0	3	ECE
120.	22ECO02	Optical Engineering	3	0	0	3	EEE
121.	22EEO17	Smart Grid Technologies	3	0	0	3	EEE
122.	22EEO18	Biomass Energy Systems	3	0	0	3	EEE
123.	22EIO12	Environmental Sensors	3	0	0	3	EIE
124.	22EIO13	Pollution Control and Management	3	0	0	3	EIE
125.	22CSO04	Machine Translation	3	0	0	3	CSE
126.	22CSO05	Fundamentals of Blockchain	3	0	0	3	CSE
127.	22ITO06	Introduction to Ethical Hacking	3	0	0	3	IT
128.	22ITO07	Business Continuity Planning	3	0	0	3	IT
129.	22CDX02	Virtual Reality and Augmented Reality	3	0	0	3	CSD
130.	22ADO03	Business Analytics	3	0	0	3	AIDS
131.	22ALO03	Machine Learning for Smart Cities	3	0	0	3	AIML
132.	22CHO09	Industrial Accident Prevention and Management	3	0	0	3	CHEM
133.	22CHO10	Electrochemical Engineering	3	0	0	3	CHEM
134.	22CHO11	Smart and Functional Materials	3	0	0	3	CHEM
135.	22FTO04	Food Ingredients	3	0	0	3	FT
136.	22FTO05	Food and Nutrition	3	0	0	3	FT
137.	22CYO09	Chemistry of Nutrition for Women Health	3	0	0	3	CHEMISTRY

#### GENERAL OPEN ELECTIVE (Common to All BE/BTech branches)

SNo	Course Code	Course Title	L	Т	Ρ	С	Offering Department	Semester
1.	22GEO01	German Language Level 1	4	0	0	4	ECE	ALL
2.	22GEO02	Japanese Language Level 1	4	0	0	4	ECE	ALL
3.	22GEO03	Design Thinking for Engineers	3	1	0	4	CSE	5
4.	22GEO04	Innovation and Business Model Development	3	1	0	4	MTS	6
5.	22GEO05	German Language Level 2	4	0	0	4	ECE	ALL
6.	22GEO06	German Language Level 3	3	0	0	3	ECE	ALL
7.	22GEO07	German Language Level 4	3	0	0	3	ECE	ALL
8.	22GEO08	Japanese Language Level 2	4	0	0	4	ECE	ALL
9.	22GEO09	Japanese Language Level 3	3	0	0	3	ECE	ALL
10.	22GEO10	Japanese Language Level 4	3	0	0	3	ECE	ALL
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11.	22GEO11	French Language Level 1	4	0	0	4	ECE	ALL
12.	22GEO12	French Language Level 2	4	0	0	4	ECE	ALL
13.	22GEO13	French Language Level 3	3	0	0	3	ECE	ALL
14.	22GEO14	Spanish Language Level 1	4	0	0	4	ECE	ALL
15.	22GEO15	Spanish Language Level 2	4	0	0	4	ECE	ALL
16.	22GEO16	Spanish Language Level 3	3	0	0	3	ECE	ALL
17.	22GEO17	Entrepreneurship Development	3	0	0	3	MTS	7
18.	22GEX01	NCC Studies (Army Wing) - I	3	0	2	4	EEE	5 / 6
19.	22GEX02	NCC Studies (Air Wing) - 1	3	0	2	4	IT	5 / 6
20.	22MBO01	Cost Accounting for Engineers	3	1	0	4	MBA	5
21.	22MBO02	Economic Analysis for Decision Making	3	1	0	4	MBA	6
22.	22MBO03	Marketing Analytics	3	1	0	4	MBA	7

# KEC R2022: SCHEDULING OF COURSES – BE (Mechanical Engineering) Total Credits: 168

100	Course1	Course2	Course3	Course4	Course5	Course6	Course7	Course8	Course9	Course10	Cre dits
	22EGT11 Communication Skills - I (3-0-0-3)	22MAC11 Matrices and Ordinary Differential Equations (3-1*-2*-4)	22PHT12 Physics for Mechanical Engineering (3-0-0-3)	22MET11 Engineering Drawing (2-1-0-3)	22MET12 Engineering Mechanics (3-0-0-3)	22CSC11 Problem Solving and Programming in C (3-0-2-4)	22MEL11 Engineering Practices Laboratory (0-0-2-1)	22PHL12 Physics Laboratory for Mechanical Engineering (0-0-2-1)	22VEC11 Yoga and Values for Holistic Development (1-0-1-1)	22MNT11 Student Induction Program (0-0-0-0)	23
I	22EGT21 Communication Skills - II (3-0-0-3)	22MAC21 Multivariable Calculus and Complex Analysis (3-1*-2*-4)	22CYT22 Chemistry for Mechanical Engineering (3-0-0-3)	22MET21 Engineering Materials and Metallurgy (3-0-0-3)	22CSC21 Fundamentals of Data Structures (3-0-2-4)	22EET22 Electrical and Electronics Engineering (3-0-0-3)	22TAM01 Heritage of Tamils (1-0-0-1)	22CYL22 Chemistry Laboratory for Mechanical Systems (0-0-2-1)	22EEL14 Electrical and Electronics Engineering Laboratory (0-0-2-1)		23
I	22ITC31 Introduction to Python (3-0-2-4)	22MEC31 Fluid Mechanics and Hydraulic Machines (3-0-2-4)	22MET31 Manufacturing Technology (3-0-0-3)	22MET32 Engineering Thermodynami cs (3-1-0-4)	22MET33 Strength of Materials (3-0-0-3)	22MNT31 Environmental Science (2-0-0-0)	22TAM02 Tamils and Technology (1-0-0-1)	22MEL31 Manufacturing Technology and Material Property Testing Laboratory (0-0-2-1)	22MEL32 Machine Drawing using AutoCAD Laboratory (0-0-2-1)	22EGL31 Communication Skills Development Laboratory (0-0-2-1)	22
ľ	22MAT41 Numerical V Methods for Engineers (3-1-0-4)	22MET41 Thermal Engineering (3-0-0-3)	22MET42 Machining and Measurements (3-0-0-3)	22MET43 CAD/CAM/CIM for Automation (3-0-0-3)	22MET44 Kinematics of Machinery (3-0-0-3)	22MEL41 Thermal Engineering and Renewable Energy Laboratory (0-0-2-1)	22MEL42 Machining and Measurements Laboratory (0-0-2-1)	22MEl43 Solid Modeling Laboratory (0-0-2-1)	22GCL41/ 22GCl41 Professional Skills Training I / Industrial Training I (0-0-0-2)		21
`	22MEC51 Heat and Mass Transfer (3-0-2-4)	22MEC52 Dynamics of Machinery (3-0-2-4)	22MET51 Operations Research (3-1-0-4)	22MET52 Artificial Intelligence in Mechanical Systems (3-0-0-3)	Professional Elective I (3-0-0-3)	Open Elective I (3-1/0-0/2-4)	22MEL51 CAM and Robotics Laboratory (0-0-2-1)	22MEL52 Surface and Sheet Metal Design Laboratory (0-0-2-1)	22GCL51/22GCI51 Professional Skills Training II / Industrial Training II (0-0-0-2)		26
V	22MET61 Design of Machine Elements (3-1-0-4)	22MET62 Finite Element Analysis (3-0-0-3)	Professional Elective II (3-0-0-3)	Open Elective II (3-1/0-0/2-4)	22MEL61 Simulation Laboratory (0-0-2-1)	22MEP61 Project Work I (0-0-8-4)	22GEP61 Comprehensive Test and Viva (0-0-0-2)	22GET31 Universal Human Values (2-0-0-2)			23
v	22GCT71 Engineering II Economics and Management (3-0-0-3)	Professional Elective III (3-0-0-3)	Professional Elective IV (3-0-0-3)	Professional Elective V (3-0-0-3)	Open Elective III (3-0-0-3)	22MEP71 Project Work II Phase I (0-0-10-5)					20
v	Professional III Elective VI (3-0-0-3)	Open Elective IV (3-0-0-3)	22MEP81 Project Work II Phase II (0-0-8-4)								10

#### **PO1** P01 Sem. **Course Code** Course Title **PO1** PO2 PO3 PO4 PO5 PO6 PO7 PO8 PO9 PO10 PSO1 PSO<sub>2</sub> 2 1 ~ ✓ ~ 22EGT11 Communication Skills – I ✓ ✓ 1 Matrices and Ordinary Differential Equations ✓ ✓ $\checkmark$ ✓ 22MAC11 1 22PHT12 Physics for Mechanical Engineering 1 $\checkmark$ ✓ ✓ ✓ ✓ ✓ ✓ ✓ 22MET11 ✓ ✓ ✓ ✓ ✓ ✓ 1 Engineering Drawing 22MET12 Engineering Mechanics ✓ ✓ ✓ ✓ ✓ ✓ 1 1 22CSC11 Problem Solving and Programming in C ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ 22MEL11 Engineering Practices Laboratory ✓ ✓ ✓ ✓ ✓ ✓ 1 ✓ ✓ Foundation Laboratory - Electrical, IoT, Web ✓ ✓ 22GCL12 ✓ $\checkmark$ ✓ 1 Physics Laboratory for Mechanical ✓ ✓ ✓ 22PHL12 ✓ ✓ ✓ ✓ √ 1 Engineering 22VEC11 Yoga and Values for Holistic Development ✓ ✓ ~ 1 22MNT11 Student Induction Program 1 22EGT21 Communication Skills – II ✓ √ ✓ ✓ ✓ 2 Multivariable Calculus and Complex Analysis ✓ 22MAC21 ✓ ✓ $\checkmark$ 2 √ ✓ ✓ 22CYT22 Chemistry for Mechanical Engineering ✓ 2 1 22MET21 ~ 1 1 1 2 Engineering Materials and Metallurgy 22CSC21 ✓ √ ✓ ✓ 2 Fundamentals of Data Structures √ √ ✓ ✓ ✓ ✓ 2 22EET14 Electrical and Electronics Engineering ✓ ✓ ✓ 2 22TAM01 Heritage of Tamils ✓ ✓ Chemistry Laboratory for Mechanical 22CYL22 ✓ ✓ ✓ ✓ ✓ 2 Systems Foundation Laboratory - Manufacturing, 22GCL11 ✓ ✓ ✓ ✓ ~ ✓ ✓ 2 Design and Robotics Electrical and Electronics Engineering 22EEL14 ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ 2 Laboratory ✓ 3 22ITC32 Introduction to Python ✓ ✓ ✓ 22MEC31 Fluid Mechanics and Hydraulic Machines ✓ ✓ ✓ ✓ ✓ ✓ 3 22MET31 Manufacturing Technology ✓ ✓ ✓ ~ ✓ 3 ✓ ✓ ✓ ✓ ✓ 3 22MET32 Engineering Thermodynamics ✓ ✓ ✓ ~ 22MET33 ~ 3 Strength of Materials ✓ 3 22MNT31 Environmental Science ~ ✓ ✓ Tamils and Technology ✓ ✓ ✓ ✓ ✓ 22TAM02 3

#### MAPPING OF COURSES WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

Sem.	Course Code	Course Title	P01	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	PO1 1	PO1 2	PSO1	PSO2
3	22MEL31	Manufacturing Technology and Material Property Testing Laboratory	✓	✓		~					~	✓				<b>√</b>
3	22MEL32	Machine Drawing using AutoCAD Laboratory	~				~				~				✓	✓
3	22EGL31	Communication Skills Development Laboratory									*	*		~		
4	22MAT41	Numerical Methods for Engineers	1	1	1											
4	22MET41	Thermal Engineering	1	1	1									✓		✓
4	22MET42	Machining and Measurements	1	~			✓								✓	✓
4	22MET43	CAD/CAM/CIM for Automation	~	1			~								•	•
4	22MET44	Kinematics of Machinery	1	~	1											✓
4	22MEL41	Thermal Engineering and Renewable Energy Laboratory	*	*		~	~				~	✓			1	~
4	22MEL42	Machining and Measurements Laboratory	~	~			~				~				~	~
4	22MEL43	Solid Modeling Laboratory	✓	1			✓				~				1	✓
4	22GCL41/ 22GCI41	Professional Skills Training I / Industrial Training I	*	*				*	*		~	~	~	*		
5	22MEC51	Heat and Mass Transfer	~		~	~	~		~		~	✓		~	1	✓
5	22MEC52	Dynamics of Machinery	~	1		1					~					✓
5	22MET51	Operations Research	>	*	1								~		1	✓
5	22MET52	Artificial Intelligence in Mechanical Systems	1	1	1		~	~			~				~	✓
6	22MEL51	CAM and Robotics Laboratory	1	~			~				~				~	✓
6	22MEL52	Surface and Sheet Metal Design Laboratory	1		1		~				~			~	~	✓
6	22GCL51/ 22GCI51	Professional Skills Training II / Industrial Training II	~	~				~	~		~	~	~	~		
6	22MET61	Design of Machine Elements	~	~												✓
6	22MET62	Finite Element Analysis	~	~	✓											✓
6	22MEL61	Simulation Laboratory	>		~		~				~				1	✓
6	22MEP61	Project Work I	✓	✓	1	✓	✓	✓	✓	✓	~	✓	✓	✓	✓	✓
6	22GEP61	Comprehensive Test and Viva														
6	22GET31	Universal Human Values	1	~	1	~										

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO1 1	PO1 2	PSO1	PSO2
7	22GCT71	Engineering Economics and Management	1	~	✓			✓	✓	~	✓	✓	~	✓		
7	22MEP71	Project Work II Phase I	1	~		~	~	✓	✓	~	1	✓	~	✓	✓	✓
8	22MEP81	Project Work II Phase II	~	~	~	~	~	~	~	~	1	✓	~	1	✓	✓
5	22MEE01	Fluid Power System	1	1	✓											✓
5	22MEE02	Piping Design	~	~	✓											✓
5	22MEE03	Unconventional Machining Processes	1				~								✓	✓
5	22MEE04	Design for Manufacture and Assembly	1	~	✓											✓
5	22MEE05	Automobile Engineering	1		✓		~		~						~	✓
5	22MEE06	Fuels and Combustion Technology	~		✓				✓	~						✓
5	22MEE07	Industrial Engineering	1	~		~							1		1	✓
5	22MEE08	Production Planning and Control	~	~	✓								~		✓	✓
6	22MEE09	Design of Transmission Systems	~	~	~											✓
6	22MEE10	Vibration and Noise Control	~	~	~											✓
6	22MEE11	Intelligent Manufacturing Systems	~	1	~		~								1	✓
6	22MEE12	Manufacturing Information System	1	~			~							✓	✓	✓
6	22MEE13	Alternative Energy Systems and Applications	~		~			~	~							✓
6	22MEE14	Instrumentation in Thermal Engineering	~				~							1	~	✓
6	22MEE15	Digitalization in Supply Chain Management	~	~	~	~	~									✓
6	22MEE16	Lean Six Sigma	1	~			~				1				1	✓
7	22GEE01	Fundamentals of Research	1	~	✓	~	~	~	~	~	✓	✓	~	✓	✓	✓
7	22MEE17	Mechanics of Composite Materials	~	~	~	~										✓
7	22MEE18	Design of Jigs, Fixtures and Press Tools	~	~	~											✓
7	22MEE19	CNC Technology	1		~		~									✓
7	22MEE20	Precision Engineering	1	~	~				~						~	✓
7	22MEE21	Computational Fluid Dynamics	1				~							✓	✓	✓
7	22MEE22	Gas Dynamics and Jet Propulsion	1		✓									✓		✓
7	22MEE23	Project Management	1	1			~						1		✓	✓

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO1 1	PO1 2	PSO1	PSO2
7	22GEE02	Total Quality Management	1	~				~						1		~
7	22MEE24	Industrial Tribology	✓	✓										1		✓
7	22MEE25	Advanced Mechanics of Materials	✓	~	✓											✓
7	22MEE26	Additive Manufacturing	✓	~	~											✓
7	22MEE27	Welding Technology	~	~	~											~
7	22MEE28	Power Plant Engineering	~		1			~	~				~			✓
7	22MEE29	Design of Heat Exchangers	~		1				~							✓
7	22MEE30	Quality Control and Reliability Engineering	*	~	✓		~						✓	✓	✓	✓
7	22MEE31	Multi - Variate Artificial Intelligence Data Analysis	✓	✓		1	✓								✓	✓
7	22MEE32	Hybrid Vehicle Technology	~	✓	1											✓
7	22MEE33	Introduction to Aircraft Systems	~	~	1											✓
7	22MEE34	Mechatronics and IoT	~		✓		~								✓	
7	22MEE35	Modeling and Analysis of Manufacturing Systems	*	✓	✓											✓
7	22MEE36	Micro Electro Mechanical Systems	~		✓		~								✓	✓
7	22MEE37	Refrigeration and Air Conditioning	~	1	✓			1								✓
7	22MEE38	Energy Auditing and Management	1	~	✓		~	1	1					✓	✓	✓
7	22MEE39	Maintenance Engineering	1	1	✓		✓								✓	✓
7	22MEE40	Industrial Safety Engineering	1	~	✓			1	1						✓	✓
8	22MEE41	Introduction to Aircraft Structures	~	✓	1											✓
8	22MEE42	Product Design and Optimization	1	1	✓		1	✓	1						✓	✓
8	22MEE43	Nanotechnology for Mechanical Engineers	1	1	✓	✓	1	1							✓	✓
8	22MEE44	Non Destructive Evaluation Techniques	✓		✓		~								✓	✓
8	22MEE45	Turbomachines	~	1	✓										✓	✓
8	22MEE46	Energy Conservation in HVAC System	✓		✓			✓	✓					✓		~
8	22MEE47	Industrial Marketing	~	~			~					✓		✓	✓	✓
8	22MEE48	Decision Support Systems	~	~	~		~				~				✓	~
5	22MEX01	Renewable Energy Sources	✓		✓	~	✓	✓	✓		✓					

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO1 1	PO1 2	PSO1	PSO2
6	22MEX02	Design of Experiments	~	~	✓	~	~				~					
7	22MEO01	Fundamentals of Ergonomics	~	✓	✓	✓	✓	✓	✓					✓		
7	22MEO02	Principles of Management and Industrial Psychology	~					~				1	~			
7	22MEO03	Waste Heat Recovery System and Storage	1	~	~	~			1							
8	22MEO04	Safety Measures for Engineers	~					✓	~	1						
8	22MEO05	Energy Conservation in Thermal Equipments	~		~		~	~	~					~		
8	22MEO06	Climate Change and New Energy Technology	~		~			~	~	1						

# MAPPING OF COURSES WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
5	22CEX01	Remote Sensing and its Applications	~	~	~	~		~			~			✓		
5	22MEX01	Renewable Energy Sources	✓		~	✓	✓	~	✓	~	✓					
5	22MTO01	Design of Mechatronics Systems	✓	✓	✓	✓	✓							✓		
5	22MTX01	Data Acquisition and Virtual Instrumentation	~	~	~	~	~							✓		
5	22MTX02	Factory Automation	✓	✓	✓	✓	✓				✓	✓		✓		
5	22AUX01	Automotive Engineering	✓	✓	✓			✓	✓		✓	✓		✓		
5	22ECX01	Basics of Electronics in Automation Appliances	✓	✓	~	✓		~	✓	~			~	~		
5	22ECX02	Image Processing	✓	✓	$\checkmark$	✓	✓				✓	✓		✓		
5	22EEO01	Solar and Wind Energy Systems	✓	✓	✓			✓	✓					✓		
5	22EEO02	Electrical Wiring and Lighting	✓	✓	✓	✓	✓							✓		
5	22EEO03	Programmable Logic Controller and SCADA	✓	✓	~	✓		~			✓			✓		
5	22EEO04	Analog and Digital Electronics	✓	✓	$\checkmark$	✓	✓							✓		
5	22EEO05	Power Electronics and Drives	✓	✓	✓	✓	✓	✓			✓					
5	22EEO06	Sensors and Actuators	✓	✓	✓			✓						✓		
5	22EIO01	Measurements and Instrumentation	✓	✓	✓	✓	✓									

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
5	22EIO02	Biomedical Instrumentation and Applications	✓	✓	✓	✓	✓	✓		✓						
5	22EIO03	Industrial Automation	✓	✓	✓	✓	✓									
5	22CSX01	Fundamentals of Databases	✓	✓	✓											
5	22CSX02	Data science for Engineers	✓	✓	✓	✓	✓									
5	22CSX03	Enterprise Application Development Using Java	~	~	~	~	~	~	~	~	~	~	~	~		
5	22CSO01	Computational science for Engineers	✓	✓	~											
5	22CSO02	Formal Languages and Automata Theory	~	~	✓											
5	22ITO01	Artificial Intelligence	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓			
5	22ITX01	Next Generation Databases	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
5	22CDO01	Fundamentals of User Experience Design	~	~	~	~	✓				✓	✓	✓			
5	22ADO01	Data Warehousing and Data Mining	~	✓	✓											
5	22ALO01	Business Intelligence	✓	✓	✓											
5	22CHO01	Industrial Enzymology	✓	✓	✓							✓	✓	✓		
5	22CHO02	Waste to Energy Conversion	✓	✓												
5	22CHO03	Applied Nanotechnology	✓	✓	✓	✓	✓	✓	✓	✓				✓		
5	22FTX01	Baking Technology	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓		
5	22FTO01	Food Processing Technology	✓	✓	✓	✓		✓				✓		✓		
5	22MAO01	Mathematical Foundations for Machine Learning	~	✓	✓	✓	✓									
5	22MAO02	Numerical Computing	✓	✓	✓											
5	22MAO03	Stochastic Processes and Queuing Theory	~	~	~											
5	22MAO04	Statistics for Engineers	✓	✓	✓											
5	22PHO01	Thin Film Technology	✓	✓	✓						✓	✓		✓		
5	22PHO02	High Energy Storage Devices	✓	✓	✓						✓	✓		✓		
5	22PHO03	Structural and Optical Characterization of Materials	✓	✓	✓						✓	✓		✓		
5	22CYO01	Instrumental Methods of Analysis	✓	✓	✓	✓										

Sem.	Course Code	Course Title	P01	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
5	22CYO02	Chemistry Concepts for Competitive Examinations	1	✓	✓											
5	22CYO03	Organic Chemistry for Industry	✓	✓	✓	✓										
5	22MBO01	Cost Accounting for Engineers										✓	✓	✓		
6	22CEO01	Disaster Management	✓	✓	✓			✓	✓					✓		
6	22MEX02	Design of Experiments	1	✓	✓	✓	✓				✓					
6	22GEO04	Innovation and Business Model Development	~	~	~	~	~	~	~	~	~	~	~	~		
6	22MTO02	Robotics	✓	✓	✓	✓	✓							✓		
6	22MTO03	3D Printing and Design	✓	✓			✓							✓		
6	22AUO01	Automotive Electronics	✓	✓	✓	✓								✓		
6	22ECX03	PCB Design and Fabrication	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		
6	22EEO07	Energy Conservation and Management	~	~	~		~		~	~	✓			~		
6	22EEO08	Microprocessors and Microcontrollers Interfacing	1	✓	✓	~	~	✓	✓	~		✓	✓	✓		
6	22EEO09	Electrical Safety	✓	✓	✓				✓	✓			✓	✓		
6	22EEO10	VLSI System Design	✓	✓	✓	✓	✓				✓		✓	✓		
6	22EEO11	Automation for Industrial Applications	~	✓	~	✓			✓		✓			~		
6	22EIO04	PLC Programming with High Level Languages	✓	✓	✓	✓	✓									
6	22EIO05	Virtual Instrumentation	✓	✓	✓	✓	✓									
6	22CSX04	Foundations of Machine Learning	✓	✓	✓											
6	22CSX05	Web Engineering	✓	✓	✓											
6	22ITX02	Advanced Java Programming	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
6	22ITO02	Internet of Things	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓			
6	22ITO03	Fundamentals of Software Development	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓			
6	22ITO04	Mobile Application Development	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
6	22CDX01	Fundamentals of User Interactive Design	✓	✓	✓	✓										
6	22ADX01	Data Visualization	<ul> <li>✓</li> </ul>	✓	✓											

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	P011	PO12	PSO1	PSO2
6	22ALX01	Data Exploration and Visualization Techniques	~	~	~											
6	22CHO04	Air Pollution Monitoring and Control	~	✓	~			✓	~							
6	22CHO05	Paints and Coatings	✓	✓	✓				✓							
6	22CHO06	Powder Technology	✓	✓	✓			✓	✓					✓		
6	22FTX02	Processing of milk and milk products	~	~	~		~	~		~	~	1		~		
6	22FTX03	Processing of Fruits and Vegetables	~	~	~		~	~		~	~	✓		1		
6	22MAO05	Graph Theory and its Applications	✓	✓	✓											
6	22MAX01	Data Analytics using R Programming	~	~	~	~	~									
6	22MAO06	Operations Research	✓	✓	✓											
6	22MAO07	Number Theory and Cryptography	✓	✓	✓		✓									
6	22PHO04	Synthesis, Characterization and Biological Applications of Nanomaterials	~	~	~						~	~		~		
6	22PHO05	Techniques of Crystal Growth	✓	✓	✓						✓	✓		✓		
6	22CYO04	Corrosion Science and Engineering	~	~	~	~										
6	22CYO05	Chemistry of Cosmetics in Daily Life	✓	✓	~											
6	22CYO06	Nanocomposite Materials	✓	✓	✓	✓										
6	22MBO02	Economic Analysis for Decision Making					~					✓	~			
7	22CEO02	Introduction to Smart Cities	✓	✓	✓	✓	✓									
7	22CEO03	Environmental Health and Safety	✓	✓	✓			✓	✓							
7	22MEO01	Fundamentals of Ergonomics	✓	✓	✓	✓	✓	✓	✓					✓		
7	22MEO02	Principles of Management and Industrial Psychology	✓					~				✓	✓			
7	22MEO03	Waste Heat Recovery System and Storage	✓	✓	✓	✓			✓							
7	22GEO05	Entrepreneurship Development	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
7	22MTO04	Drone System Technology	✓	✓	✓	✓	✓							✓		
7	22AUO02	Vehicle Maintenance	✓	✓			✓		✓					✓		

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	P011	PO12	PSO1	PSO2
7	22ECO01	Wearable Devices	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓		
7	22ECX04	Electronic Hardware and Troubleshooting	✓	✓	✓	✓	✓	✓	~	~	~	✓		✓		
7	22EEO12	Electric Vehicle	✓	✓	✓	✓		✓	✓		✓			✓		
7	22EEO13	E-Waste Management	✓	✓	✓	✓		✓	~					✓		
7	22EEO14	Embedded System Design	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓		
7	22EEO15	Energy Storage Systems and Controllers	~	~	✓			~			~		~	~		
7	22EEO16	AI Techniques for Engineering Applications	✓	~	~	~										
7	22EIO06	Introduction to Distributed Control Systems	✓	✓	✓	✓	✓			✓		✓				
7	22EIO07	Instrumentation in Aircraft Navigation and Control	✓	✓	✓	✓	✓									
7	22EIO08	Industry 4.0 with Industrial IoT	✓	✓	✓	✓	✓			✓						
7	22EIO09	Industrial Data Communication	✓	✓	✓	✓	✓	✓								
7	22EIO10	Wireless Instrumentation	✓	✓	✓	✓	✓		✓							
7	22EIO11	Instrumentation Techniques in Agriculture	✓	~	~	~	~									
7	22CSO03	Nature Inspired optimization techniques	✓	~	✓											
7	22ITO05	Fundamentals of Cloud Computing	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
7	22ITO06	Introduction to Ethical Hacking	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
7	22CDO02	Introduction to Mobile Game Design	~	~	~	~										
7	22CDO03	Introduction to Graphics Design	✓	✓	✓	✓										
7	22ADO02	Neural Networks and Deep Learning	✓	~	✓	~										
7	22ALO02	Industrial Machine Learning	✓	✓	✓											
7	22CHO07	Hydrogen Energy	✓	✓										✓		
7	22CHO08	Rubber Technology	✓	✓				✓	✓					✓		
7	22FTO02	Principles of Food safety	✓	✓	✓			✓	✓	✓		✓		✓		
7	22FTO03	Fundamentals of Food Packaging and Storage	~	~	~	~	~	~		~		~		~		
7	22MAO08	Non-Linear Optimization	✓	✓	✓											

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	P011	PO12	PSO1	PSO2
7	22MAO09	Optimization for Engineers	✓	✓	✓											
7	22CYO07	Waste and Hazardous Waste Management	~	~	~	~			~							
7	22CYO08	Chemistry in Every day Life	✓	✓	✓	✓										
7	22MBO03	Marketing Analytics										✓	✓	✓		
8	22CEO04	Infrastructure Planning and Management	~	~	~		~									
8	22CEO05	Environmental Laws and Policy	✓	✓			✓									
8	22MEO04	Safety Measures for Engineers	✓					✓	✓	✓						
8	22MEO05	Energy Conservation in Thermal Equipments	✓		✓		✓	~	✓					~		
8	22MEO06	Climate Change and New Energy Technology	✓		✓			✓	✓	✓						
8	22MTO05	Micro and Nano Electromechanical Systems	✓	✓	~	~								~		
8	22AUO03	Public Transport Management	✓	✓				✓	✓	✓				✓		
8	22AUO04	Autonomous Vehicles	✓	✓	✓	✓	✓	✓	✓					✓		
8	22ECO02	Optical Engineering	✓	✓	✓	✓		✓	✓	✓	✓			✓		
8	22EEO17	Smart Grid Technologies	✓	✓	✓	✓	✓			✓				✓		
8	22EEO18	Biomass Energy Systems	✓	✓	✓			✓	✓				✓	✓		
8	22EIO12	Environmental Sensors	✓	✓	✓	✓	✓		✓							
8	22EIO13	Pollution Control and Management	✓	✓	✓	✓	✓	✓		✓						
8	22CSO04	Machine Translation	✓	✓	✓											
8	22CSO05	Fundamentals of Blockchain	✓	✓	✓											
8	22ITO07	Business Continuity Planning	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓			
8	22CDX02	Virtual Reality and Augmented Reality	~	~	~	~										
8	22ADO03	Business Analytics	✓	✓	✓	✓										
8	22ALO03	Machine Learning for Smart Cities	✓	✓	✓	✓										
8	22CHO09	Industrial Accident Prevention and Management	✓		✓	✓		~	✓	✓	✓	✓	✓	✓		
8	22CHO10	Electrochemical Engineering	✓	✓	✓											
8	22CHO11	Smart and Functional Materials	✓	✓					✓	✓	✓			✓		

Sem.	Course Code	Course Title	P01	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	P011	PO12	PSO1	PSO2
8	22FTO04	Food Ingredients	✓	✓	✓			✓		✓		✓		✓		
8	22FTO05	Food and Nutrition	✓	✓	✓			✓				✓		✓		
8	22CYO09	Chemistry of Nutrition for Women Health	~	~	✓											
		General Open Elective Courses														
ALL	22GEO01	German Language Level 1								✓	✓	✓		✓		
ALL	22GEO02	Japanese Language Level 1								✓	✓	✓		✓		
5	22GEO03	Design Thinking for Engineers	✓	✓	✓	✓										
6	22GEO04	Innovation and Business Model Development	1	✓	~	~	~	~	~	~	~	✓	✓	~		
ALL	22GEO05	German Language Level 2								✓	✓	✓		✓		
ALL	22GEO06	German Language Level 3								✓	✓	✓		✓		
ALL	22GEO07	German Language Level 4								✓	✓	✓		✓		
ALL	22GEO08	Japanese Language Level 2								✓	✓	✓		✓		
ALL	22GEO09	Japanese Language Level 3								✓	✓	✓		✓		
ALL	22GEO10	Japanese Language Level 4								✓	✓	✓		✓		
ALL	22GEO11	French Language Level 1								✓	✓	✓		✓		
ALL	22GEO12	French Language Level 2								✓	✓	✓		✓		
ALL	22GEO13	French Language Level 3								✓	✓	✓		✓		
ALL	22GEO14	Spanish Language Level 1								✓	✓	✓		✓		
ALL	22GEO15	Spanish Language Level 2								✓	✓	✓		✓		
ALL	22GEO16	Spanish Language Level 3								✓	~	✓		✓		
7	22GEO17	Entrepreneurship Development	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
5/6	22GEX01	NCC Studies (Army Wing) - I	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
5/6	22GEX02	NCC Studies (Air Wing) - 1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
5	22MBO01	Cost Accounting for Engineers										✓	✓	✓		
6	22MBO02	Economic Analysis for Decision Making					~					✓	✓			
7	22MBO03	Marketing Analytics										✓	✓	✓		

# B.E. MECHANICAL ENGINEERING CURRICULUM – R2022 (For the students admitted from the academic year 2022-23 onwards)

SEMESTER -	-1								
Course	Course Title	Но	urs/V	Veek	Credit	Мах	Cate		
Code		L	Т	Ρ		CA	ESE	Total	gory
Theory/Theo	ry with Practical								
22EGT11	Communication Skills – I	3	0	0	3	40	60	100	HS
22MAC11	Matrices and Ordinary Differential Equations	3	1*	2*	4	50	50	100	BS
22PHT12	Physics for Mechanical Engineering	3	0	0	3	40	60	100	BS
22MET11	Engineering Drawing	2	1	0	3	40	60	100	ES
22MET12	Engineering Mechanics	3	0	0	3	40	60	100	PC
22CSC11	Problem Solving and Programming in C	3	0	2	4	50	50	100	ES
Practical / Er	nployability Enhancement								
22MEL11	Engineering Practices Laboratory	0	0	2	1	60	40	100	ES
22PHL12	Physics Laboratory for Mechanical Engineering	0	0	2	1	60	40	100	BS
22VEC11	Yoga and Values for Holistic Development	1	0	1	1	100	0	100	HS
22MNT11	Student Induction Program				0	100	0	100	MC
	Total Credits to be earned				23				

\* Alternate Weeks

SEMESTER	- 11								
Course	Course Title	Hours / Week		Credit	Мах	imum	Cate		
Code		L	Т	Р		CA	ESE	Total	gory
Theory/Theo	ory with Practical								
22EGT21	Communication Skills – II	3	0	0	3	40	60	100	HS
22MAC21	Multivariable Calculus and Complex Analysis	3	1*	2*	4	50	50	100	BS
22CYT22	Chemistry for Mechanical Engineering	3	0	0	3	40	60	100	BS
22MET21	Engineering Materials and Metallurgy	3	0	0	3	40	60	100	PC
22CSC21	Fundamentals of Data Structures	3	0	2	4	50	50	100	ES
22EET14	Electrical and Electronics Engineering	3	0	0	3	40	60	100	ES
22TAM01	Heritage of Tamils	1	0	0	1	100	0	100	HS
Practical / E	mployability Enhancement								
22CYL22	Chemistry Laboratory for Mechanical Systems	0	0	2	1	60	40	100	BS
22EEL14	Electrical and Electronics Engineering Laboratory	0	0	2	1	60	40	100	ES
	Total Credits to be earned				23				

\* Alternate Weeks

# B.E. - MECHANICAL ENGINEERING CURRICULUM – R2022 (For the students admitted from the academic year 2022-23 onwards)

SEMESTER	- III								
Course	Course Title	Но	urs / V	Veek	Credit	Max	imum	Cate	
Code		L	Т	Р		CA	ESE	Total	gory
Theory/Theo	ory with Practical								
22ITC32	Introduction to Python	3	0	2	4	100	0	100	ES
22MEC31	Fluid Mechanics and Hydraulic Machines	3	0	2	4	50	50	100	ES
22MET31	Manufacturing Technology	3	0	0	3	40	60	100	PC
22MET32	Engineering Thermodynamics	3	1	0	4	40	60	100	PC
22MET33	Strength of Materials	3	0	0	3	40	60	100	PC
22MNT31	Environmental Science	2	0	0	0	100	0	100	MC
22TAM02	Tamils and Technology	1	0	0	1	100	0	100	HS
Practical / E	mployability Enhancement								
22MEL31	Manufacturing Technology and Material Property Testing Laboratory	0	0	2	1	60	40	100	PC
22MEL32	Machine Drawing using AutoCAD Laboratory	0	0	2	1	60	40	100	PC
22EGL31	Communication Skills Development Laboratory	0	0	2	1	60	40	100	HS
	Total Credits to be earned				22				

SEMESTER	– IV								
Course	Course Title	Ηοι	urs / V	Veek	Credit	Мах	imum	Cate	
Code		L	Т	Р		CA	ESE	Total	gory
Theory/Theo	ory with Practical								
22MAT41	Numerical Methods for Engineers	3	1	0	4	40	60	100	BS
22MET41	Thermal Engineering	3	0	0	3	40	60	100	PC
22MET42	Machining and Measurements	3	0	0	3	40	60	100	PC
22MET43	CAD/CAM/CIM for Automation	3	0	0	3	40	60	100	PC
22MET44	Kinematics of Machinery	3	0	0	3	40	60	100	PC
Practical / E	mployability Enhancement								
22MEL41	Thermal Engineering and Renewable Energy Laboratory	0	0	2	1	60	40	100	PC
22MEL42	Machining and Measurements Laboratory	0	0	2	1	60	40	100	PC
22MEL43	Solid Modeling Laboratory	0	0	2	1	60	40	100	PC
22GCL41/ 22GCl41	Professional Skills Training I / Industrial Training I				2	100	0	100	EC
	Total Credits to be earned				21				

### B.E. MECHANICAL ENGINEERING CURRICULUM – R2022 (For the students admitted from the academic year 2022-23 onwards)

SEMESTER – V Hours / Week **Maximum Marks** Course Cate Credit **Course Title** Code gory L т Ρ CA ESE Total Theory/Theory with Practical 22MEC51 Heat and Mass Transfer 3 0 2 4 PC 50 50 100 22MEC52 Dynamics of Machinery 3 2 50 50 PC 0 4 100 22MET51 Operations Research 3 1 0 4 40 60 100 PC 22MET52 Artificial Intelligence in Mechanical Systems 3 40 PC 0 0 3 60 100 Professional Elective – I 3 0 0 3 40 60 100 ΡE 3 1/0 4 Open Elective - I 0/2 40 60 100 OE Practical / Employability Enhancement 22MEL51 CAM and Robotics Laboratory PC 0 0 2 1 60 40 100 22MEL52 Surface and Sheet Metal Design Laboratory 0 2 1 PC 0 60 40 100 22GCL51/ Professional Skills Training II / Industrial Training II 2 100 0 100 EC ------22GCI51 Total Credits to be earned 26

SEMESTER – VI										
Course	Course Title	Но	urs / V	Veek	Credit	Мах	imum	Cate		
Code		L	Т	Р		CA	ESE	Total	gory	
Theory/Th	eory with Practical									
22MET61	Design of Machine Elements	3	1	0	4	40	60	100	PC	
22MET62	Finite Element Analysis	3	0	0	3	40	60	100	PC	
	Professional Elective – II	3	0	0	3	40	60	100	PE	
	Open Elective – II	3	1/0	0/2	4	40	60	100	OE	
Practical /	Employability Enhancement									
22MEL61	Simulation Laboratory	0	0	2	1	60	40	100	PC	
22MEP61	Project Work I	0	0	8	4	100	0	100	EC	
22GEP61	Comprehensive Test and Viva				2	100	0	100	EC	
22GET31	Universal Human Values	2	0	0	2	100	0	100	HS	
	Total Credits to be earned				23					

### B.E. MECHANICAL ENGINEERING CURRICULUM – R2022 (For the students admitted from the academic year 2022-23 onwards)

SEMESTER – VII Hours / Week **Maximum Marks** Course Cate **Course Title** Credit Code gory Т CA ESE Total L Ρ Theory/Theory with Practical 22GCT71 Engineering Economics and Management 3 HS 0 0 3 40 60 100 Professional Elective - III 3 0 0 3 40 60 100 ΡE Professional Elective - IV 3 0 0 3 40 60 100 ΡE Professional Elective - V 3 0 0 3 40 60 100 ΡE Open Elective – III 3 0 0 3 40 60 100 OE Practical / Employability Enhancement 22MEP71 Project Work II Phase I 0 50 0 10 5 50 100 EC Total Credits to be earned 20

SEMESTE	R – VIII								
Course Code	Course Title	Но	urs / V	Veek	Credit	Max	imum	Categor	
Code		L	Т	Р	-	CA ESE Total	У		
Theory/Th	eory with Practical								
	Professional Elective – VI	3	0	0	3	40	60	100	PE
	Open Elective – IV	3	0	0	3	40	60	100	OE
Practical /	Employability Enhancement								
22MEP81	Project Work II Phase II	0	0	8	4	50	50	100	EC
	Total Credits to be earned	•		•	10		•		

**Total Credits: 168** 

	LIST OF PROFESSIONAL ELECTIVES (PEs) (For the students admitted in the year 2022-23)										
S. No.	Course Code	Course Name	L	т	P	С	Domain/ Stream				
		Semester – V	I				I				
	I	Elective – I		1			Γ				
1.	22MEE01	Fluid Power System	3	0	0	3	Design				
2.	22MEE02	Piping Design	3	0	0	3	Design				
3.	22MEE03	Unconventional Machining Processes	3	0	0	3	Mfg.				
4.	22MEE04	Design for Manufacture and Assembly	3	0	0	3	Mfg.				
5.	22MEE05	Automobile Engineering	3	0	0	3	Thermal				
6.	22MEE06	Fuels and Combustion Technology	3	0	0	3	Thermal				
7.	22MEE07	Industrial Engineering	3	0	0	3	Ind. Engg.				
8.	22MEE08	Production Planning and Control	3	0	0	3	Ind. Engg.				
		Semester – VI									
	1	Elective – II	r	1							
9.	22MEE09	Design of Transmission Systems	3	0	0	3	Design				
10.	22MEE10	Vibration and Noise Control	3	0	0	3	Design				
11.	22MEE11	Intelligent Manufacturing Systems	3	0	0	3	Mfg.				
12.	22MEE12	Manufacturing Information System	3	0	0	3	Mfg.				
13.	22MEE13	Alternative Energy Systems and Applications	3	0	0	3	Thermal				
14.	22MEE14	Instrumentation in Thermal Engineering	3	0	0	3	Thermal				
15.	22MEE15	Digitalization in Supply Chain Management	3	0	0	3	Ind. Engg.				
16.	22MEE16	Lean Six Sigma	3	0	0	3	Ind. Engg.				
		Semester – VII									
		Elective – III		1							
17.	22GEE01	Fundamentals of Research	3	0	0	3	General				
18.	22MEE17	Mechanics of Composite Materials	3	0	0	3	Design				
19.	22MEE18	Design of Jigs, Fixtures and Press Tools	3	0	0	3	Design				
20.	22MEE19	CNC Technology	3	0	0	3	Mfg.				
21.	22MEE20	Precision Engineering	3	0	0	3	Mfg.				
22.	22MEE21	Computational Fluid Dynamics	3	0	0	3	Thermal				
23.	22MEE22	Gas Dynamics and Jet Propulsion	3	0	0	3	Thermal				
24.	22MEE23	Project Management	3	0	0	3	Ind. Engg.				
25.	22GEE02	Total Quality Management	3	0	0	3	Ind. Engg.				

		Elective – IV					
26.	22MEE24	Industrial Tribology	3	0	0	3	Design
27.	22MEE25	Advanced Mechanics of Materials	3	0	0	3	Design
28.	22MEE26	Additive Manufacturing	3	0	0	3	Mfg.
29.	22MEE27	Welding Technology	3	0	0	3	Mfg.
30.	22MEE28	Power Plant Engineering	3	0	0	3	Thermal
31.	22MEE29	Design of Heat Exchangers	3	0	0	3	Thermal
32.	22MEE30	Quality Control and Reliability Engineering	3	0	0	3	Ind. Engg.
33.	22MEE31	Multi - Variate Artificial Intelligence Data Analysis	3	0	0	3	Ind.Engg.
34.	22MEE32	Hybrid Vehicle Technology	3	0	0	3	Thermal
	1	Elective – V	1	1	1		
35.	22MEE33	Introduction to Aircraft Systems	3	0	0	3	Design
36.	22MEE34	Mechatronics and IoT	3	0	0	3	Design
37.	22MEE35	Modeling and Analysis of Manufacturing Systems	3	0	0	3	Mfg.
38.	22MEE36	Micro Electro Mechanical Systems	3	0	0	3	Mfg.
39.	22MEE37	Refrigeration and Air Conditioning	3	0	0	3	Thermal
40.	22MEE38	Energy Auditing and Management	3	0	0	3	Thermal
41.	22MEE39	Maintenance Engineering	3	0	0	3	Ind.Engg.
42.	22MEE40	Industrial Safety Engineering	3	0	0	3	Ind.Engg.
		Semester – VIII					
		Elective – VI	1	1	1		Γ
43.	22MEE41	Introduction to Aircraft Structures	3	0	0	3	Design
44.	22MEE42	Product Design and Optimization	3	0	0	3	Design
45.	22MEE43	Nanotechnology for Mechanical Engineers	3	0	0	3	Mfg.
46.	22MEE44	Non Destructive Evaluation Techniques	3	0	0	3	Mfg.
47.	22MEE45	Turbomachines	3	0	0	3	Thermal
48.	22MEE46	Energy Conservation in HVAC System	3	0	0	3	Thermal
49.	22MEE47	Industrial Marketing	3	0	0	3	Ind.Engg.
50.	22MEE48	Decision Support Systems	3	0	0	3	Ind.Engg.

# B.E. MECHANICAL ENGINEERING CURRICULUM – R2022 (For the students admitted from the academic year 2023-24 onwards)

SEMESTER ·	-1								
Course	Course Title	Hours / Week			Credit	Мах	Cate		
Code		L	Т	Ρ		CA	ESE	Total	gory
Theory/Theo	ry with Practical								
22EGT11	Communication Skills – I	3	0	0	3	40	60	100	HS
22MAC11	Matrices and Ordinary Differential Equations	3	1*	2*	4	50	50	100	BS
22PHT12	Physics for Mechanical Engineering	3	0	0	3	40	60	100	BS
22MET11	Engineering Drawing	2	1	0	3	40	60	100	ES
22CSC11	Problem Solving and Programming in C	3	0	2	4	50	50	100	ES
22TAM01	Heritage of Tamils	1	0	0	1	100	0	100	HS
Practical / Er	nployability Enhancement								
22GCL12	Foundation Laboratory - Electrical, IoT, Web	0	0	6	3	60	40	100	ES
22PHL12	Physics Laboratory for Mechanical Engineering	0	0	2	1	60	40	100	BS
22VEC11	Yoga and Values for Holistic Development	1	0	1	1	100	0	100	HS
22MNT11	Student Induction Program				0	100	0	100	MC
	Total Credits to be earned				23				

\* Alternate Weeks

SEMESTER ·	- 11								
Course	Course Title	Hours / Week		Credit	Max	imum	Cate		
Code		L	Т	Р		CA	ESE	Total	gory
Theory/Theo	ry with Practical								
22EGT21	Communication Skills – II	3	0	0	3	40	60	100	HS
22MAC21	Multivariable Calculus and Complex Analysis	3	1*	2*	4	50	50	100	BS
22CYT22	Chemistry for Mechanical Engineering	3	0	0	3	40	60	100	BS
22MET12	Engineering Mechanics	3	0	0	3	40	60	100	PC
22CSC21	Fundamentals of Data Structures	3	0	2	4	50	50	100	ES
22TAM02	Tamils and Technology	1	0	0	1	100	0	100	HS
Practical / Er	nployability Enhancement								
22GCL11	Foundation Laboratory - Manufacturing, Design and Robotics	0	0	6	3	60	40	100	ES
22CYL22	Chemistry Laboratory for Mechanical Systems	0	0	2	1	60	40	100	BS
	Total Credits to be earned				22				

# B.E. - MECHANICAL ENGINEERING CURRICULUM – R2022 (For the students admitted from the academic year 2023-24 onwards)

SEMESTER	- III								
Course	Course Title	Но	urs / V	Veek	Credit	Мах	imum	Cate	
Code		L	Т	Р		CA	ESE	Total	gory
Theory/Theo	ory with Practical								
22ITC32	Introduction to Python	3	0	2	4	50	50	100	ES
22MEC31	Fluid Mechanics and Hydraulic Machines	3	0	2	4	50	50	100	ES
22MET31	Manufacturing Technology	3	0	0	3	40	60	100	PC
22MET32	Engineering Thermodynamics	3	1	0	4	40	60	100	PC
22MET33	Strength of Materials	3	0	0	3	40	60	100	PC
22MNT31	Environmental Science	2	0	0	0	100	0	100	MC
Practical / E	mployability Enhancement								
22MEL31	Manufacturing Technology and Materials Testing Laboratory	0	0	2	1	60	40	100	PC
22MEL32	Machine Drawing using AutoCAD Laboratory	0	0	2	1	60	40	100	PC
22EGL31	Communication Skills Development Laboratory	0	0	2	1	60	40	100	HS
	Total Credits to be earned				21				

SEMESTER	– IV								
Course	Course Title	Ηοι	urs / V	Veek	Credit	Max	imum	Cate	
Code		L	Т	Ρ		CA	ESE	Total	gory
Theory/Theo	ory with Practical								
22MAT41	Numerical Methods for Engineers	3	1	0	4	40	60	100	BS
22MET41	Thermal Engineering	3	0	0	3	40	60	100	PC
22MET42	Machining and Measurements	3	0	0	3	40	60	100	PC
22MET21	Engineering Materials and Metallurgy	3	0	0	3	40	60	100	PC
22MET44	Kinematics of Machinery	3	0	0	3	40	60	100	PC
Practical / E	mployability Enhancement								
22MEL41	Thermal Engineering and Renewable Energy Laboratory	0	0	2	1	60	40	100	PC
22MEL42	Machining and Measurements Laboratory	0	0	2	1	60	40	100	PC
22MEL43	Solid Modeling Laboratory	0	0	2	1	60	40	100	PC
22GCL41/ 22GCl41	Professional Skills Training I / Industrial Training I				2	100	0	100	EC
	Total Credits to be earned				21				

# B.E. MECHANICAL ENGINEERING CURRICULUM – R2022 (For the students admitted from the academic year 2023-24 onwards)

SEMESTE	R – V								
Course	Course Title	Но	urs / \	Week	Credit	Мах	imum	Cate	
Code		L	Т	Р		CA	ESE	Total	yory
Theory/Th	eory with Practical								
22MEC51	Heat and Mass Transfer	3	0	2	4	50	50	100	PC
22MEC52	Dynamics of Machinery	3	0	2	4	50	50	100	PC
22MET51	Operations Research	3	1	0	4	40	60	100	PC
22MET43	CAD/CAM/CIM for Automation	3	0	0	3	40	60	100	PC
	Professional Elective – I	3	0	0	3	40	60	100	PE
	Open Elective – I	3	1/0	0/2	4	40	60	100	OE
Practical /	Employability Enhancement								
22MEL51	CAM and Robotics Laboratory	0	0	2	1	60	40	100	PC
22MEL52	Surface and Sheet Metal Design Laboratory	0	0	2	1	60	40	100	PC
22GCL51/ 22GCl51	Professional Skills Training II / Industrial Training II				2	100	0	100	EC
	Total Credits to be earned				26				

SEMESTE	SEMESTER – VI												
Course	Course Title	Ηοι	urs / V	Veek	Credit	Мах	imum	Cate					
Code		L	Т	Р		CA	ESE	Total	gory				
Theory/Th	eory with Practical												
22MET61	Design of Machine Elements	0	4	40	60	100	PC						
22MET62	Finite Element Analysis	3	0	0	3	40	60	100	PC				
	Professional Elective – II	3	0	0	3	40	60	100	PE				
	Open Elective – II	3	1/0	0/2	4	40	60	100	OE				
Practical /	Employability Enhancement												
22MEL61	Simulation Laboratory	0	0	2	1	60	40	100	PC				
22MEP62	Project Work I	0	0	10	5	100	0	100	EC				
22GEP61	Comprehensive Test and Viva				2	100	0	100	EC				
22GET31	Universal Human Values	2	0	0	2	100	0	100	HS				
	Total Credits to be earned		24										

# B.E. MECHANICAL ENGINEERING CURRICULUM – R2022 (For the students admitted from the academic year 2023-24 onwards)

SE	MESTER – VII									
Course	Course Title	Ηοι	urs / \	Neek	Credit	Мах	imum	Cate		
Code		L	Т	Р		CA	ESE	Total	gory	
Theory/Th	eory with Practical									
22GCT71	Engineering Economics and Management	3	0	0	3	40	60	100	HS	
22MET52	Artificial Intelligence in Mechanical Systems	3	0	0	3	40	60	100	PC	
	Professional Elective – III	3	0	0	3	40	60	100	PE	
	Professional Elective – IV	3	0	0	3	40	60	100	PE	
	Open Elective – III	3	0	0	3	40	60	100	OE	
Practical /	Employability Enhancement									
22MEP72	Project Work II Phase I	12	6	50	50	100	EC			
	Total Credits to be earned				21					

SEMESTE	R – VIII								
Course	Course Title	Ηοι	urs / V	Veek	Credit	Max	imum	Cate	
Code		L	Т	Р		CA	ESE	Total	gory
Theory/Th	eory with Practical								
	Professional Elective – V	3	0	0	3	40	60	100	PE
	Open Elective – IV	3	0	0	3	40	60	100	OE
Practical /	Employability Enhancement								
22MEP81	Project Work II Phase II	0	0	8	4	50	50	100	EC
	Total Credits to be earned				10				

**Total Credits: 168** 

		LIST OF PROFESSIONAL ELECTI (For the students admitted in the ye	VES ( ear 20	(PEs) )23-2	4)		
S. No.	Course Code	Course Name	L	т	Ρ	С	Domain/ Stream
		Semester – V					
	Γ	Elective – I	T			1	Γ
1.	22MEE01	Fluid Power System	3	0	0	3	Design
2.	22MEE02	Piping Design	3	0	0	3	Design
3.	22MEE03	Unconventional Machining Processes	3	0	0	3	Mfg.
4.	22MEE04	Design for Manufacture and Assembly	3	0	0	3	Mfg.
5.	22MEE05	Automobile Engineering	3	0	0	3	Thermal
6.	22MEE06	Fuels and Combustion Technology	3	0	0	3	Thermal
7.	22MEE07	Industrial Engineering	3	0	0	3	Ind. Engg.
8.	22MEE08	Production Planning and Control	3	0	0	3	Ind. Engg.
		Semester – VI					
	1	Elective – II		1			
9.	22MEE09	Design of Transmission Systems	3	0	0	3	Design
10.	22MEE10	Vibration and Noise Control	3	0	0	3	Design
11.	22MEE11	Intelligent Manufacturing Systems	3	0	0	3	Mfg.
12.	22MEE12	Manufacturing Information System	3	0	0	3	Mfg.
13.	22MEE13	Alternative Energy Systems and Applications	3	0	0	3	Thermal
14.	22MEE14	Instrumentation in Thermal Engineering	3	0	0	3	Thermal
15.	22MEE15	Digitalization in Supply Chain Management	3	0	0	3	Ind. Engg.
16.	22MEE16	Lean Six Sigma	3	0	0	3	Ind. Engg.
		Semester – VII					
	ſ	Elective – III	1	1			
17.	22GEE01	Fundamentals of Research	3	0	0	3	General
18.	22MEE17	Mechanics of Composite Materials	3	0	0	3	Design
19.	22MEE18	Design of Jigs, Fixtures and Press Tools	3	0	0	3	Design
20.	22MEE19	CNC Technology	3	0	0	3	Mfg.
21.	22MEE20	Precision Engineering	3	0	0	3	Mfg.
22.	22MEE21	Computational Fluid Dynamics	3	0	0	3	Thermal
23.	22MEE22	Gas Dynamics and Jet Propulsion	3	0	0	3	Thermal
24.	22MEE23	Project Management	3	0	0	3	Ind. Engg.
25.	22GEE02	Total Quality Management	3	0	0	3	Ind. Engg.

		Elective – IV					
26.	22MEE24	Industrial Tribology	3	0	0	3	Design
27.	22MEE25	Advanced Mechanics of Materials	3	0	0	3	Design
28.	22MEE26	Additive Manufacturing	3	0	0	3	Mfg.
29.	22MEE27	Welding Technology	3	0	0	3	Mfg.
30.	22MEE28	Power Plant Engineering	3	0	0	3	Thermal
31.	22MEE29	Design of Heat Exchangers	3	0	0	3	Thermal
32.	22MEE30	Quality Control and Reliability Engineering	3	0	0	3	Ind. Engg.
33.	22MEE31	Multi - Variate Artificial Intelligence Data Analysis	3	0	0	3	Ind.Engg.
34.	22MEE32	Hybrid Vehicle Technology	3	0	0	3	Thermal
35.	22MEE33	Introduction to Aircraft Systems	3	0	0	3	Design
36.	22MEE34	Mechatronics and IoT	3	0	0	3	Design
37.	22MEE35	Modeling and Analysis of Manufacturing Systems	3	0	0	3	Mfg.
38.	22MEE36	Micro Electro Mechanical Systems	3	0	0	3	Mfg.
39.	22MEE37	Refrigeration and Air Conditioning	3	0	0	3	Thermal
40.	22MEE38	Energy Auditing and Management	3	0	0	3	Thermal
41.	22MEE39	Maintenance Engineering	3	0	0	3	Ind.Engg.
42.	22MEE40	Industrial Safety Engineering	3	0	0	3	Ind.Engg.
		Semester – VIII					
		Elective – V					
43.	22MEE41	Introduction to Aircraft Structures	3	0	0	3	Design
44.	22MEE42	Product Design and Optimization	3	0	0	3	Design
45.	22MEE43	Nanotechnology for Mechanical Engineers	3	0	0	3	Mfg.
46.	22MEE44	Non Destructive Evaluation Techniques	3	0	0	3	Mfg.
47.	22MEE45	Turbomachines	3	0	0	3	Thermal
48.	22MEE46	Energy Conservation in HVAC System	3	0	0	3	Thermal
49.	22MEE47	Industrial Marketing	3	0	0	3	Ind.Engg.
50.	22MEE48	Decision Support Systems	3	0	0	3	Ind.Engg.

	LIST OF	OPEN ELECTIVECOURSESOFFEREDTOOTH	ERD	EPAF	RTME	ENTS(C	DEs)
S. No.	Course Code	Course Name	L	т	Ρ	С	Semester
1.	22MEX01	Renewable Energy Sources	3	0	2	4	V
2.	22MEX02	Design of Experiments	3	0	2	4	VI
3.	22MEO01	Fundamentals of Ergonomics	3	0	0	3	VII
4.	22MEO02	Principles of Management and Industrial Psychology	3	0	0	3	VII
5.	22MEO03	Waste Heat Recovery System and Storage	3	0	0	3	VII
6.	22MEO04	Safety Measures for Engineers	3	0	0	3	VIII
7.	22MEO05	Energy Conservation in Thermal Equipments	3	0	0	3	VIII
8.	22MEO06	Climate Change and New Energy Technology	3	0	0	3	VIII

	22EGT11 - COMMUNICATION SKILLS	I					
	(Common to All Engineering and Technology Br	anches)					
Programme & Branch	All B.E./B.Tech. Branches	Sem.	Category	L	т	Ρ	Credit
Prerequisites	Nil	I	HS	3	0	0	3
Preamble	This course is designed to impart required levels of Communication necessary for different professional contexts.	n Skills a	and Proficien	cy in E	nglisł	n lang	guage
Unit – I	Grammar, Vocabulary, Listening, Speaking, Reading & Writing	9					9
Grammar: Part Negative - Geru - Listening to sl Types of Readir	of speech - Tenses - Types of sentences: Assertive, Imperative nds & Infinitives - Vocabulary: Affixes - Synonyms & Antonyms - Liste ort talks - TV shows - Speaking: Verbal & Non-verbal communicatio g – Intensive: scanning, word by word, survey - Writing: Dialogue way	e, Interro <b>ening:</b> T n - Pair iting, Inf	gative & Exc ypes of lister conversation ormal Letters	lamato ing - E i - Rol - Para	ory – Barrie e pla grap	Affirr rs to y <b>- F</b> h writ	mative & listening <b>Reading:</b> ting
Unit – II	Grammar, Vocabulary, Listening, Speaking, Reading & Writing	9					9
Grammar: Voic listening - Lis Reading: Read sentences	es - Impersonal passives - <b>Vocabulary:</b> Homonyms, Homophones ening to announcements & radio broadcasts - <b>Speaking:</b> Persua ng comprehension - Articles from Newspapers/Magazines - Cloze	s & Hon sive & I exercise	nographs - L mpromptu ta es - Writing:	<b>istenii</b> lks <b>-</b> N Essay	<b>ng:</b> In Jarrat / writ	mpor ting a ting,	tance of a story - Jumbled
Unit – III	Grammar, Vocabulary, Listening, Speaking, Reading & Writing	9					9
Grammar: Prep Introduction - R - Formal letters Unit – IV Grammar: Arti	eading: Extensive: speed, skimming - Identifying lexical & contextual : Seeking permission for Industrial visits & Inviting guests Grammar, Vocabulary, Listening, Speaking, Reading & Writing	IED 1a meanin	alks, Comme igs - Writing:		- Sp ction:	s & V	ng: Self Varnings 9
Listening: Liste Paraphrasing & placing orders	ning to conversations - <b>Speaking:</b> Tongue twisters - Skill Sharing Summarizing - Writing: Recommendations & Suggestions - Busin	- N ess lette	ote-taking - I ers: Enquiry,	Readir Calling	ig: N g for	lote i quot	making - ations &
Unit – V	Grammar, Vocabulary, Listening, Speaking, Reading & Writin	g					9
Grammar: Cau personalities - - IELTS type pas	se and effect expressions - <b>Vocabulary:</b> Abbreviations & acronyms <b>Speaking:</b> Commonly mispronounced words - Welcome address, Chi sages - <b>Writing:</b> Preparing transcript for a speech - Interpreting news	, Definit ef guest articles	ions Listenin address & Vo & advertisem	ng: Lis ote of t ents	tenin hank	ig to s - I	eminent Reading
							Total:45
TEXT BOOK:							
1. Sanjay	Kumar & Pushp Lata, "Communication Skills", 2 <sup>nd</sup> Edition, Oxford Unive	ersity Pro	ess, New Del	hi, 201	8.		
REFERENCES							
1. Ashraf F	izvi, "Effective Technical Communication", 2 <sup>nd</sup> Edition, McGraw-Hill In	dia, 201	7.				
2. S. P. Dr Hyderal	anavel, "English and Communication Skills for Students of Science an ad, 2009.	d Engine	eering", Orier	t Black	Swa	n Pu	blishers,
3. Jack C. 2014.	Richards and Chuck Sandy, "Passages" Student's Book 1, 3 <sup>rd</sup> Edition,	Cambrie	dge Universit	y Press	s, Ne	w Yo	rk,

COUR On co	SE O mple	UTCOM tion of t	IES: he course, t	the st	uder	nts will b	e able	e to						B (Hig	T Mappe ghest Lev	d /el)						
CO1	use	languag	ge effectively	by a	cquiri	ng vocab	ulary	and	syntax in o	context				Ap	oplying (K	3)						
CO2	liste	en and co	omprehend o	differe	ent sp	oken diso	course	es fro	om a varie	ty of situati	ons			Ap	oplying (K	3)						
CO3	spe	ak confi	dently in diffe	erent	profe	ssional co	ontext	ts an	d with pee	rs				Cr	eating (K	6)						
CO4	com	nprehend	d different ge	enres	of tex	kts by add	opting	y vario	ous readin	ig strategie	S			Unde	rstanding	(K2)						
CO5	writ of w	e legibly vords an	and flawless	sly at	varie	d profess	ional	conte	exts profic	iently with	appro	priat	e choice	Cr	eating (K	6)						
														1								
						Мар	ping o	of CC	Os with P	Os and PS	Os											
COs/P	Os	PO1	PO2	PC	)3	PO4	PC	D5	PO6	PO7	PC	<b>D</b> 8	PO9	PO10	PO11	PO12						
CO1	1								2				1	3	1	1						
CO2	2												2	3		1						
CO3	3												2	3		2						
CO4	4								1					3	1	1						
CO5	5													3		2						
1 – Slig	ght, 2	. – Mode	erate, 3 – Sub	ostant	tial, B	T- Bloom	i's Ta	xono	my	_1	1			1	I.							
						ASS	ESSN	IENT	PATTER	N – THEO	RY											
Test Ca	/ Blo tego	om's ry*	Remember (K1) %	ring	Un	derstand (K2) %	ing	A  (	pplying (K3) %	Analyzi (K4) %	ng 6	Eva (ł	luating (5) %	Creating (K6) %	То	tal %						
(	CAT1					37			30					Understandin           Creating (I           PO10         PO11           3         1           33         1           33         1           33         1           33         1           33         1           33         1           33         1		100						
(	CAT2					30			30					40		100						
(	САТЗ	6				33			34					33	Creating (H         Understanding         Creating (H         9010       P011         3       1         33       20							
	ESE					17			63					20	Creating (Ki       Understanding       Creating (Ki       O10     PO11       3     1       40     1       33     20       1     1							
* ±3%	may	be varie	d (CAT 1,2,3	- 50	mark	s & ESE	- 100	) mai	rks)	•					·							

		22MAC11 - MATRICES AND ORDINARY DIFFERENT	IAL EQU	ATIONS				
		(Common to all Engineering and Technology I	branches	5)				
Progra Branch	mme &	All BE/BTech Branches	Sem.	Category	L	т	Р	Credit
Prereq	uisites	Nil	1	BS	3	1*	2*	4
Pream	ble	To provide the skills to the students for solving different real ti differential equations.	ime probl	ems by apply	ing	matrie	ces ar	nd ordinary
Unit – I		Matrices:						9
Introduce (without symme orthogo Unit – I Introduce Clairaut	ction – Chara t proof) – Ca tric matrix to nal transform I ction – Solutio	cteristic equation – Eigen values and Eigen vectors of a real matri yley – Hamilton theorem (Statement and applications only) - Ortho diagonal form – Quadratic form – Nature of Quadratic forms - F ation – Applications of Eigen values and Eigen vectors: Stretching of Ordinary Differential Equations: ons of First order differential equations: Exact differential equations – Applications: Law of natural growth and decay.	x – Prope ogonal m Reduction an elastic Leibnitz's	erties of Eiger atrices – Orth of quadratic c membrane. s Linear Equat	i va ogo forn ion	lues a nal tra n to c – Berr	nd Eig ansforr anonic noulli's	gen vectors nation of a cal form by <b>9</b> equation –
Unit - I	11	Ordinary Differential Equations of Higher Order:						9
Linear of x <sup>n</sup> – e <sup>av</sup> Legend	differential equ ′x <sup>n</sup> , e <sup>ax</sup> sinbx re's equation.	uations of second and higher order with constant coefficients - Partici and $e^{ax} cosbx - x^n sinax$ and $x^n cosax - Differential Equations wit$	ular Integ h variable	rals for the typ e coefficients:	es: ( Eule	e <sup>ax</sup> – er-Cau	cosa Ichy's	ax / sinax – equation –
Unit – I	V	Applications of Ordinary Differential Equations:						9
Method equatio	of variation ns: Simple ha	of parameters – Simultaneous first order linear equations with c rmonic motion – Electric circuits (Differential equations and associate	constant o ed conditio	coefficients – ons need to be	App giv	olicatio en).	ons of	differential
Laplace transfor transfor Applica	Transform: ms –Transfor m: Inverse L tions: Solution	Conditions for existence – Transform of elementary functions – rms of derivatives and integrals – Transform of unit step function – aplace transform of elementary functions – Partial fraction met of linear ODE of second order with constant coefficients.	Basic p - Transfor thod – C	roperties – D rm of periodic convolution the	eriva fun eore	atives ctions m (S	and i Inver ateme	ntegrals of se Laplace ent only) –
1.	Introduction	to MATLAB						
2.	Computation	n of eigen values and eigen vectors						
3.	Plotting and	visualizing single variable functions						
4.	Solving first	and second order ordinary differential equations						
5.	Solution of S	Simultaneous first order ODEs						
6.	Solving seco	ond order ODE by variation of parameters						
7.	Determining	Laplace and inverse Laplace transform of basic functions						
8.	Solution of S	Second order ODE by employing Laplace transforms						
			Lecture	45, Tutorials	and	Prac	tical:1	5, Total:60
TEXT E	BOOK:							
1.	Ramana B V	/, "Higher Engineering Mathematics", 1 <sup>st</sup> Edition, Tata McGraw-Hill Pu	ublishing	Company Limi	ted,	New	Delhi, 2	2018.
REFER	ENCES/ MAN	NUAL / SOFTWARE:						
1.	Kreyszig E,	"Advanced Engineering Mathematics ", 10 <sup>th</sup> Edition, John Wiley, New	/ Delhi, In	dia, 2016.				
2.	Kandasamy S.Chand and	P., Thilagavathy K. and Gunavathy K., "Engineering Mathematics d Co., New Delhi.	For First	Year B.E/B.Te	ech"	, Rep	rint Ed	lition 2014,
3.	Duraisamy ( Education, N	C., Vengataasalam S., Arun Prakash K. and Suresh M., "Enginee New Delhi, 2018.	ering Math	nematics - I",	2 <sup>nd</sup>	Editic	n, Pea	arson India

4.	Grev	wal B.S.	, "Higher	Engineerii	ng Mathe	matics"	44thEditio	on, Khai	nna Pu	blishers,	New D	Delhi, 2018.			
5.	MAT	ΓLAB – Ι	Laborato	ry Manual											
COUR: On cor	SE OL mpleti	JTCOMI on of th	ES: ne cours	e, the stuc	lents wil	l be able	e to							BT Mappe (Highest Le	ed evel)
CO1	solv	e engine	eering pro	oblems wh	ich needs	s matrix o	computat	ions.						Applying (ł	(3)
CO2	iden	tify the a	appropria	ate method	for solvir	ng first oi	rder ordir	nary diffe	erential	equation	s.			Applying (ł	(3)
CO3	solv	e higher	order lin	ear differe	ntial equa	ations wi	th consta	int and v	variable	coefficie	nts.			Applying (ł	(3)
CO4	apply the concept of ordinary differential equations for modeling and finding solutions to engineering Applying (K3) problems.														
CO5	apply Laplace Transform to find solutions of Linear Ordinary Differential Equations       Applying (K3)														
CO6	und usin	erstand g MATL	the basic AB.	s of MATL	AB, solve	e ordinar	y differen	ntial equ	ations a	and comp	oute La	aplace transform	s N	Applying (k lanipulation	(S2)
						Маррі	ng of CC	Os with	POs ar	nd PSOs					
COs/P	POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1	0 PO11	PO12	PSO1	PSO2
CO	1	3	3	2											
CO	2	3	3	2											
CO	3	3	3	2											
CO	4	3	3	2											
CO	5	3	3	3											
CO	6					3									
1 – Slig	ght, 2 ·	- Moder	ate, 3 – 3	Substantial	, BT- Blo	om's Ta	xonomy					h			
						ASSE	SSMENT		ERN - T	HEORY					
Tes C	st / Blo Catego	oom's ory*	R	ememberi (K1) %	ng l	Jndersta (K2)	anding %	Apply (K3)	ying %	Analyzi (K4) %	ing %	Evaluating (K5 %	) Cre	ating (K6) %	Total %
	CAT	1		10		20		70	)	-		-		-	100
	CAT	2		10		20		70	)	-		-		-	100
	CAT	3		10		20		70	)	-		-		-	100
	ESE	=		10		20		70	)	-		-		-	100

\* ±3% may be varied (CAT 1,2,3 - 50 marks & ESE – 100 marks)

\*Alternate week

22PHT12 - PHYSICS FOR MECHANICAL ENGINEERING															
Programme & Branch	BE- Mechanical Engineering	Sem.	Category	L	т	Ρ	Credit								
Prerequisites	Nil	1	BS	3	0	0	3								
Preamble Unit – I	nble       This course aims to impart the knowledge on conductors, semiconductors, dielectrics, sound absorb materials and select materials characterization techniques. It also describes the applications aforementioned topics in mechanical engineering.         - I       Conducting materials:       9														
Conductors – Classical free electron theory of metals – Electrical and thermal conductivity – Wiedemann-Franz law – Lorentz number – Draw backs of classical theory – Quantum free electron theory – Fermi distribution function – Effect of temperature on Fermi function – Density of energy states – Carrier concentration in metals.															
Unit – II	Semiconducting materials and Devices:						9								
Intrinsic semiconductor – Carrier concentration – Electrical conductivity and band gap – Extrinsic semiconductors – Carrier concentration in n-type and p-type semiconductors – Hall effect – Determination of Hall coefficient – Applications – Un Junction Transistor (UJT) – Junction Field Effect Transistor (JFET).															
Unit – III	Dielectric materials:						9								
Dielectrics – Dielectric constant – Polarization – Displacement vector – Electric susceptibility – Types of polarization mechanisms:Electronic, ionic, orientational and space-charge – Frequency and temperature dependence – Internal field – Clausius-Mosotti															
Unit – IV	Acoustics and Sound absorbing materials:						9								
Classification of and decay of s Sound absorb Natural sound absorbing mate	of sound – Characteristics of sound – Sound Intensity level – Re ound – Sabine's formula for reverberation time – Determination or ng materials – Types of sound absorbing materials: Porous rials – Synthetic sound absorbing materials – Sound proofing and its	everbera of sound s, meml s types (o	ation – Reve l absorption o brane and r qualitative).	rber coef eso	ation ficien nanc	time it of n e ab	– Growth naterials – sorbers –								
Importance of	materials characterization X ray diffraction (nowder method)	Sconnin	a oloctron m	ioro		<u>_</u>	9								
Transmissione	lectron microscope (qualitative) – Raman spectroscopy – Ther	mo grav	vimetric anal	ysis		= -									
							Total:45								
TEXT BOOK:															
1. Hitendı I,II,III)	a K. Malik and A.K. Singh, "Engineering Physics", 2 <sup>nd</sup> Edition McGrav	v-Hill Ed	ucation , New	/ De	lhi, 20	018. (	Units								
2. Kosten 1949. (	, Cornelis Willem, and Zwikker, Cornelis. Sound Absorbing Materials. Unit IV)	Elsevie	r Publishing (	Com	oany,	Neth	erlands,								
3. Sam Z (Unit V	nang, Lin Li and Ashok Kumar, "Materials Characterization Technique )	es", 1 <sup>st</sup> E	dition, CRC P	ress	s, Boo	a Rat	ton, 2008.								
REFERENCES	:														
1. Gaur R	.K. and Gupta S.L., "Engineering Physics", 8th Edition, Dhanpat Rai a	nd Sons	s, New Delhi, 1	2009	9.										
2. Zine El	Abiddine Fellah and Erick Ogam (Ed.), "Acoustics of Materials", Inter	h open,	2019.				<u>.</u>								
3. Avadha Compa	inulu M.N., Kshirsagar P.G. and Arun Murthy T.V.S., "A Textbook of E ny Pvt. Ltd., New Delhi, 2019.	ngineer	ring Physics",	11 <sup>tr</sup>	Editi	on, S.	Chand &								

COUR	SE OUTCOMES:	BT Mapped
On col	mpletion of the course, the students will be able to	(Highest Level)
CO1	apply the concepts of classical and quantum free electron theory of metals to compute the electrical and thermal conductivity of metals and to comprehend the effect of temperature on Fermi function and to compute the expressions for density of states and carrier concentration in metals	Applying (K3)
CO2	use the concept of density of states to compute the carrier concentration, electrical conductivity and band gap of intrinsic semiconductors, and to compute the carrier concentration of extrinsic semiconductors, and also to explain the phenomenon related to Hall Effect and the working of UJT and JFET.	Applying (K3)
CO3	apply the concept of electric dipole moment and electric polarization to comprehend the different polarization mechanisms in dielectrics, Clausius-Mosotti relation, dielectric loss, dielectric breakdown and to describe its uses in capacitors.	Applying (K3)
CO4	utilize the concepts of sound propagation and sound absorption in a medium to compute reverberation time and sound absorption coefficient, and to realize the applications of sound absorbing and sound proofing materials in industries.	Applying (K3)
CO5	apply the concepts of X-ray diffraction, matter waves, Raman effect and thermogram to describe the principle and working of select material characterization techniques.	Applying (K3)

Mapping of (	COs with	POs and	<b>PSOs</b>
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		PO2	PO3		PO5	POG		<b>D</b> O8		PO10	PO11	PO12	DSO1	PSO2
CU3/FU3	FUI	FUZ	FUJ	FU4	FUJ	FUU	FUI	FUO	FU9	FOID	FUII	FUIZ	F301	F302
CO1	3	2	2						2	2		2		1
CO2	3	2	2						2	2		2		1
CO3	3	2	2						2	2		2		1
CO4	3	2	2						2	2		2		2
CO5	3	2	2						2	2		2	2	2

1 - Slight, 2 - Moderate, 3 - Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY													
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %						
CAT1	20	60	20				100						
CAT2	20	50	30				100						
CAT3	20	50	30				100						
ESE	10	50	40				100						
* . 00/													

\*  $\pm$ 3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

(Common to All Engineering and Technology Branches)         Programme & Branch       All BE/BTech Branches       Sem.       Category       L       T       P       Credit         Prerequisites       Nil       1/2       ES       2       1       0       3         Preamble       To impart knowledge on orthographic, isometric projections, sectional views and development of surfaces by solving different application oriented problems.       643         Unit - I       General Principles of Orthographic Projection - Projections or Projection or Points, Lines and Planes - General Principles of Orthographic Projection - First Angle Projection - Layout of Views - Projection or Points Located in all Quadrant and Straight Lines Located in the First Quadrant - Determination of True Lengths and True Inclinations and Location of Traces - Projection of Polygonal Surface and Circular Lamina Inclined to both Reference Planes.       643         Unit - II       Projections of Solid:       643         Unit - III       Sectioning of Solids:       643         Unit - III       Sectioning of Solids:       643         Unit - III       Development of Surface Solidis:       643         Unit - III       Sectioning of Solids:       643         Unit - III       Development of Surface Solidis:       643         Unit - III       Sectioning of Solids:       643         Projections of Solids:       643		22MET11 - ENGINEERIN	IG DRAWING													
Programme & Branch       All BE/BTech Branches       Sem.       Category       L       T       P       Credit         Prerequisites       Nil       1/2       ES       2       1       0       3         Prerequisites       Nil       1/2       ES       2       1       0       3         Preamble       To impart knowledge on orthographic, isometric projections, sectional views and development of surfaces by solving different application oriented problems.       643         Unit - I       General Principles of Orthographic Projection or Points, Lines and Planes - General Principles of Orthographic Projection of Points, Lines and Planes - General Principles of Orthographic Projection of Points, Lines and Planes - General Principles of Orthographic Projection - Layout of Views - Projection of Points Located in all Quadrant and Straight Lines Located in the First Quadrant - Determination of True Lengths and True Inclinations and Location of Traces - Projection of Polygonal Surface and Circular Lamina Inclined to both Reference Planes.       643         Sectioning of Solids Like Prisms, Pyramids, Cylinder and Cone in Simple Vertical Position by Cutting Planes inclined to Ore Reference Plane and Prependicular to the other - Obtaining True Shape of Section.       643         Sectioning of Solids Like Prisms, Pyramids, Cylinder and Cone in Simple Vertical Position by Cutting Planes inclined to Ore Reference Planes.       643         Unit - IV       Development of Surfaces:       643         Development of Lateral Surfaces of Simple		(Common to All Engineering an	nd Technology	Branches)												
Prerequisites       Nil       1/2       ES       2       1       0       3         Preambler       To impart knowledge on orthographic, isometric projections or inted problems.       Inportance of artaphication oriented problems.       Integration oriented problems.       643         Unit - I       General Principles of Orthographic Projection - Projection of Points, Lines and Planes - General Principles of Orthographic Projection - First Angle Projection - Layout of Views - Projection of Points, Lines and Planes - General Principles of Orthographic Projection of Drawing Sheets - Lettering and Dimensioning - Projections of Points, Lines and Planes - General Principles of Orthographic Projection of Solid:       643         Unit a III       Projections of Solid:       Folgengation by Culting France       Folgengation by Culting France       Folgengation Solid:       Folg	Programme Branch	All BE/BTech Branches	Sem.	Category	L	т	Ρ	Credit								
Preamble       To impart knowledge on orthographic, isometric projections, sectional views and development of surfaces by solving different application oriented problems.         Unit - I       General Principles of Orthographic Projection:       643         Importance of Graphics in Engineering Applications - Use of Dratting Instruments - BIS Conventions and Specifications - Size, Layout and Folding of Drawing Sheets - Lettering and Dimensioning - Projection of Points, Lines and Planes - General Principles of Orthographic Projection - First Angle Projection - Layout of Views - Projection of Points Located in all Quadrant and Straight Lines Located in the First Quadrant - Determination of True Lengths and True Inclinations and Location of Traces - Projection of Polyonal Surface and Circular Lamia Inclined to both Reference Planes.       643         Unit - II       Projections of Solid:       643         Projections of Simple Solids Like Prisms, Pyramids, Cylinder and Cone when the Axis is inclined to One Reference Plane by Change of Position Method.       643         Unit - IV       Development of Surfaces of Simple Solids Like Prisms, Pyramids, Cylinders and Cones .       643         Development of Lateral Surfaces of Simple Solids Like Prisms, Pyramids, Cylinders and Cones .       643         Development of Lateral Surfaces of Simple Solids Like Prisms, Pyramids, Cylinders and Cones .       643         Development of Simple Solids Like Prisms, Pyramids, Cylinders and Cones .       643         Development of Lateral Surfaces of Simple Solids Like Prisms, Pyramids, Cylinders and Cones .       643         Devel	Prerequisit	es Nil	1 / 2	ES	2	1	0	3								
Unit - I       General Principles of Orthographic Projection:       643         Importance of Graphics in Engineering Applications - Use of Drafting Instruments - BIS Conventions and Specifications - Size, Layout and Folding of Drawing Sheets - Lettering and Dimensioning - Projections of Points, Lines and Planes - General Principles of Orthographic Projection - First Angle Projection - Layout of Views - Projection of Points Located in all Quadrant and Straight Lines Located in the First Quadrant - Determination of True Lengths and True Inclinations and Location of Traces - Projection of Polygonal Surface and Circular Lamina Inclined to both Reference Planes.         Unit - II       Projections of Solid:       643         Projections of Simple Solids Like Prisms, Pyramids, Cylinder and Cone when the Axis is inclined to One Reference Plane by Change of Position Method.       643         Sectioning of Solids - Prisms, Pyramids, Cylinder and Cone in Simple Vertical Position by Cutting Planes inclined to One Reference Plane by Change of Solids - Prisms, Pyramids, Cylinder and Cone in Simple Vertical Position by Cutting Planes inclined to One Reference Plane and Perpendicular to the other - Obtaining True Shape of Section.       643         Unit - IV       Development of Surfaces:       643         Principles of Isometric Projection and Introduction to AutoCAD:       643         Principles of Isometric Projection and Introduction to AutoCAD:       643         Principles of Isometric Projection and Introduction to AutoCAD:       643         Principles of Isometric Projection into Orthographic Projection - Introductin to AutoCAD:       643 <td>Preamble</td> <td colspan="15">e To impart knowledge on orthographic, isometric projections, sectional views and development of surfaces by solving different application oriented problems.</td>	Preamble	e To impart knowledge on orthographic, isometric projections, sectional views and development of surfaces by solving different application oriented problems.														
Importance of Graphics in Engineering Applications - Use of Drafting Instruments - BIS Conventions and Specifications - Size, Layout and Folding of Drawing Sheets - Lettering and Dimensioning - Projections of Points, Lines and Planes - General Principles of Orthographic Projection - First Angle Projection - Layout of Views - Projection of Points Located in all Quadrant and Straight Lines Located in the First Quadrant - Determination of True Lengths and True Inclinations and Location of Traces - Projection of Polygonal Surface and Circular Lamina Inclined to both Reference Planes. Unit – II Projections of Simple Solids Like Prisms, Pyramids, Cylinder and Cone when the Axis is inclined to One Reference Plane by Change of Position Method. Unit – III Sectioning of Solids: Sectioning of Solids - Prisms, Pyramids, Cylinder and Cone in Simple Vertical Position by Cutting Planes inclined to One Reference Plane and Perpendicular to the other - Obtaining True Shape of Section. Unit – IV Development of Surfaces: Unit – IV Development of Surfaces of Simple Solids Like Prisms, Pyramids, Cylinders and Cones - Development of Simple Truncated Solids Involving Prisms, Pyramids, Cylinders and Cones. Unit – V Isometric Projection and Introduction to AutoCAD: 0 hit – V Isometric Projection and Introduction to AutoCAD: 1. Natarajan.K.V. "A Textbook of Engineering Graphics", 35 <sup>th</sup> Edition, Dhanalakshmi Publishers, Chennai, 2022, REFERENCES: 1. Venugopal K. and Prabhu Raja V., "Engineering Graphics", 16 <sup>th</sup> Edition, New Age International Publishers, Chennai, 2022. 2. Basant Agrawal, Agrawal C.M., "Engineering Drawing", 1 <sup>st</sup> Edition, Oxford University Press, 2015.	Unit – I	General Principles of Orthographic Projection:						6+3								
Unit - II       Projections of Solid:       0+3         Projections of Simple Solids Like Prisms, Pyramids, Cylinder and Cone when the Axis is inclined to One Reference Plane by Change of Position Method.       6+3         Unit - III       Sectioning of Solids:       6+3         Sectioning of Solids - Prisms, Pyramids, Cylinder and Cone in Simple Vertical Position by Cutting Planes inclined to One Reference Plane and Perpendicular to the other - Obtaining True Shape of Section.       6+3         Unit - IV       Development of Surfaces:       6+3         Development of Lateral Surfaces of Simple Solids Like Prisms, Pyramids, Cylinders and Cones.       6+3         Unit - IV       Development of Solids:       6+3         Development of Lateral Surfaces of Simple Solids Like Prisms, Pyramids, Cylinders and Cones.       6+3         Unit - V       Isometric Projection and Introduction to AutoCAD:       6+3         Principles of Isometric Projection and Introduction to AutoCAD:       6+3         Principles of Isometric Projection - Isometric Scale - Isometric Projection - Introduction to AutoCAD.       6+3         I.       Natarajan.K.V. "A Textbook of Engineering Graphics", 16 <sup>th</sup> Edition, Dhanalakshmi Publishers, Chennai, 2022,       REFERENCES:         1.       Venugopal K. and Prabhu Raja V., "Engineering Drawing", 3 <sup>rd</sup> Edition, McGraw Hill Education, 2019.       2022.         2.       Basant Agrawal, Agrawal C.M., "Engineering Drawing", 1 <sup>st</sup> Edition, Oxford Unive	Importance and Folding Orthographi Located in t Surface and	of Drawing Sheets - Lettering and Dimensioning - Pro c Projection - First Angle Projection - Layout of Views - I he First Quadrant - Determination of True Lengths and Tr Circular Lamina Inclined to both Reference Planes.	pjections of Popolections of Popolection of Popolection of Popolection of Popolection of Popolections	oints, Lines and oints Located ir and Location o	and Spe d Planes n all Qua f Traces	- Gene drant ar - Projec	ral Prir nd Strai tion of I	e, Layout nciples of ght Lines Polygonal								
Projections of Simple Solids Like Prisms, Pyramids, Cylinder and Cone when the Axis is inclined to One Reference Plane by Change of Position Method.       6+3         Unit – III       Sectioning of Solids - Prisms, Pyramids, Cylinder and Cone in Simple Vertical Position by Cutting Planes inclined to One Reference Plane and Perpendicular to the other - Obtaining True Shape of Section.       6+3         Unit – IV       Development of Surfaces:       6+3         Development of Lateral Surfaces of Simple Solids Like Prisms, Pyramids, Cylinders and Cones.       6+3         Unit – V       Development of Solids - Prisms, Pyramids, Cylinders and Cones.       6+3         Unit – V       Isometric Projection and Introduction to AutoCAD:       6+3         Principles of Isometric Projection - Isometric Scale - Isometric Projections of Simple and Truncated Solids Like Prisms, Pyramids, Cylinders and Cones - Conversion of Isometric Projection into Orthographic Projection - Introduction to AutoCAD.       6+3         TEXT BOOK:       1.       Natarajan.K.V. "A Textbook of Engineering Graphics", 35 <sup>th</sup> Edition, Dhanalakshmi Publishers, Chennai, 2022,       REFERENCES:         1.       Venugopal K. and Prabhu Raja V., "Engineering Graphics", 16 <sup>th</sup> Edition, New Age International Publishers, Chennai, 2022.       2.         2.       Basant Agrawal, Agrawal C.M., "Engineering Drawing", 3 <sup>rd</sup> Edition, Oxford University Press, 2015.       3.	Unit – II	Projections of Solid: 6+3														
Unit – III       Sectioning of Solids:       6+3         Sectioning of Solids - Prisms, Pyramids, Cylinder and Cone in Simple Vertical Position by Cutting Planes inclined to One Reference       Plane and Perpendicular to the other - Obtaining True Shape of Section.       6+3         Unit – IV       Development of Surfaces:       6+3         Development of Lateral Surfaces of Simple Solids Like Prisms, Pyramids, Cylinders and Cones.       6+3         Unit – V       Isometric Projection and Introduction to AutoCAD:       6+3         Principles of Isometric Projection - Isometric Scale - Isometric Projection - Introduction to AutoCAD.       6+3         Principles of Isometric Projection - Isometric Projection - Introduction to AutoCAD.       6+3         Lecture: 30, Tutorial:15, Total:45         TEXT BOUE:         1.       Natarajan.K.V. "A Textbook of Engineering Graphics", 35 <sup>th</sup> Edition, Dhanalakshmi Publishers, Chennai, 2022,         REFERENCES:         1.       Venucopal K. and Prabhu Raja V., "Engineering Graphics", 16 <sup>th</sup> Edition, New Age International Publishers, Chennai, 2022.         2.       Basart Agrawal, Agrawal C.M., "Engineering Drawing", 3 <sup>rd</sup> Edition, McGraw Hill Education, 2019.         3.       Parthasarthy N.S., Vela Murali. "Engineering Drawing", 1 <sup>st</sup> Edition, Oxford University Press, 2015.	Projections Change of	of Simple Solids Like Prisms, Pyramids, Cylinder and Position Method.	Cone when the	ne Axis is inclir	ned to O	ne Refe	erence	Plane by								
Sectioning of Solids - Prisms, Pyramids, Cylinder and Cone in Simple Vertical Position by Cutting Planes inclined to One Reference Plane and Perpendicular to the other - Obtaining True Shape of Section.       6+3         Unit - IV       Development of Surfaces:       6+3         Development of Lateral Surfaces of Simple Solids Like Prisms, Pyramids, Cylinders and Cones - Development of Simple Truncated Solids Involving Prisms, Pyramids, Cylinders and Cones.       6+3         Unit - V       Isometric Projection and Introduction to AutoCAD:       6+3         Principles of Isometric Projection - Isometric Scale - Isometric Projections of Simple and Truncated Solids Like Prisms, Pyramids, Cylinders and Contex - Conversion of Isometric Projection into Orthographic Projection - Introduction to AutoCAD.       6+3         TEXT BOOK:       I.       Natarajan.K.V. "A Textbook of Engineering Graphics", 35 <sup>th</sup> Edition, Dhanalakshmi Publishers, Chennai, 2022,       REFERENCES:         1.       Venugopal K. and Prabhu Raja V., "Engineering Graphics", 16 <sup>th</sup> Edition, New Age International Publishers, Chennai, 2022.       2.         2.       Basant Agrawal, Agrawal C.M., "Engineering Drawing", 3 <sup>rd</sup> Edition, McGraw Hill Education, 2019.       3.         3.       Parthasarathy N.S., Vela Murali. "Engineering Drawing", 1 <sup>st</sup> Edition, Oxford University Press, 2015.       1.	Unit – III	Sectioning of Solids:						6+3								
Unit - IV       Development of Surfaces:       6+3         Development of Lateral Surfaces of Simple Solids Like Prisms, Pyramids, Cylinders and Cones - Development of Simple Truncated Solids Involving Prisms, Pyramids, Cylinders and Cones.       6+3         Unit - V       Isometric Projection and Introduction to AutoCAD:       6+3         Principles of Isometric Projection - Isometric Scale - Isometric Projections of Simple and Truncated Solids Like Prisms, Pyramids, Cylinders and Cones.       6+3         Principles of Isometric Projection - Isometric Scale - Isometric Projection - Introduction to AutoCAD.       6+3         Lecture: 30, Tutorial:15, Total:45         TEXT BOOK:         1.       Natarajan.K.V. "A Textbook of Engineering Graphics", 35 <sup>th</sup> Edition, Dhanalakshmi Publishers, Chennai, 2022,         REFERENCES:         1.       Venugopal K. and Prabhu Raja V., "Engineering Graphics", 16 <sup>th</sup> Edition, New Age International Publishers, Chennai, 2022.         2.       Basant Agrawal, Agrawal C.M., "Engineering Drawing", 3 <sup>rd</sup> Edition, McGraw Hill Education, 2019.         3.       Parthasarathy N.S., Vela Murali. "Engineering Drawing", 1 <sup>st</sup> Edition, Oxford University Press, 2015.	Sectioning of Plane and P	of Solids - Prisms, Pyramids, Cylinder and Cone in Simple erpendicular to the other - Obtaining True Shape of Section	e Vertical Posi n.	tion by Cutting I	Planes in	clined to	o One F	Reference								
Development of Lateral Surfaces of Simple Solids Like Prisms, Pyramids, Cylinders and Cones - Development of Simple Truncated Solids Involving Prisms, Pyramids, Cylinders and Cones.       6+3         Unit - V       Isometric Projection and Introduction to AutoCAD:       6+3         Principles of Isometric Projection - Isometric Scale - Isometric Projection of Simple and Truncated Solids Like Prisms, Pyramids, Cylinders and Cones - Conversion of Isometric Projection into Orthographic Projection - Introduction to AutoCAD.       6+3         Lecture: 30, Tutorial:15, Total:45         TEXT BOOK:         1.       Natarajan.K.V. "A Textbook of Engineering Graphics", 35 <sup>th</sup> Edition, Dhanalakshmi Publishers, Chennai, 2022,         REFERENCES:         1.       Venugopal K. and Prabhu Raja V., "Engineering Graphics", 16 <sup>th</sup> Edition, New Age International Publishers, Chennai, 2022.         2.       Basant Agrawal, Agrawal C.M., "Engineering Drawing", 3 <sup>rd</sup> Edition, McGraw Hill Education, 2019.         3.       Parthasarathy N.S., Vela Murali. "Engineering Drawing", 1 <sup>st</sup> Edition, Oxford University Press, 2015.	Unit – IV	Development of Surfaces:						6+3								
Unit – V       Isometric Projection and Introduction to AutoCAD:       6+3         Principles of Isometric Projection - Isometric Scale - Isometric Projections of Simple and Truncated Solids Like Prisms, Pyramids, Cylinders and Cones - Conversion of Isometric Projection into Orthographic Projection - Introduction to AutoCAD.       6+3         Lecture: 30, Tutorial:15, Total:45         TEXT BOOK:         1.       Natarajan.K.V. "A Textbook of Engineering Graphics", 35 <sup>th</sup> Edition, Dhanalakshmi Publishers, Chennai, 2022,         REFERENCES:         1.       Venugopal K. and Prabhu Raja V., "Engineering Graphics", 16 <sup>th</sup> Edition, New Age International Publishers, Chennai, 2022.         2.       Basant Agrawal, Agrawal C.M., "Engineering Drawing", 3 <sup>rd</sup> Edition, McGraw Hill Education, 2019.         3.       Parthasarathy N.S., Vela Murali. "Engineering Drawing", 1 <sup>st</sup> Edition, Oxford University Press, 2015.	Developmer Solids Involv	t of Lateral Surfaces of Simple Solids Like Prisms, Pyraling Prisms, Pyramids, Cylinders and Cones.	mids, Cylinder	s and Cones - E	Developm	ent of S	Simple <sup>-</sup>	Fruncated								
Principles of Isometric Projection - Isometric Scale - Isometric Projections of Simple and Truncated Solids Like Prisms, Pyramids, Cylinders and Cones - Conversion of Isometric Projection into Orthographic Projection - Introduction to AutoCAD.         Lecture: 30, Tutorial:15, Total:45         TEXT BOOK:         1.       Natarajan.K.V. "A Textbook of Engineering Graphics", 35 <sup>th</sup> Edition, Dhanalakshmi Publishers, Chennai, 2022,         REFERENCES:         1.       Venugopal K. and Prabhu Raja V., "Engineering Graphics", 16 <sup>th</sup> Edition, New Age International Publishers, Chennai, 2022.         2.       Basant Agrawal, Agrawal C.M., "Engineering Drawing", 3 <sup>rd</sup> Edition, McGraw Hill Education, 2019.         3.       Parthasarathy N.S., Vela Murali. "Engineering Drawing", 1 <sup>st</sup> Edition, Oxford University Press, 2015.	Unit – V	Isometric Projection and Introduction to AutoCA	D:					6+3								
Lecture: 30, Tutorial:15, Total:45         Lecture: 30, Tutorial:15, Total:45         TEXT BOOK:         1.       Natarajan.K.V. "A Textbook of Engineering Graphics", 35 <sup>th</sup> Edition, Dhanalakshmi Publishers, Chennai, 2022,         REFERENCES:         1.       Venugopal K. and Prabhu Raja V., "Engineering Graphics", 16 <sup>th</sup> Edition, New Age International Publishers, Chennai, 2022.         2.       Basant Agrawal, Agrawal C.M., "Engineering Drawing", 3 <sup>rd</sup> Edition, McGraw Hill Education, 2019.         3.       Parthasarathy N.S., Vela Murali. "Engineering Drawing", 1 <sup>st</sup> Edition, Oxford University Press, 2015.	Principles o Cylinders an	f Isometric Projection - Isometric Scale - Isometric Proje d Cones - Conversion of Isometric Projection into Orthogra	ctions of Simp phic Projection	ble and Truncate - Introduction to	ed Solids	Like P D.	risms, l	Pyramids,								
TEXT BOOK:         1.       Natarajan.K.V. "A Textbook of Engineering Graphics", 35 <sup>th</sup> Edition, Dhanalakshmi Publishers, Chennai, 2022,         REFERENCES:         1.       Venugopal K. and Prabhu Raja V., "Engineering Graphics", 16 <sup>th</sup> Edition, New Age International Publishers, Chennai, 2022.         2.       Basant Agrawal, Agrawal C.M., "Engineering Drawing", 3 <sup>rd</sup> Edition, McGraw Hill Education, 2019.         3.       Parthasarathy N.S., Vela Murali. "Engineering Drawing", 1 <sup>st</sup> Edition, Oxford University Press, 2015.				l	_ecture:	30, Tuto	rial:15	, Total:45								
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<ol> <li>Venugopal K. and Prabhu Raja V., "Engineering Graphics", 16<sup>th</sup> Edition, New Age International Publishers, Chennai, 2022.</li> <li>Basant Agrawal, Agrawal C.M., "Engineering Drawing", 3<sup>rd</sup> Edition, McGraw Hill Education, 2019.</li> <li>Parthasarathy N.S., Vela Murali. "Engineering Drawing", 1<sup>st</sup> Edition, Oxford University Press, 2015.</li> </ol>	REFERENC	ES:														
<ol> <li>Basant Agrawal, Agrawal C.M., "Engineering Drawing", 3<sup>rd</sup> Edition, McGraw Hill Education, 2019.</li> <li>Parthasarathy N.S., Vela Murali. "Engineering Drawing", 1<sup>st</sup> Edition, Oxford University Press, 2015.</li> </ol>	1. \	enugopal K. and Prabhu Raja V., "Engineering Graphics",	16 <sup>th</sup> Edition, Ne	ew Age Internati	onal Publ	ishers, (	Chenna	i, 2022.								
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	3. F	Parthasarathy N.S., Vela Murali. "Engineering Drawing", 1 <sup>st</sup>	Edition, Oxford	University Pres	s, 2015.											

COURSE	OURSE OUTCOMES:														BT Mapped			
On comp	oletion	of the	course, th	e studer	nts will I	be able	to						(High	est Leve	el)			
CO1	interp plane	oret inte es	rnational s	tandards	of draw	rings an	d sketch	the pro	jections	of points	s, lines an	d	Арр	lying (K3	)			
CO2	draw	the pro	jections of	3D primi	tive obje	ects like	prisms,	pyramic	ls, cylind	ders and	cones		Арр	lying (K3	5)			
CO3	cons	truct the	e various se	ectional	views of	solids li	ke prism	is, pyrar	nids, cyl	inders a	nd cones		Арр	lying (K3	)			
CO4	deve	lop the	lateral surf	aces of s	imple a	nd trunc	ated sol	ids					Арр	lying (K3	)			
CO5	sketo draw	ch the i ing into	sometric p orthograp	rojection hic proje	s of sin ction	nple an	d trunca	ted soli	ds and	convert	isometric		Арр	lying (K3	5)			
	Mapping of COs with POs and PSOs																	
COs/P	Os	PO1	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	P011	PO12	PSO1	PSO2			
CO	1	3	2			2					3		2					
CO	2	3	2	1		2					3		2					
CO	3	3	2	1		2					3		2					
CO	4	3	2	1		2					3		2					
CO	5	3	2	1		2					3		2					
1 – Slight	t, 2 – M	loderate	e, 3 – Subs	tantial, B	T- Blooi	m's Tax	onomy											
					AS	SSESSI		ATTERI	N – THE	ORY								
Test / Bl Catego	oom's ory*	Rem (	embering K1) %	Unde (	rstandi K2) %	ng	Applying (K3) %	g /	Analyzir (K4) %	ng	Evaluat (K5) %	ing %	Creatin (K6) %	g T	otal %			
CAT	1		6		9		85								100			
CAT	2		6		9		85								100			
CAT	3		6		9		85								100			
ESE	Ξ		10		10		80								100			
* ±3% ma	ay be v	aried (C	AT 1,2,3 –	50 mark	s & ESE	E – 100	marks)											

22MET12 - ENGINEERING MECHANICS												
		(Common to Mechanical & Mechatronics Enginee	ering bran	ches)								
Progran Branch	nme &	B.E Mechanical Engineering, B.E Mechatronics Engineering branches	Sem.	Category	L	т	Р	Credit				
Prerequ	uisites	Nil	1/2	PC	3	0	0	3				
•												
Preamb	le	This course provides introduction to the basic concepts of fore their effects. It introduces the phenomenon of friction and its e applied mechanics and develops problem-solving skills.	ces, inertia ffects. It fa	a, centroid and amiliarizes stude	mome ents to	nt of a cogn	area itive l	along with earning in				
Unit - I		Statics of Particles						9				
Introduction – Laws of Mechanics – Parallelogram and Triangular Law of Forces – Principle of Transmissibility – Coplanar Forces – Resolution and Composition of Force - Free Body Diagram – Equilibrium of a Particle in Plane – Forces in Space - Vectorial representation of Forces – Equilibrium of a Particle in Space.												
Unit - II Statics of Rigid Bodies 9												
Moments: Moment of a Force about a Point and about an Axis – Vectorial Representation of Moments and Couples – Varignon's Theorem – Equivalent Systems of Forces – Single Equivalent Force. Types of Supports and their Reactions – Requirements of Stable Equilibrium – Equilibrium of Rigid Bodies in Two Dimensions – Trusses: Method of Joints - Method of Sections-Equilibrium of Rigid Bodies in Three Dimensions.												
Unit - III		Properties of Surfaces and Solids						9				
Determin Hollow S Axis The Moment	nation of A Section Fr eorem - T cof Inertia	Areas and Volumes — First Moment of Area and Centroid of om Primary Simpler Sections — Second Moment of Plane A Section - I Section - Angle Section - Hollow Section — Polar of Plane Area - Mass Moment of Inertia – Relation to Area Mor	Sections Areas — F Moment ments of Ir	<ul> <li>T Section - I</li> <li>Parallel Axis Th</li> <li>of Inertia — Prenertia.</li> </ul>	Secti eoren oduct	on - A n and of Ine	ngle Perp ertia -	Section - pendicular Principal				
Unit - IV		Friction and Rectilinear motion of particles						9				
Friction: – Belt F Curviline	Surface Friction. R ear Motior	Friction – Laws of Dry Friction – Sliding Friction – Static and lectilinear Motion of Particles: Displacement - Velocity and Aco m – Projectile Motion.	Kinetic Fri celeration	ction – Ladder and their Relat	Frictio ionshi	on – V p – R	Vedg elativ	e Friction e Motion-				
Unit - V		Dynamics of Particles and Kinematics of Rigid body						9				
Dynamic Kinemat	cs of Pai ics of Rigi	rticles: Newton's Law, Work - Energy and Impulse - Mo d Body: Translation - Rotation about a Fixed Axis – General Pla	mentum ne Motion.	Principles — I Kinetics of Rigi	mpact d Bod	of I y.	Elasti	c Bodies.				
								Total:45				
TEXT B	OOK:											
1.	Rajaseka Chennai	aran S and Sankarasubramanian G, "Fundamentals of Engi , 2017.	neering N	lechanics", 3 <sup>rd</sup>	Editio	n, Vił	kas F	Publishing,				
REFER	ENCES:											
1.	Beer Fe Engineer	rdinand P., Russel Johnston Jr., David F. Mazure, Philip J. s: Statics and Dynamics", 12 <sup>th</sup> Edition, McGraw Hill Education, C	Cornwell, Chennai, 2	Sanjeev Sang 019.	hi, "V	ector	Mec	hanics for				
2.	Hibbeler	R.C., "Engineering Mechanics", 14th Edition, Pearson Education,	, New Dell	ni, 2017.			_					
3.	Meriam Wiley stu	J L, Kraige L G , Bolton J.N., " Engineering Mechanics: Statics ident edition, 2021	and Engi	neering Mechar	nics: D	)ynam	ics, 🤅	9 <sup>th</sup> edition,				

COURS On com	SE O	UTCC	MES:	urse	e, the s	tudent	s wi	ill be al	ble to						(1	BT Mapp lighest L	oed evel)
CO1	rep	resent	the for	ces	in vecto	r comp	oner	nts (bot	h 2D an	d 3D) a	nd apply	equilibriu	ım condi	tions		Applying (	K3)
CO2	calculate the moment produced by various force systems and conclude the static equilibriu equations for rigid body system															Analyzing	(K4)
CO3	O3 compute the centroid, centre of gravity and moment of inertia of geometrical shapes and solids respectively															Applying (	(K3)
CO4	D4     manipulate the effect of dry friction and its applications     Applyi															Applying (	(K3)
CO5	O5 apply the different principles to study the motion of a body and analyse their constitutive equations Analyzing (K4)														(K4)		
Mapping of COs with POs and PSOs																	
COs/PC	Ds	P01	PO2	2	PO3	PO4		PO5	PO6	P07	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		3	2		2	1									1		3
CO2		3	2		2	1									1		3
CO3		3	2		2	1									1		3
CO4		3	2		2	1									1		3
CO5		3	2		2	1									1		3
1 – Slig	ht, 2	– Mo	derate	, 3 -	- Subst	antial,	BT	- Bloor	n's Tax	onomy	/					1	
							AS	SESS	MENT	PATTE	ERN – T	HEORY					
Test Ca	/ Blo tego	oom's ory*	;	Rer	nembe (K1) %	ring	U	nderst (K2)	anding ) %	Ap (I	plying (3) %	Analy (K4	/zing ) %	Evaluati (K5) %	ing C %	reating (K6) %	Total %
	CAT	1			5			5			70	2	0				100
	CAT	2			5			5			70	2	0				100
	CAT	3			5			5			70	2	20				100
	ESE	Ξ			5			5			70	2	0				100
* <b>±3%</b> n	nay	be va	ried (C	CAT	<sup>-</sup> 1,2,3 -	- 50 m	ark	s & ES	SE – 10	0 mar	ks)		1		1		·
		22CSC11 - PROBLEM SOLVING AND PROGRAM	MMING	IN C													
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	(Co	mmon to All Engineering and Technology branches except	CSE, IT	, CSD, AIDS	& A	ML)											
Progra Branch	mme & N	All BE/BTech Engineering & Technology branches , except CSE, IT, CSD, AIDS & AIML	Sem.	Category	L	т	Ρ	Credit									
Prereq	uisites	Nil	1	BS	3	0	2	4									
					1												
Pream	ble	The course aims to provide exposure to problem-solving fundamental concepts of C Programming. This course provides C	through s adequa	n programmin ate knowledg	ng. e to	lt inti solve	oduce probl	es all the ems using									
Unit –	Į	Introduction to C and Operators:						9									
The str Basic d	ucture of a C lata Types – '	C program – Compiling and executing C program – C Tokens - Variables – constants – Input / Output statements – Operators	- Chara	cter set in C	– Ke	eywor	ds – i	identifiers-									
Unit –	II	Control Statements and Arrays:						9									
Decision-making and looping statements, Arrays: Declaring, initializing and accessing arrays – operations on arrays – dimensional arrays and their operations.																	
Unit –	it – III Functions: 9																
Functio	unctions: Introduction- Using functions, function declaration and definition – function call – return statement – passing parar o functions: basic data types and arrays – storage classes – recursive functions																
Unit –	nit – IV Strings and Pointers:																
Strings: Introduction – operations on strings: finding length, concatenation, comparing and copying – string and char manipulation functions, Arrays of strings. Pointers : declaring pointer variables – pointer expression and arithmetic, pointers ar arrays, pointers and strings																	
Unit –	v	User-defined Data Types and File Handling:						9									
User-de enume positior	efined data t rated data typ n indicator : fs	ypes: Structure: Introduction – nested structures– arrays of spe. File Handling : Introduction - opening and closing files – reaseek(), ftell() and rewind()	structure iding and	e – structure d writing data	and to f	func les -l	tions Vanip	-unions – ulating file									
LIST O	FEXPERIME	ENTS / EXERCISES:															
1.	Programs for	or demonstrating the use of different types of format Specifiers															
2.	Programs for	or demonstrating the use of different types of operators like arithm	netic, log	gical, relationa	al, ar	nd ter	nary c	perators									
3.	Programs for	or demonstrating the use of using decision making statements															
4.	Programs for	or demonstrating the use of repetitive structures															
5.	Programs for	or demonstrating one-dimensional arrays															
6.	Programs for	or demonstrating two-dimensional arrays															
7.	Programs to	o demonstrate modular programming concepts using functions	6														
8.	Programs to	o demonstrate recursive functions.															
9.	Programs to	o demonstrate strings (Using built-in and user-definedfunctions	s)														
10.	Programs to	o illustrate the use of pointers															
11.	Programs to	billustrate the use of structures and unions															
12.	Programs to	o implement file Handling					1 00	T-1-1-75									
TEVT				Lecture:4	15, P	ractio	cai:30	, Iotal:75									
		role "Drearcomming in C." and Edition Contrad University D	New D	IL: 0040													
1.	Reema Tha	reja, "Programming in C", 2nd Edition, Oxford University Press,	New De	ini, 2018.													

REFER	RENCE	S/ MA	NUAL/S	SOFTWA	RE:										
1.	Yasha	avant	Kanetka	r, "Let us	C", 10	6 <sup>th</sup> Edition,	BPB Pu	Iblicatio	ns, 20 <sup>-</sup>	18.					
2.	Sumit	labha [	Das, "Co	mputer Fu	undar	nentals an	d C Pro	grammiı	ng", 1s	t Edition	, McGra	w Hill, 2018	3.		
3.	Balag	Jurusar	my E., "P	rogrammi	ing in	ANSI C",	7th Editi	on, McC	Graw H	lill Educa	ation, 20	17.			
4.	Behro Cenga	ouz A. age,20	Forouzar )17.	n & Richa	rd F.(	Gilberg, "Co	omputer	Scienc	e A St	ructured	Progran	nming Appr	oach Usi	ng C", 3 <sup>rd</sup>	Edition,
5.	https:/	//www.	.cprograr	nming.co	m/tute	orial/c-tuto	rial.html								
													1		
COUR: On cor	SE OU⊺ npletio	TCOM on of tl	ES: he cours	e, the stu	uden	ts will be a	able to						(	BT Mapı Highest L	ped .evel)
CO1	develo	op sim	ple prog	ams usin	g inp	ut/output st	tatemen	ts and c	perato	ors				Applying Precision	(K3), (S3)
CO2	identif	fy the	appropria	ate loopir	ig an	d control s	tatemer	nts in C	and c	levelop a	applicati	ons using		Applying	(K3), (S3)
CO3       develop simple C programs using the concepts of arrays and modular programming       Applying (K3), Precision (S3)															
CO4     apply the concepts of pointers and develop C programs using strings and pointers     Applying (K3), Precision (S3)															
CO4     apply the concepts of pointers and develop C programs using strings and pointers     Precision (S3)       CO5     make use of user-defined data types and file concepts to solve given problems     Applying (K3),															
CO5     make use of user-defined data types and file concepts to solve given problems     Precision (S3)															
Mapping of COs with POs and PSOs															
COs/P	Mapping of COs with POs and PSOs         COs/POs       PO1       PO2       PO3       PO4       PO6       PO7       PO8       PO10       PO11       PO12       PSO1       PSO2														
CO	1	3	2	2	2	1	1.00	10/	100	1	1		1	1001	1002
CO2	2	3	2	2	2	1				1	1		1		
CO	3	3	2	2	2	1				1	1		1		
CO4	4	3	2	2	2	1				1	1		1		
CO	5	3	2	2	2	1				1	1		1		
1 – Slig	ght, 2 –	Mode	rate, 3 –	Substanti	al, B⁻	Γ- Bloom's	Taxono	my							
	-							-							
						ASSES	SMENT	PATTE	RN - 1	THEORY	,				
Tes C	t / Bloc ategor	om's 'y*	Re	memberii (K1) %	ng	Understa (K2)	anding %	Apply (K3)	/ing %	Analyz (K4) 9	ing %	Evaluating (K5) %	) C	reating (K6) %	Total %
	CAT1	-		10		30		60	)					· ·	100
	CAT2			10		30		60	)						100
	CAT3			10		30		60	)						100
	ESE			10		30		60	)						100
* ±3% ı	may be	varied	d (CAT 1	2,3 – 50 ı	marks	s & ESE –	100 mai	ˈks)							

	22MEL11 - ENGINEERING PRACTICES LABORATORY														
			(	Commo	on to Al	l Engine	eering a	nd Tecł	nnology	Branche	es)				
Programm Branch	е &	All B	E/BTec	h Bran	ches					Sem.	Category	L	т	Р	Credit
Prerequisi	tes	Nil								1/ 2	ES	0	0	2	1
Preamble		This engin	course eering p	is desi practice	gned to s.	o provid	de a ha	ands-on	experi	ence in	basic of m	necha	nical	and e	ectrical
LIST OF E	XPERIM	ENTS /	EXERC	CISES:											
					PA	RT A –	MECHA	NICAL	ENGIN	IEERING	3				
1.	Prepar Tappin	e a Squ g, and /	uare / R Assemb	ectangu ling Tas	ular / V- sks fron	Shape	Projecti ven Squ	ion with are / R	its Cou ectangu	Interpart	for Mating Plates using	and I Mod	Perfori ern Po	m the ower T	Drilling, ools.
2.	Prepar Power	e T/L/ Tools.	/ Lap Jo	oint from	n given	vvoode	n work	Piece a	ind Mak	е а вох	/ Tray out o	of Ply	wood	using	Modern
3.	Perforr Leak-P	n the T Proof.	hread F	Formatio	on on a	GI/PV	C Pipe a	and Pre	epare a	Water L	ine from th	e Ov	erhead	d Tan	< that is
4.	Make a	a Butt / I	Lap / Te	e Joint	of MS I	Plate us	sing Arc	Weldin	g Proce	ess and V	Velding Sim	nulato	r.		
5.	Activit Involvir	y: Prep ng Mode	oare an ern Pow	Innova /er Tool	ative Mo s.	odel wit	th the H	Knowled	dge fror	m Fitting	g / Carpent	ry / F	Plumbi	ng / '	Welding
				PA	RT B -	ELEC	TRICAL	AND B	ELECTR	RONICS	ENGINEEF	RING			
6.	Wiring	circuit f	or fluore	escent l	amp an	d Stair	case wi	ring							
7.	Wiring Circuit of Incandescent lamp using Impulse Relay														
8.	Measurement of Earth Resistance														
9.	Soldering of Simple Circuits and trouble shooting														
10.	10. Implementation of half wave and full wave Rectifier using diodes														
	Total:30														
REFEREN	CES/ MA	NUAL	/SOFT\	NARE:											
1.	Engine	ering P	ractices	Labora	atory Ma	anual.									
COURSE C On comple	OUTCON etion of t	IES: the cou	irse, the	e stude	nts wil	l be abl	le to						BT (Hig	' Map hest I	ped ₋evel)
CO1	plan tl innova	he sequ itive arti	uence o cles	of oper	ations f	for effe	ctive co	ompletic	on of th	ne plann	ed models	/	Crea Man	ting (ł pulati ′S2)	(6) on
CO2	identify accura	y and u ately	se app	ropriate	moder	n powe	r tools	and co	mplete	the exer	cises/mode	ls	Appl Man	/ing (l pulati	(3) on
CO3	nerforn	n house	wiring	and rea	lizo tho	import	ance of	oarthin	<b>n</b>				App	lying	(K3),
CO3	periori	n nouse						carunnų	9				Manip App	oulatio lying	<u>)n (S2)</u> (K3),
	Solden	ng with	simple	election		uits							Manip Apr	oulatio	on (S2) (K3)
CO5	trouble	shoot t	he elec	trical ar	Manni	ronic cir	Cuits		and PS(	)e			Manip	oulatio	on (S2)
COs/POs	PO1	P02	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	P01	2 P	SO1	PSO2
CO1	3		3	1	3	1			3	3		3			
CO2	3		3	1	3				3	3		3			
CO3	3		3	2	1				2	2		3			
CO4	3		2	1	1				2	3		3			
CO5	3		3	2	1				2	2		3			
1 – Slight, 2	2 – Mode	erate, 3	– Subs	tantial,	BT- Blo	om's Ta	axonom	y	·		• •				

			22	GCL12	– Fou	Indatio	on La	borator	y - Elect	rical, IoT	, Web					
Progr	ramme&			•	(Con	nmon	to all E	BE/Blec	h branch	ies)				-	_	
Brand	ch		BE/Biech	h branc	hes					Sem.	Category	'	L	-	Р	Credit
Prere	quisites	Nil								1 /2	ES		0	0	6	3
Pream	nble	This on tl	course is ne house	s design wiring, l	ned to p Interne	provide et of Th	e a fou hings a	Indation and Web	al knowle Techno	edge on e logies.	engineering v	vith	hai	nds-	on e>	perience
LIST	OF EXPERI	IMENTS	6/EXER	CISES:												
				PA	ART A	– Elec	ctrical	Installa	tion (30	Hours)						
1.	Develop	wiring o	liagrams	using so	oftware	e tools.	j.									
2.	Identify a	and sele	ct suitabl	e compo	onents	for Er	nergy N	Measure	ment an	d Circuit	Protection					
3.	Design a	a wiring	circuit inte	egrating	energ	gy Mete	er, MC	B and F	ССВ							
4.	Develop a wiring circuit for incandescent lamp and fluorescent lamp															
5.	Develop and Investigate Simple and Staircase Wiring for Residential Applications															
6.	Design the Wiring Circuits for Calling Bell System and Dimmable Light															
7.	Create wiring circuits for power loads															
8.	Measurement of Earth Resistance and its connections.															
				F	PART	B – Int	ternet	of Thin	gs (30 H	lours)						
1.	Design a	a Single	layer PC	B layout	t desig	ning										
2.	Fabricate	e Single	layer PC	B printir	ng											
3.	Assembli	ling, sole	dering an	d desolo	dering	practio	ce on s	single la	er PCB							
4.	GPIO pro	ogramm	ing in ES	P8266												
5.	Sensor a	and actu	ator inter	facing w	vith inte	ernet e	enable	d microo	ontroller	device						
6.	Sensor a	and actu	ator calib	ration												
7.	Integratio	on of mi	crocontro	ller bas	ed sys	stem wi	ith Clo	oud platfo	orm							
				P	PART	C – We	eb Tec	chnolog	ies (30 H	lours)						
1.	Design a	a websit	e for an a	pplicatio	on usir	ng HTN	ML and	CSS.								
2.	Convert t	the des	gned web	osite inte	o respo	onsive	) websi	ite using	Bootstra	ap.						
3.	Add dyna	amism t	o the web	site by	using	JavaS	cript a	nd embe	ed the So	ocial Med	ia componer	nts	to tł	ne w	ebsit	Э.
4.	Incorpora	ate data	base inte	raction	to the	websit	te.									
5.	Deploy th	he deve	loped we	bsite in	the se	rver.										
D																Total:90
KEFE			L /SOFT	WARE:												
2.	Eric T.Fre O'Reilly .	eeman, 2014.	Elisabeth	Robsor	n, "Hea	ad Firs	st Java	Script P	rogramm	ning A Bra	ain-Friendly	Gui	de"	, 1st	t Editi	on,

3.	Eric	T.Fre	eman,E	lisabeth	Robso	n, "Hea	d First I	HTML a	nd CSS	",2nd E	dition, O'	Reilly , 20	12		
4.	Lyn	n Beig	hley,"He	ead Firs	t SQL",	1st Edit	in, O'Re	eilly,200	7.						
COUR On cor	COURSE OUTCOMES:BT Mapped (Highest Level)On completion of the course, the students will be able to(Highest Level)														
CO1	CO1design electrical wiring circuits for buildings based on their requirementApplying(K3), Precision (S3)														
CO2	CO2 develop IoT based solutions and PCB for real world use cases. Applying (K3), Precision (S3)														
CO3	CO3       design and host an interactive dynamic website.       Applying(K3), Precision (S3)														
						Mappi	ing of C	COs wit	h POs a	and PS	Os				
COs/P	Os	PO1	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	I	3	2	2	1					1					
CO2	2	3	2	2	1					1					
CO3	3	3	2	2	1					1					

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

Programme & BranchBE - Mechanical EngineeringSem.CategoryLTPCredPrerequisitesNil1BS0021PreambleThis course aims to impart hands on training in the determination of parameters such as specific resis thermal conductivity, Fermi energy level, band gap. Hall coefficient. dielectric constant. velocity of ultrast	it tance,												
Branch       BE - Mechanical Engineering       Sen.       Category       L       I       P       Cred         Prerequisites       Nil       1       BS       0       0       2       1         Preamble       This course aims to impart hands on training in the determination of parameters such as specific resis thermal conductivity, Fermi energy level, band gap. Hall coefficient. dielectric constant. velocity of ultrast	tance,												
Preamble This course aims to impart hands on training in the determination of parameters such as specific resis thermal conductivity, Fermi energy level, band gap. Hall coefficient, dielectric constant, velocity of ultrast	tance,												
thermal conductivity, Fermi energy level, band gap. Hall coefficient, dielectric constant, velocity of ultras	tance,												
	sound,												
compressibility of a liquid, AC frequency, thickness of thin film and knowledge on the working of p-n diod UJT, and also to impart skills on writing coding / developing project / product related to societal requirement	le and it.												
LIST OF EXPERIMENTS / EXERCISES:													
1. Determination of the specific resistance of the given metallic wire using Carey-Foster's bridge.													
2. Determination of the thermal conductivity of a bad conductor using Lee's disc.													
3. Determination of the Fermi energy level of copper using Wheatstone's bridge.													
4. Determination of the band gap of a given semiconducting material using post-office box / Determination of the Hall coefficient of a material using Hall effect arrangement.													
5. Observation of the I-V characteristics of a p-n junction diode.													
6. Observation of the I-V characteristics of a uni junction transistor / Determination of the dielectric constant of a material bycharging and discharging.													
7. Determination of the velocity of ultrasonic waves in a liquid and the compressibility of the liquid using ultrasonic interferometer.													
8. Determination of the frequency of alternating current using electrically vibrating tuning fork (Melde's apparatus).													
Determination of the thickness of a thin film by air-wedge arrangement.													
10. Writing coding for any one of the above experiments / developing a project / a product.													
Тс	tal:30												
REFERENCES/ MANUAL /SOFTWARE:													
1. Physics Laboratory Manual / Record, Department of Physics, 1 <sup>st</sup> Edition, 2020.													
COURSE OUTCOMES: BT Mapped													
On completion of the course, the students will be able to (Highest Level) determine the specific resistance of a given wire using the principle of Wheatstone bridge													
CO1 and the thermal conductivity of a bad conductor using the concept of heat conduction Applying (K3), Precisio through materials.	n (S3)												
determine the Fermi energy level of copper and band gap of a semiconductor using the													
material using the concept of Hall effect. To obtain the I-V characteristics of a p-n junction Applying (K3), Precisio	า (S3)												
creation of negative resistance region or to determine the dielectric constant of a dielectric	. (00)												
material using the concepts of charging and discharging of a capacitor determine the velocity of ultrasound in a liquid and the frequency of alternating current													
CO3 using the concept of formation of stationary waves and also to compute the thickness of a Applying (K3), Precisio	n (S3)												
product.	( )												
Mapping of Cos with POs and PSOs													
COs/POs         PO1         PO2         PO3         PO4         PO5         PO6         PO7         PO8         PO9         PO10         PO11         PO12         PS01         PS01	2												
CO1         3         2         2         3         2         2         2         2         3													
CO2         3         2         2         3         2         2         3													
CO3         3         2         2         3         2         2         3           1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy         2         2         2         3													

		22VEC11 - YOGA AND VALUES FOR													
		(Common to All Engineering and	I Technology Bran	ches)											
Progra Branci	ımme & n	All B.E./B.Tech. Branches	Sem.	Category	L	т	Ρ	Credit							
Prereq	uisites	Nil	1/2	HS	1	0	1	1							
Preaml	ble	Yoga or yogasanas are considered as art and scien harmony of body and mind for general wellbeing. Yo Indians for healthy living. Students in particular are	nce of healthy livin Yoga is considerec benefitted by lear	g by our ancie I as one of the ning yoga.	nt guru greate	is. It i est gil	s me ts to	thod to bring the world by							
Unit –		Introduction:						2							
The Origins of Yoga – Definitions - Concepts - Aims and objectives of Yoga – Yoga is a Science and Art – Rules and Regulations of Asanas – Classifications of Yogasanas – Patanjali's Ashtanga Yoga – Pranayama – Mudras & Bandhas - Shatkarma (Cleansing Practice) - Streams of Yoga – Modern Trends in yoga.															
Unit –	Unit – II Yoga and Mind: 2														
The Nature of Mind - Five Elements and the Mind - Meditation and the Mind - Functions of the Mind - Role of Yoga in Psychological problems: Mood Disorders, Major Depressive Disorder, Cyclothymic Disorder.															
Unit –		Yoga and Values, Diet:						2							
Unit – III         Yoga and Values, Diet:         2           Human Values – Social Values – Role of Yoga in Personality Integration - Concepts of Natural Diet - Naturopathy Diet – Eliminative Diet – Soothing Diet – Constructive Diet.         2															
Unit –	IV	Asanas:						2							
Prayer Princip	<ul> <li>Starting les of Pract</li> </ul>	& Closing - Preparatory practices – Loosening Pr icing Asanas. Asanas: Standing – Sitting – Prone – S	ractices – Meanin Supine – Suryanan	g, Definitions naskar.	and O	bject	ives	of Asanas -							
Unit –	V	Pranayama and Meditation:						2							
Breathi Nadi S	ing Practice huddhi - Ka	s for awareness - Definitions and Objectives of Pr apalabathi – Sitali – Sitkari – Bhranari – Ujjayi – Rela	anayama - Princip xation Techniques	oles of Practic – Meditation.	ing Pra	anaya	ama.	Pranayama:							
				Lecture	e: 10, I	Pract	ical:	10, Total:20							
TEXT	BOOK:														
1.	Swami sa	tyananda saraswathi, "Asana pranayama mudra ban	dha", Bihar school	of yoga, 4 <sup>th</sup> Eo	dition, <sup>2</sup>	1969.									
2.	Swami mu	ukthi Bodhanandha, "Hatha yoga pradipika", Bihar sc	hool of yoga, 4 <sup>th</sup> E	dition, 1985.											
REFER	RENCES:														
1.	B.K.S. lye	nkar, "Yoga the path of holistic health", DK Limited, 2	2 <sup>nd</sup> Edition, 1969.												
2.	Selvarasu	, "Kriya cleansing in yoga", Aruvi yoga, 3 <sup>rd</sup> Edition, 20	002.												

COURS On com	E OU <sup>-</sup>	TCOMES	course, t	the stud	ents will	be able t	0						BT M (Highe	lapped st Level)	
CO1	real	ize the im	nportance	of yoga	in physic	al health.							Apply	ring (K3)	
CO2	real	ize the im	nportance	of yoga	in menta	l health.							Apply	ring (K3)	
CO3	real	ize the ro	le of yoga	a in perso	onality de	evelopmer	nt and diet.						Apply	ring (K3)	
CO4	do t	he looser	ning pract	tices, Asa	anas and	realize its	s benefits.						Apply	ring (K3)	
CO5	do t	he practio	ce of Prar	nayama,	meditatio	on and rea	alize its ben	efits					Apply	ring (K3)	
	Mapping of COs with POs and PSOs														
COs/P	Mapping of COs with POs and PSOs           COs/POs         PO1         PO2         PO3         PO4         PO5         PO6         PO7         PO8         PO9         PO10         PO11         PO12														
CO1	Sires         For         For </td <td></td>														
CO2	2						3			2					
CO3	3						3			3					
CO4	4						3			2	3				
CO5	5						3			3					
1 – Sligh	nt, 2 –	Moderate	e, 3 – Sul	ostantial,	BT- Bloc	om's Taxo	nomy								
					AS	SESSME	NT PATTE	RN –	THE	ORY					
Test Bloon Catego	:/ n's ory*	Reme (I	embering (1) %	g U	nderstar (K2) %	nding %	Applyir (K3) %	ng %	Ar (	nalyzing (K4) %	Eva (ł	lluating (5) %	Creating (K6) %	g Total %	
CAT	1		-		-		-			-		-	-	-	
CAT	XAT2												-	-	
CAT	T3 20 30 50 100												100		
ESE	Ξ		-		-		-			-		-	-	-	
* ±3% m	nay be	varied (C	CAT3 – 1	00 marks	5)										

		22EGT21 - COMMUNICATION SKILLS	SII												
		(Common to All Engineering and Technology	Branches	3)											
Program Branch	nme &	All B.E./B.Tech. Branches	Sem.	Category	L	т	Ρ	Credit							
Prerequi	isites	Communication Skills I	2	HS	3	0	0	3							
Preamble	e	This course is designed to equip students with the necessary s develop their linguistic and communicative competencies.	skills to lis	sten, read, wr	ite a	and s	peak so	as to							
Unit – I		Grammar, Vocabulary, Listening, Speaking, Reading & Wri	iting					9							
Gramma substituti Reading	ar: Senten ion - Liste i: Reading	ce Patterns - Simple, Compound & Complex sentences - Vening: Speeches from company CEOs - TV debates <b>Speak</b> for Gist - <b>Writing:</b> Job application letter with resume – Transco	ocabula ing: Jus ding	r <b>y:</b> Portmant st-a-minute ta	eau alk -	wo Gro	rds - O oup disc	ne word cussion -							
Unit – II		Grammar, Vocabulary, Listening, Speaking, Reading & Wri	iting					9							
Grammar: Concord - Vocabulary: Phrasal verbs - Idioms & Phrases - Listening: Listening to celebrity talks - Speaking: Talking about celebrities - Practicing Pronunciation through web tools - Reading: Company correspondence, technical texts/working principles of a machine - Writing: Description: Person, Place, Process, Product and PictureSpeaking: 0Unit - IIIGrammar, Vocabulary, Listening, Speaking, Reading & Writing9															
Unit – III	:exts/working principles of a machine - Writing: Description: Person, Place, Process, Product and Picture         Unit – III       Grammar, Vocabulary, Listening, Speaking, Reading & Writing       9														
Grammar: Discourse markers -       Transitional words and phrases -       Vocabulary: Commonly confused words -       Listening:         Listening to guest lectures -       Speaking: Technical & Non-technical presentations -       Workshop presentations -       Reading: Reputed company profiles, Business Plans -       Writing: a dream job/company -       Letter to the Editor -       Biography & Autobiography -       Checklist															
Unit – IV     Grammar, Vocabulary, Listening, Speaking, Reading & Writing     9															
Gramma Listening comment Technica	ar: Degree g: Listeni taries - Mo al reports	s of Comparison - Punctuations – Fragments & run-ons - Vocal ng to global accents - listening to motivational speeches - Spe ovie Enactment - Reading: Narrative passages - Writing: E m	bulary: E aking: N ail - Age	British & Ame Narrating pers Inda & Minute	ricar sona es o	n - Sp I mile f Mee	belling 8 estones eting - S	& words - - Sports Special &							
Unit – V		Grammar, Vocabulary, Listening, Speaking, Reading & Wri	iting					9							
Gramma Listening speeches from jour	ar: Purpos to sampl s/conversa mals Writi	e and Function - If clause - Error detection - Vocabulary: Co e HR Interviews - Speaking: Introduction to phonetics - Stres tions - Giving feedback – Debate - Reading: Key Note speech ng: Circulars - Critical Appreciation of a non-detailed text - Tech	ding & D ss, rhythi nes - Nev nical pro	Decoding - Al m & Intonatio wspaper repo posals	phai on - orts -	oet te Gui sho	est - Li ded & ι rt techni	stening: unguided ical texts							
								Total:45							
TEXT BO	DOK:														
1. 3	Sanjay Ku	mar & Pushp Lata, "Communication Skills", 2 <sup>nd</sup> Edition, Oxford L	Jniversity	Press, New	Delł	ni, 20	18.								
REFERE	NCES:														
1.	Meenaks University	hi Raman and Sangeeta Sharma. "Technical Communication- / Press, New Delhi, 2022.	Principle	s and Practic	e". 4	I <sup>th</sup> Ec	lition, O	xford							
2.	Murphy F	aymond, "English Grammar in Use", 5 <sup>th</sup> Edition, Cambridge Uni	iversity P	ress, New Yo	ork, i	2019	•								
3.	Jack C. Ri 2014.	chards and Chuck Sandy, "Passages" Student's Book 2, 3 <sup>rd</sup> Edit	tion, Carr	nbridge Unive	ersity	Pre	ss, New	York,							

COURS	SE OUT(	ON of t	IES: he course	. the	stude	ents will be a	able to					BT I (High)	Mapped est Leve	D
CO1	use fu	ncti	onal gramr	nar fo	or impr	roving comm	unicatio	n skills				Apply	ying (K3)	- <b>/</b>
CO2	listen	and	comprehe	nd di	fferent	accents and	l infer ir	mplied m	eanings			Apply	ying (K3)	
CO3	speak comm	cle unic	arly, initia	ite a egies	nd su	istain a dis	cussion	and ne	gotiate us	ing app	ropriate	Crea	ting (K6)	
CO4	read evalua	diffe ate t	erent genre hem	es of	texts	s, infer impl	ied mea	anings a	nd critical	ly analy:	ze and	Underst	anding (I	<2)
CO5	CO5 produce different types of narrative, descriptive expository texts and understand creative, critical, analytical and evaluative writing Creating (K6)													
	Manning of COs with POs and PSOs													
COs/P	Os PO	01	PO2	Р	<b>O</b> 3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	P011	PO12
CO1								2			1	3	1	1
CO2											2	3		1
CO3											2	3		2
CO4								1				3	1	1
CO5												3		2
1 – Slig	ht, 2 – N	lode	erate, 3 – S	ubsta	antial,	BT- Bloom's	Taxono	my						
<b>T</b>		-		•		ASSES	SMENT	PATTER	N - THEO	RY –		0		
Cate	gory*		(K1) %	ing	Und	erstanding (K2) %	App (K:	alying 3) %	Analyzir (K4) %	ng Ev	aluating (K5) %	(K6) %	<b>Т</b>	otal %
CA	AT1					37	3	30				33		100
CA	AT2					7	Ę	50				43		100
CA	<b>Δ</b> Τ3					17	5	50				33		100

\* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

ESE

		22MAC21 - MULTIVARIABLE CALCULUS AND COMF	PLEX AN	ALYSIS				
		(Common to CIVIL, MECH, MTS, ECE, EEE, EIE &	FT brand	:hes)	1	1		
Progra Branch	mme & I	B.E &Civil, Mech, MTS, ECE, EEE, EIE & FT branches	Sem.	Category	L	т	Ρ	Credit
Prereq	uisites	Nil	2	BS	3	1*	<b>2</b> *	4
Pream	ble	To impart the knowledge of partial derivatives, evaluation of re analytic functions to the students for solving the problems related	eal and o to various	complex integrations engineering of	rals, discip	vecto lines.	r calc	ulus and
Unit – I		Functions of Several Variables:						9
Functio	ns of two or r a and minima	nore variables – Partial derivatives – Total differential – Taylor's se – Constrained maxima and minima – Lagrange's multiplier method.	eries for fu	unctions of two	o varia	ables	– App	olications:
Unit – I	I	Multiple Integrals:	_			_		9
Double in carte	integration in sian coordina	ecartesian coordinates – Change of order of integration – Application tes – Volume as triple integrals.	on: Area	between two c	curves	s – Tr	iple ir	itegration
Unit – I		Vector Calculus:						9
Directic Irrotatic the abo	onal derivative onal vectors – ove theorems	e – Gradient of a scalar point function – Divergence of a vector po Vector Integration: Introduction – Green's, Stoke's and Gauss dive and evaluation of integrals using them.	oint funct orgence th	ion – Curl of a neorems (witho	a vect out pr	or – oof) -	Solen - Verif	oidal and ication of
Unit – I	V	Analytic Functions:						9
Functio equatio Applica	ns of a com ns (Statemer tions: Fluid flo	plex variable – Analytic functions – Necessary and sufficient control of the only) – Properties of analytic function (Statement only) – Harmo ow – Conformal mapping: w = z + a, az, 1/z – Bilinear transformation	onditions nic functi n.	(excluding pr on – Construc	oof) tion c	<ul> <li>Ca</li> <li>f ana</li> </ul>	uchy– Ilytic f	Riemann unction –
Unit – V	V atian Oanah	Complex Integration:		ent a seis a lois			0	9
- Cauc	hy's residue	theorem (without proof) – Cauchy's integral formula – Taylor's a theorem (without proof) – Applications: Evaluation of definite integr	rals invol	ving sine and	cosin	e fun	ctions	over the
circular	contour.							
LIST O	F EXPERIME	INTS / EXERCISES:						
1.	Finding ord	nary and partial derivatives						
2.	Computing	extreme values of function of two variables						
3.	Evaluating	double and triple integrals						
4.	Finding the	area between two curves						
5.	Computing	gradient, divergence and curl of point functions						
6.	Applying Mi	Ine-Thomson method for constructing analytic function						
7.	Determinati	on of Mobius transformation for the given set of points						
8.	Finding pole	es and residues of an analytic function						
		L	ecture:4	5, Tutorials a	nd Pr	actic	al:15,	Total:60
TEXT E	BOOK:							
1.	Ramana B	/, "Higher Engineering Mathematics", 1 <sup>st</sup> Edition, Tata McGraw-Hill	Publishin	ig Company Li	mited	, Nev	v Delh	i, 2018.
REFER	ENCES/ MA	NUAL / SOFTWARE:						
1.	Kreyszig E,	"Advanced Engineering Mathematics ", 10 <sup>th</sup> Edition, John Wiley, Ne	w Delhi,	India, 2016.				
2.	Kandasamy S.Chand an	P., Thilagavathy K. and Gunavathy K., "Engineering Mathematics I d Co., New Delhi	For First `	Year B.E/B.Te	ch", F	Reprir	nt Edit	ion 2014,
3.	Duraisamy Education, I	C., Vengataasalam S., Arun Prakash K. and Suresh M.,"Engineer New Delhi, 2018.	ring Math	ematics - I", 2	2 <sup>nd</sup> Ec	lition,	Pear	son India
4.	Grewal B.S.	"Higher Engineering Mathematics" 44thEdition, Khanna Publishers,	,New Del	hi, 2018.				
5.	MATLAB -	Laboratory Manual						

COUR: On cor	SE O nplet	UTCOM	IES: he cours	se, the st	udents	will be a	ble to						(	BT Map Highest L	ped .evel)
CO1	com	npute th	e total de	erivatives	and extr	eme valı	ies of mu	ultivariab	le func	tions.				Applying	(K3)
CO2	eva	luate m	ultiple int	egrals an	d apply t	them to c	ompute	the area	and vo	lume of t	he regi	ons.		Applying	(K3)
CO3	арр	ly the c	oncepts o	of derivat	ives and	l line inte	grals of v	ector fu	nctions	in engin	eering p	oroblems.		Applying	(K3)
CO4	con und	struct a er the g	nalytic fi	unctions formal ma	and bilir apping.	near tran	sformatio	ons and	detern	nine the	image	of given regi	ion	Applying	(K3)
CO5	app clos	ly the t sed curv	technique res.	es of cor	nplex int	tegration	to evalu	uate rea	l and	complex	integra	ls over suital	ble	Applying	(K3)
CO6	den ope	nonstrat rators, i	e MATLA multiple i	AB progra ntegrals a	amming and comp	to unders plex varia	stand the ables.	e concep	ots of fu	Inctions	of two v	variables, vec	tor N	Applying Ianipulatio	(K3), n (S2)
	Mapping of COs with POs and PSOs														
COs/POs         PO1         PO2         PO3         PO4         PO5         PO6         PO7         PO8         PO9         PO10         PO11         PO12         PS6															PSO2
CO1 3 3 2															
CO2	2	3	3	2											
COS	3	3	3												
CO4	1	3	3												
COS	5	3	3	3											
CO	6					3									
1 – Slig	ght, 2	– Mode	rate, 3 –	Substant	ial, BT- E	Bloom's T	Faxonom	у							
			_			ASSE	SSMEN		ERN - 1	HEORY					
Tes C	ateg	oom's ory*	Re	member (K1) %	ing l	Jndersta (K2)	anding %	Apply (K3)	ving %	Analyzi (K4) %	ng l %	Evaluating (M %	(5) C	reating (K6) %	Total %
	CAT	1		10		30		60	)	-		-		-	100
	CAT	2		10		30		60	)	-		-		-	100
	CAT	3		10		30		60	)	-		-		-	100
	ESI	Ξ		10		30		60	)	-		-		-	100
* ±3% ı	may b	e varie	d (CAT 1	& 2 - 60	marks &	. ESE – 1	00 mark	s)							

\*Alternate week

		22CYT22 – CHEMISTRY FOR MECHANICAL EN	GINEER	RING											
Progra	mme &														
Brancl	1	B.E & Mechanical Engineering	Sem.	Category	L	Т	F	י	Credit						
Prereq	uisites	Nil	2	BS	3	0	(	)	3						
Droom		This source sime to emphasize the environmenting students to	, realize	the importe					homiotry						
Pream	bie	electrochemical storage devices, fuels & combustion, enginee control methods.	ring mat	erials and the	nce d nee	d fo	or co	rros	sion & its						
Unit –		ELECTROCHEMISTRY							9						
Introdu EMF) standa potenti (redox)	action – cells –calculation of rd hydrogen ometric titrat – conductor	s – types – representation of galvanic cell – electrode pot of cell EMF from single electrode potential – reference electrode electrode, standard calomel electrode, glass electrode ions netric titrations – mixture of weak and strong acid vs strong base	ential – des: con e – EN e.	Nernst equa struction, wo MF series a	ation rking and	(d an its	eriva d ap app	atio plic plica	n of cell ations of ations –						
Unit –	<b>II</b>	ELECTROCHEMICAL STORAGE DEVICES							9						
Batter –variou battery – main Fuel C cells: H	tteries:       Introduction- types of batteries – discharging and charging of battery – characteristics of battery – battery rating arious tests on battery – primary battery: silver button cell – secondary battery: Ni-Cd battery –modern battery: lithium-ion tery naintenance of batteries – choice of batteries for electric vehicle applications.         al Cells:       Introduction-Importance and classification of fuel cells – description, principle, components and applications of fuel s: H2-O2 fuel cell, alkaline fuel cell, molten carbonate fuel cell and direct methanol fuel cell.         it – III       CORROSION AND ITS CONTROL METHODS       9														
Unit –	III         CORROSION AND ITS CONTROL METHODS         9           sion:         Introduction – chemical corrosion – Pilling-Bedworth rule – electrochemical corrosion and it's types – galvar														
Corrosi ofcorro Contro surface – meta	Corrosion:       Introduction – chemical corrosion – Pilling-Bedworth rule – electrochemical corrosion and it's types – galvanic corrosion – differential aeration corrosion with examples – galvanic series – factors influencing rate of corrosion – measurement of corrosion (wt. loss method only).       9         Control methods – sacrificial anodic protection method – corrosion inhibitors – protective coatings – pretreatment of meta surface       9         – metallic coating:       electroplating, electroless plating and hot dipping (tinning and galvanizing) methods – non-metallic coating: anodizing – organic coating: paints, constituents and functions – ceramic coatings.														
Unit –	IV	FUELS AND COMBUSTION	1110 000	ungo.					9						
Introdu values – theorits vari of petr octane introdu	retical calcula eties – proxir oleum – man number, cor iction of	sification of fuels – characteristics of a good fuel – combusti ation of calorific value by Dulong's formula – flue gas analysi mate analysis – significance – metallurgical coke – Otto-Hoffr nufacture of synthetic petrol – hydrogenation of coal – bergius npression ignition engine – cetane number – power alcohol	on – ca s by Ors nan byp s proces and bio	lorific values sat's method roduct metho s – knocking diesel – gas	– gr – so od – l : spa eous	oss iqu rk i fue	fuels id fu gniti el –	d no s – el - on wat	et calorific coal and - refining engine – ter gas –						
Unit –	Stage ⊑missi V	CHEMISTRY OF ENGINEERING MATERIALS							9						
Lubric aniline RDX). of abra industr adhesi	ants: Introduc point and car Rocket proj asives: i) natu ial application ve bonding- a	ction – classification – properties : viscosity, viscosity index, flas rbon residue. <b>Explosives:</b> Introduction - classification – manufa <b>pellants:</b> Introduction – properties and classification. <b>Abrasive</b> ural abrasives – diamond, corundum and quartz ii) synthetic ns of abrasives. <b>Adhesives</b> : Introduction-requisites of a good dhesive action-classification of adhesives-industrial applications	h and fir acture of s: Introd abrasive adhesiv of adhes	e point, cloud important ex luction-proper es – silicon c ve-advantage sives.	and plosiv ties o arbid s and	pou /es f al e, l d di	ur po (TN prasi boro isadv	int, T, ( ves n c /an	oiliness, GTN and - types arbide – tages of Total:45						
ΤΕΧΤ Ι	BOOK:														
1.	Wiley Editor	ial Board, "Wiley Engineering Chemistry", 2 <sup>nd</sup> Edition, Wiley India	a Pvt. Lto	d, New Delhi,	Repr	int :	2019	).							
REFEF	RENCES:														
1.	Palanisam Education	ny P.N., Manikandan P., Geetha A., Manjula Rani K., Kowshalya , New Delhi, Revised Edition 2019.	V.N., "E	invironmental	Scier	nce	", Pe	ars	on						
2.	Dara .S.S	, "A Text book of Engineering Chemistry", S. Chand and compar	ny Ltd., 2	2021.			_								
3.	Sunita Ra 2022.	ttan, " A Text book of Engineering Chemistry", S.K. Kataria& Sor	ns Publis	shers, First ed	ition,	20	18, F	Rep	rint-						

COUR On cor	SE OI mplet	UTCON ion of t	IES: he cou	irse, the st	udents	s will be a	able to							BT Mapp (Highest Lo	ed evel)
CO1	appl	ly the pi	rinciple	s of electroo	chemis	try for va	rious app	olication	IS					Applying (	K3)
CO2	use	the con	cepts o	of batteries,	fuel ce	ells and th	eir appli	cations	in vari	ous field	S.			Applying (	K3)
CO3	mak	e use o	of corro	sion control	metho	ds to solv	ve corros	sion rela	ated iss	sues.				Applying (	K3)
CO4	appl	ly the co	oncept	s of fuels an	d com	oustion fo	or engine	ering a	pplicati	ons				Applying (	K3)
CO5	utiliz	ze the c	oncept	s of lubricar	nts, exp	olosives a	ind adhe	sives fo	or vario	us applio	cations.			Applying (	K3)
Mapping of Cos with POs and PSOs															
Mapping of Cos with POs and PSOs           Cos/POs         PO1         PO2         PO3         PO4         PO5         PO6         PO7         PO8         PO9         PO10         PO11         PO12         PSO1         PSO															PSO
															2
CO	1	3	2	1	1										
CO	2	3	2	1	1										
CO	3	3	2	1	1										
CO	4	3	2	1	1										
CO	5	3	2	1	1										
1 – Slig	ght, 2	– Mode	erate, 3	8 – Substan	tial, B	Γ- Bloom	's Taxor	nomy				1	l.		
						ASSES	SMENT	PATTE	RN – 1	THEORY	1				
Tes C	t / Blo atego	oom's ory*	F	Rememberi (K1) %	ng	Understa (K2)	anding %	Apply (K3)	ying %	Analyzi (K4) 9	ing %	Evaluating (K5) %		Creating (K6) %	Total %
	CAT	1		25		35	5	40	)						100
	CAT	2		25		35	5	40	)						100
	CAT	3		25		35	5	40	)						100

\* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

ESE

	22MET21 - ENGINEERING MATERIA	ALS AND ME	ETALLURGY											
			1											
Programm Branch	<sup>e &amp;</sup> B.E. & Mechanical Engineering	Sem.	Category	L	т	Ρ	Credit							
Prerequisi	tes Physics for Mechanical Engineering	2/4	PC	3	0	0	3							
Draambla		1 (2 1 2			,									
Preamble	ferrous metals, alloys, polymers, ceramics, bio-materials, the different heat treatment processes and their influence	elationship a composite i on the phys	and allied applica materials and nan ico-mechanical pr	tions of o mater operties	ials. It of me	us me t also etals.	etais, non- describes							
Unit - I	Ferrous Metals						9							
Classificati Alloy Form Peritectic - Properties	ion of Engineering Materials - Comparison between Metals a lation - Substitutional and Interstitial - Phase Diagrams - and Peritectoid Reactions - Iron - Iron Carbide Equilibrium Diagr s and Applications - Ferrite and Austenite Stabilizers.	nd Non-Me Lever Rul ram - Classit	tals - Alloys - Sc e - Isomorphou ïcation of Steel a	olid Solu s - Eu nd Cast	itions tectic Iron	- Pri - E - Mici	inciples of utectoid - rostructure							
Unit - II	Unit - II         Ferrous and Non-Ferrous Alloys         9           Effect of Alloving Elements - Manganese - Silicon - Chromium - Molybdenum - Vanadium - Titanium and Tungsten on the													
Unit - II       Ferrous and Non-Ferrous Alloys       9         Effect of Alloying Elements - Manganese - Silicon - Chromium - Molybdenum - Vanadium - Titanium and Tungsten on the TechnicalProperties of Steel - Stainless and Tool Steels - High Strength Low Alloy Steels - Maraging Steels - Aluminium and its Alloys - Precipitation Strengthening Treatment - Copper and its Alloys - Magnesium and its Alloys - High Entropy Alloys.       9         Unit - III       Heat Treatment       9														
Unit - III	High Entropy Alloys         Unit - III       Heat Treatment       9         Definition       Definition       Stress Delict       Description													
Unit - III       Heat Treatment       9         Definition - Purpose of Heat Treatments - Nucleation, Grain Growth and Kinetics - Full Annealing - Stress Relief - Recrystallization and Spheroidizing - Normalizing - Quenching - Hardening and Tempering of Steel - Isothermal Transformation Diagrams - Cooling Curves Superimposed on Time Temperature Transformation Diagram - Critical Cooling Rate - Austempering - Martempering - Hardenability - Jominy End Quench Test. Case Hardening - Carburizing - Nitriding - Cyaniding - Carbonitriding - Flame and Induction Hardening.         Unit - IV       Polymers and Ceramics       0														
Unit – IV	Polymers and Ceramics						9							
Polymers Properties Polyethyle sulfide - P Compressi Properties	— Types - Thermoset and Thermoplastics - Glass Transition and Applications of Polyethylene - Polypropylene - Polystyr ne terephthalate - Polycarbonate - Polyamide - Polyimide - olyether ether ketone - Polytetrafluroethylene - Urea - Phenolfo on molding - Transfer molding - Extrusion blow molding - Rota and Applications of Alumina - Silicon Carbide - Silicon Nitride - Pa	n and Meltu rene - Poly Polyamide-i prmaldehyde tional moldir artially Stabil	ng Temperature vinyl chloride - I mide - Polyphen s. Processing - E ng - Thermoformi ized Zirconia and	of Poly Poly me ylene ov xtrusion ng. Eng Sialon.	mers ethyl ide - - Inje gineei	- St metha Poly ection ring C	ructures - aacrylate - phenylene molding - Ceramics -							
Unit - V	Powder Metallurgy and Introduction to New Materials	;					9							
Introductio Metallurgy Materials - Hybrid Nan	n - Production of Metallic Powders - Processing Methods - C - Products. Anisotropic materials - Composites - Fiber and Part Temporary and Permanent Implants - Bio-degradable Materials comaterials.	Compaction ticulate Reir - Nanomate	Methods - Design forced Materials erials - Overview o	gn Cons - Bioma of Nano	idera ateria struct	tion i Is - Ir ured	n Powder nplantable Materials -							
							Total:45							
TEXT BOO	K:													
1. Ba IV	alasubramaniam R. "Callister's Materials Science and Engineering	g". 2 <sup>nd</sup> Editio	n, Wiley India Pvt.	Ltd., 20	17 fo	r Unit	s I, II, III,							
2. Si Ed	ina Ebnesajjad. "Handbook of Biopolymers and Biodegradable dition, Elsevier, Amsterdam, Netherlands, 2013 for Unit V.	e Plastics:	Properties, Proce	essing a	nd A	pplica	ations", 1 <sup>st</sup>							
REFEREN	CES:													
1. Si	idney H. Avner. "Introduction to Physical Metallurgy". 2 <sup>nd</sup> Edition, <sup>-</sup>	Tata McGrav	v Hill Education P	vt. Ltd.,	New [	Delhi,	2017.							
2. Pi M	remamoy Ghosh., "Polymer Science and Technology: Plastic cGraw HillEducation Pvt. Ltd., New Delhi, 2011.	s, Rubbers,	Blends and Co	mposite	s". 3 <sup>r</sup>	<sup>d</sup> Ed	ition, Tata							

COURS On com	E OU <sup>-</sup>	TCON	<b>IES:</b> e course	. the stude	nts will	be able	e to						(	BT Mapp Highest Le	ed evel)
CO1	infer	the m	nicrostruc	ture, comp	osition	and pro	operties	of ferro	ous met	als			U	nderstandir	ng(K2)
CO2	inter meta	pret th	ne effect	of alloying	elemer	nts on th	ne techr	nical pro	perties	of ferro	us and no	on-ferrous		Applying (	K3)
CO3	appl	y the p	orinciples	s of heat-tre	eatmen	t proces	sses						Ui	nderstandir	ng(K2)
CO4	dem	ionstra	ate the st	ructure-pro	perty re	elations	hip and	allied a	pplicati	ons of p	olymers	and ceramics	Ur	nderstandir	ng(K2)
CO5	reve	al the	principle	s of metal-	forming	g proces	ss and i	nfer the	develo	pment	of new m	aterials		Applying	(K3)
	Mapping of COs with POs and PSOs														
COc/PO	Mapping of COs with POs and PSOs           COs/POs         PO1         PO12         PS01         PS02														
	COS/POS         PO1         PO2         PO3         PO4         PO5         PO6         PO7         PO8         PO9         PO10         PO11         PO12         PS01         PS02           CO1         2         1														
001		3	1												3
CO2		3	2		1										3
CO3		3	2		1										3
CO4		3													3
CO5		3	1					2							3
1 – Sligh	nt, 2 –	Mode	erate, 3 –	Substantia	al, BT-	Bloom's	Taxon	omy		L	Ľ				
						ASS	ESSME		TTERN	- THEC	RY				
Test / Cate	Bloor egory	m's /*	Rem (	embering K1) %	Un	derstar (K2) %	nding %	App (K3	lying 8) %	Anal (K4	yzing ) %	Evaluating (K5) %	Cre (K	eating (6) %	Total %
С	AT1			20		80									100
С	AT2			20		80									100
С	AT3			20		80									100
E	SE			20		80									100
* ±3% m	ay be	e varie	d (CAT 1	,2,3 – 50 r	narks 8	ESE –	100 ma	arks)							

		22CSC21 – FUNDAMENTALS OF DA		JCTURE	5										
		(Common to Civil, Mechanical, Automobi	ile, Cherr	nical Brar	nches)										
Program	me & Branch	BE - Civil, Mechanical, Automobile & BTech – Chemical Engineering Branches	Sem.	Categ ory	L	Т	Р	Credit							
Prerequi	sites	Programming in C	2	PC	3	0	2	4							
Preamble	•	This course is indented to introduce the conce algorithms to novice learner from cross disciple	ept of eler lines in Ei	nentary d ngineering	ata struc g and Te	tures and chnology	d notion /.	of							
Unit – I		List						9							
Data Stru	ctures - Abstract	Data Types (ADT) - List ADT and Array Imple	ementatio	n - Linkeo	d List- Si	ngly Linl	ked List-	Insertion -							
Unit – II	- Copying Singly L	Stack and Queues	etion.					9							
Stack AD	DT – Array and L on Evaluation - Qu	inked List implementation of Stacks - Application of Application A	tion: Bala on of Que	ncing Pa eues – Ap	renthesis	s – Infix s	to Postf	ix - Postfix							
Unit – III		Trees						9							
Trees- Pi – FindMir	reliminaries – Bina n – FindMax – Ins	ary Trees –Binary Tree Traversals - The Searc ertion – Deletion- Expression Tree	h Tree A	DT – Bina	ary Searc	h Trees	– Operat	tions : Find							
Unit – IV	Interview - Finalwax - Insertion - Deletion- Expression Tree         It - IV       Graphs       9         aphs - Definitions - Graph Traversals: Breadth First Search - Depth First Search - Shortest-Path Algorithms: Unweight       9														
Graphs - Shortest	Init – IV       Graphs       9         Graphs – Definitions – Graph Traversals: Breadth First Search – Depth First Search - Shortest-Path Algorithms: Unweighted Shortest Paths – Dijkstra's Algorithm – Minimum Spanning Tree – Prim's Algorithm- Kruskal's Algorithm       9         Jnit – V       Sorting and Hashing       9														
Unit – V		Sorting and Hashing						9							
Unit – V         Sorting and Hashing         9           Sorting - Preliminaries – Insertion Sort – Quicksort – Merge sort – Hashing – General Idea – Hash Function – Separate Chaining – Open Addressing         9															
LIST OF	EXPERIMENTS /	EXERCISES:													
1.	Implementation	of C programs using pointers													
2.	Implementation	of singly linked list and its operations													
3.	Implementation	of doubly linked list and its operations													
4.	Implementation	of Stack and its operations													
5.	Implementation	of Queue and its operations													
6.	Implementation	of Stack and Queue using Singly Linked List													
7.	Evaluate the Po	st-fix Expression using Stack ADT													
8.	Implementation	of Binary Search Tree traversals													
9.	Implementation	of Insertion sort and Quick sort													
10.	Implementation	of hash function													
					Lecture	e:45, Pra	actical:3	0, Total:75							
TEXT BC	DOK:														
1.	Weiss M. A., "D	ata Structures and Algorithm Analysis in $C$ ", 2nd	d Edition,	Pearson	Educatio	n Asia, I	New Dell	ni, 2016.							
REFERE	NCES/ MANUAL	/ SOFTWARE:													
1.	Horowitz Sahni, Hyderabad, 201	Andreson Freed, "Fundamentals of Data Struc 1.	tures in C	;", 2nd Ed	lition, Un	iversities	s Press,								
2.	Langsam Y.M., Education, 2015	Augenstein J. and Tenenbaum A. M., "Data Str	uctures u	sing C an	d C++", 2	2nd Editi	ion, Pear	son							

COURS On con	SE OUTO	OMES: of the c	ourse, th	e stude	nts will b	e able to	)					B1 (Hig	Mapped	el)
CO1	apply	List AD	F for solvi	ng the g	iven prob	lems						Ар	olying (K3	)
CO2	make	use of a	rrays and	l linked l	ists to cre	ate Stack	c and Qu	eue AD	Ts.			Ap	olying (K3	)
CO3	utilize	e Tree Al	DT to dev	elop sim	ple applic	ation						Ар	olying (K3	)
CO4	make	use of G	Graph AD	T for sta	ndard pro	blems						Ар	olying (K3	)
CO5	illustr	ate the u	se of star	ndard sc	orting and	Hashing	Techniq	les				Ар	olying (K3	)
					Mappi	ng of CC	)s with F	POs and	1 PSOs	:				
COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1				Ū						
CO2	3	2	1	1										
CO3	3	2	1	1										
CO4	3	2	1	1										
CO5	3	2	1	1										
1 – Slig	ht, 2 – N	loderate,	3 – Subs	stantial,	BT- Bloon	n's Taxon	iomy							
					ASSE	SSMENT	PATTE	RN – Tł	HEORY	,				
Test / Cate	Bloom's egory*	Rem	embering %	g (K1)	Underst (K2)	anding ) %	Appl (K3	ying ) %	Ana (K	lyzing (4) %	Evalua ting (K5) %	Cre (K	eating 6) %	Total %
C	AT1		10		60	C	3	0						100
C	AT2		5		3	5	6	0						100
C	AT3		5		3	5	6	0						100
E	SE		5		3	5	6	0						100
* ±3% r	nay be v	aried (CA	AT 1,2,3 -	- 50 mar	ks & ESE	E – 100 m	narks)							

			22EE	[14 - E	LECT	RICA	AL AI	ND	ELE	EC1	TRO	ONI	CS	ENG	SINE	ERI	NG						
Progran Branch	nme &	B.E. & N	lechanic	al Engi	ineerir	ng								S	Sem.	(	Categ	jory	L	т	Ρ		Credit
Prerequ	isites	Nil													2		E	6	3	0	0		3
		1																					
Preambl	е	This cou	rse is aim	ed to in	ntroduc	ice the	ne fur	ndan	mer	ntal	cor	nce	pts a	and	princ	ple	s in E	lectr	ical a	nd E	lectr	oni	CS
Unit – I		Introdu	tion																				9
Introduce Electric I Electric solving s	ction: Electr Power Syste Circuits : S simple AC ci	tric Potentia em -Electr Solving sin circuits – 3	al, Curren cal Safety pple DC C phase AC	t, Powe Aspec ircuits circuit	er and cts as p using l ss (qual	Ener per IE KVL a alitativ	rgy -I E rul and ve ar	Rene les KCL nalys	newa :L- S /sis)	/able Sing )	e ar Jle p	nd N pha:	Non se A	Ren AC ci	iewał	fun	sourc dame	es of entals	Ene - Po	gy-S wer,	Pov	ture ver	e of factor –
UNIT – I	JNIT – II         DC Machines and Transformers         9           DC MOTORS: Principle of Operation- types – back emf – torque equation - speed torque characteristics – losses and efficiency –																						
DC MOTORS: Principle of Operation- types – back emf – torque equation - speed torque characteristics – losses and efficiency – speed control of DC motor –Applications.       Transformers: Single phase Transformers – Construction and working principle – Types, Emf equation         UNIT – III       AC Machines and Drives       9         AC MOTORS: 3 phase Induction Motor -construction– Principle of operation – types – torque equation - speed torque																							
	UNIT – III AC Machines and Drives 9 AC MOTORS: 3 phase Induction Motor -construction– Principle of operation – types – torque equation - speed torque																						
AC MOTORS: 3 phase Induction Motor -construction- Principle of operation - types - torque equation - speed torque characteristics - 1 phase Induction Motor - Principle of operation- types. Synchronous Motors - construction - Principle of Operation. INDUSTRIAL APPLICATIONS: Motor Selection - factors to be considered - power rating - types of Duty cycle - selection of motors for machine tools applications, centrifugal pumps.																							
UNIT – I	V	Electron	ic Devic	es and	Circu	uits																	9
ELECTR Light em ELECTR UPS and	RONIC DEVI hitting diode RONIC CIRC d SMPS (Blo	/ICES: Cor - Principle CUITS: (Q ock Diagra	struction, s and App ualitative a m approa	princip plicatior analysis ch).	ole of c ns. s only)	opera ) Half	ation, If wav	i, typ ve ar	pes and f	and full	d Cl wa	hara	acte recti	ristio	cs: Pl capa	v ju citiv	nctio /e filt	n dio ers, z	des, ener	zene volta	er dio Ige r	ode egi	e - BJT- – ulator,
UNIT – V	V	DIGITAL	. ELECTF	ONICS	S and	INTE	EGR	ATE	ED (	CIR	CU	JITS	3										9
DIGITAL LINEAR (Qualitat	LELECTRO INTEGRAT tive analysis	DNICS: Log TED CIRC s), op-amp	gic gates, UITS: Ope applicatio	Half ad erationa ons.	dder, fu al amp	ull ad	dder, rs, Ide	, Full leal c	ll su op-a	ubtra -amp	acto p cł	or, F hara	-lip f actei	flops ristic	s and s, Inv	Asy /ert	ynchr ing a	onou nd No	s Bin on-in	ary F /ertir	Rippl Ig an	e C npl	Counter ifier
																							Total:45
TEXT B	OOK:																						
1.	Muthusubra Tata McGra	amanian.R aw Hill Pub	, Salivaha lishers, 2	nan.S a 010.	and M	lurale	eedha	aran	n.K.	A, "	"Ba	sic	Elec	ctrica	al, Ele	ectr	onics	and	Com	outei	Enç	gine	eering",
REFERE	ENCES/ MA	ANUAL / S	OFTWAR	E:																			
1.	Dubey G.K.	., "Fundam	entals of	Electric	cal Driv	ves", i	2nd	Edit	ition	n, Na	aro	osa I	Publ	lishiı	ng Ho	ous	e, Ne	w De	lhi, 2	010.			
2.	Jegathesan India, <u>20</u> 11.	n V., Vinoth	Kumar K	. and S	Sarava	anaku	umar	<sup>-</sup> R., '	"Ba	asic	Ele	ectri	ical	and	Elec	ron	ics E	ngine	erin	j", 1s	t Ed	itio	n, Wiley
3.	Mehta.V.K a 2006	and Rohit	Mehta, "P	rinciple	es of El	lectric	ical E	Engir	inee	ering	g ai	nd E	Elec	tron	ics", S	S.C	hand	& Co	. Lin	ited.	,Nev	v D	elhi,

COUR On co	SE OU mpletio	ITCOM on of t	IES: he cour	se, the st	udent	s will be a	able to							BT Mapp (Highest Le	ed evel)
CO1	apply	/ the ba	asic cond	cept of ele	ctrical	systems a	and solv	e simpl	e DC a	and AC c	ircuits			Applying (	K3)
CO2	interp	oret the	e constru	iction and	opera	tion of DC	motor a	and tran	sforme	er			U	nderstandin	g (K2)
CO3	discu indus	iss the stries	operatio	on, types a	nd cha	aracteristic	cs of AC	motors	and it	s selecti	on factor	s for	U	nderstandin	g (K2)
CO4	expla	ain the	construc	tion and c	perati	on of basi	c electro	onic dev	vices a	nd circuit	s		U	nderstandin	g (K2)
CO5	desci ampli	ribe the ifiers.	e basic c	oncepts a	nd ope	eration of	adder, s	ubtract	ors, flip	o flops ar	nd opera	tional	U	nderstandin	g (K2)
	Manning of COa with DOa and BSOa														
						Mappin	g of CC	s with	POs a	nd PSO	5				
COs/F	COs/POs         PO1         PO2         PO3         PO4         PO5         PO6         PO7         PO8         PO9         PO10         PO11         PO12         PS01         PS02														
CO	1	3	2	1	1									2	3
CO	2	3	2											1	2
CO	3	3	2	1	1									1	2
CO	4	3	2											1	2
CO	5	3	2											1	2
1 – Slig	ght, 2 -	- Mode	rate, 3 -	Substant	ial, BT	- Bloom's	Taxono	my						<u> </u>	
						ASSES	SMENT	PATTE	ERN -	THEORY	•				
Tes C	atego	om's ry*	Re	ememberi (K1) %	ng	Understa (K2)	anding %	Apply (K3)	ying %	Analyz (K4) S	ing %	Evaluating (K5) %	g Cre	eating (K6) %	Total %
	CAT1			20		60		20	)						100
	CAT2	2		30		70									100
	CAT3	3		30		70									
	ESE			20		60		20	)						100
* ±3%	may be	e varie	d (CAT 1	,2,3 – 50	marks	& ESE –	100 ma	rks)							

22TAM01 - தமிழர் மரபு														
(Common to All Engineering and Technology Branches)														
Programme & Branch     All BE / BTech Branches     Sem.     Category     L     T     P     Creck	it													
Prerequisites         Nil         2/1         HS         1         0         0         1														
Preamble தமிழர்களின் மொழி, இலக்கியம், ஓவியங்கள், சிற்பக்கலைகள், நாட்டுப்புறக் கலைக வீர விளையாட்டுக்கள், திணைக் கோட்பாடுகள், இந்திய பண்பாட்டிற்குத் தமிழர்கள பங்களிப்பைப் பற்றிய அறிவை வழங்குவதே இந்த பாடத்தின் நோக்கமாகும்.	ள், Iன்													
அலகு – 1 மொழி மற்றும் இலக்கியம் 3														
இந்திய மொழிக் குடும்பங்கள் - திராவிட மொழிகள் - தமிழ் ஒரு செம்மொழி - தமிழ் செவவிலக்கியங்கள் சங்க இலக்கியத்தின் சமயச் சார்பற்ற தன்மை - சங்க இலக்கியத்தில் பகிர்தல் அறம் - திருக்குறள மேலாண்மைக் கருத்துக்கள் - தமிழ் காப்பியங்கள், தமிழகத்தில் சமண பௌத்த சமயங்களின் தாக்க பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள் – சிற்றிலக்கியங்கள் - தமிழில் நவீன இலக்கியத்தி வளர்ச்சி - தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.	ா - ில் ம் - ஸ்													
அலகு – II மரபு - பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை – சிற்பக் கலை 3														
அலகு – II மரபு - பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை – சிற்பக் கலை 3 நடுகல் முதல் நவீன சிற்பங்கள் வரை - ஐம்பொன் சிலைகள் - பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள், பொம்மைகள் - தேர் செய்யும் கலை - சுடுமண் சிற்பங்கள் - நாட்டுப்புறத் தெய்வங்கள் - குமரிமுனையில் திருவள்ளுவர் சிலை - இசைக் கருவிகள் – மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் - தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு.														
நாதஸவரம் - தமிழர்களின் சமூக பொருளாதார வாழவில் கோவில்களின் பங்கு. அலகு – III நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுக்கள் 3														
தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஒயிலாட்டம், தோல்பாவைக் கூத் சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்.	து,													
அலகு – IV தமிழர்களின் திணைக் கோட்பாடுகள் 3														
தமிழகத்தின் தாவரங்களும், விலங்குகளும் - தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்ற புறக் கோட்பாடுகள் - தமிழர்கள் போற்றிய அறக்கோட்பாடு- சங்க காலத்தில் தமிழகத்தில் எழுத்தறில கல்வியும் - சங்ககால நகரங்களும் துறை முகங்களும் - சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்கும§ கடல்கடந்த நாடுகளில் சோழர்களின் வெற்றி.	مالا ماله ج) -													
அலகு – V இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் 3 பங்களிப்பு														
இந்திய விடுதலைப்போரில் தமிழர்களின் பங்கு - இந்தியாவின் பிறபகுதிகளில் தமிழ் பண்பாட்டின் தாக்க சுயமரியாதை இயக்கம் - இந்திய மருத்துவத்தில் சித்த மருத்துவத்தின் பங்கு – கல்வெட்டுச கையெழுத்துப்படிகள் - தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு.	ம்- ள்,													
Total	15													
TEXT BOOK:														
1. ஆ. பூபாலன், தமிழர் மரபு, VRB Publishers Pvt Ltd, 2022.														
REFERENCES														
NEI ENENOLO.														
1. தமிழக வரலாறு- மக்களும் பண்பாடும்- கே கே பிள்ளை (வெளியீடு தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)														
1.       தமிழக வரலாறு- மக்களும் பண்பாடும்- கே கே பிள்ளை (வெளியீடு தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)         2.       கணினித்தமிழ் - முனைவர் இல. சுந்தரம் (விகடன் பிரசுரம்)														
1.       தமிழக வரலாறு- மக்களும் பண்பாடும்- கே கே பிள்ளை (வெளியீடு தமிழ்நாடு பாடதால் மற்றும் கல்வியியல் பணிகள் கழகம்)         2.       கணினித்தமிழ் - முனைவர் இல. சுந்தரம் (விகடன் பிரசுரம்)         3.       கீழடி - வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம்.( தொல்லியல் துறை வெளியீடு)														

COUR	SE O		MES:		ுர்க	сіт.								BT Map	ped
CO1	ற்ப் ( தம் முட	சார் சார் சார்	நவுடல் வாழி ம	ா, மாண றற்றும் இ	வர்கள் வக்ச	ியத்தில்	மதிப்	புமிக்ச	கருத்	துக்க	ளை வி	ாக்க	Und	erstanding	g (K2)
CO2	தம	் ிழர்க	ளின் 9	ிற்பம் ம	ற்றுப்	் அவர்க	ளின் ஓ	வியங்	பகள் ப	பற்றி வ	ிளக்க (	மடியும்.	Und	erstanding	g (K2)
CO3	தம் கூ	ிழர்க ற முடி	ளின் ந யும்.	நாட்டுப்ட	យ្រ ហ	ற்றும் தற்	்காப்ட	ļக் கன	രെകത	ளைப் ப	ற்றி சுரு	க்கமாகக	5 Und	erstanding	g (K2)
CO4	தம	ிழர்க	ளின் த	நிணைக்	கோ	ட்பாடுக	ளைப்	பற்றி எ	விளக்	சு முடிப	பும்.		Und	erstanding	g (K2)
CO5	இற் பங்	5திய தே பகளிட்	தேசிய பு பற்	இயக்க றி விளக்	ற் ம க மு	)றும் இந் டியும்.	திய ப	ண்பாட	ட்டிற்கு	நத் தமி	ழர்களி	ன்	Und	erstanding	g (K2)
Mapping of COs with POs and PSOs															
COs/P	Mapping of COs with POs and PSOs           COs/Pos         PO1         PO2         PO3         PO4         PO5         PO6         PO7         PO8         PO9         PO10         PO11         PO12         PS01         PS02														
CO1							3		3	2	2		3		
CO2	2						3		3	2	2		3		
CO3	3						3		3	2	2		3		
CO4	ŀ						3		3	2	2		3		
CO5	5						3		3	2	2		3		
1 – Slię	ght, 2	– Mod	erate, 3	8 – Substa	ntial, E	3T- Bloom	's Taxor	nomy		÷					
						ASSE	SSMEN	IT PAT	FERN -	- THEO	RY				
Test C	t / Blo atego	oom's ory*	R	emember (K1) %	ing	Understa (K2)	anding %	Apply (K3)	ving %	Analyz (K4) 9	ing l %	Evaluating (K5) %	Cr (I	eating K6) %	Total %
	CAT	1		40		60									100
	CAT	2		40		60									100
	CAT	3		40		60									100
	ESE	=								NA					
* ±3%	may	be varie	ed (CAT	1,2&3-	– 50 m	narks)									

	22TAM01 - HERITAGE OF TAMI	LS												
	(Common to All Engineering and Technolog	y Branch	es)											
Programme & Branch	All BE / BTech Branches	Sem.	Category	L	т	Ρ	Credit							
Prerequisites	Nil	2/1	HS	1	0	0	1							
Preamble	The objective of this course is to impart knowledge about Tar arts, heroic games, doctrines, contribution of Tamils to Indian	nil langua i culture.	ge, literature	pain	tings,	sculp	otures, folk							
UNIT I	Language and Literature						3							
Language families in india - dravidian languages – tamil as a classical language - classical literature in tamil – secular nature of sangam literature – distributive justice in sangam literature - management principles in thirukural - tamil epics and impact of buddhism & jainism in tamil land - bakthi literature azhwars and nayanmars - forms of minor poetry - development of modern literature in tamil - contribution of bharathiyar and bharathidhasan.UNIT IIHeritage - Rock Art Paintings to Modern Art - Sculpture3														
UNIT II         Heritage - Rock Art Paintings to Modern Art – Sculpture         3           Here steps to modern sculpture         bronze isope, tribes and their herediscrifts, art of temple car molying, tribes and their herediscrifts, art of temple car molying, tribes and their herediscrifts, art of temple car molying, tribes and their herediscrifts, art of temple car molying, tribes and their herediscrifts, art of temple car molying, tribes and their herediscripts, art of temple car molying, tribes and their herediscripts, art of temple car molying, tribes and their herediscripts, art of temple car molying, tribes and their herediscripts, art of temple car molying, tribes and their herediscripts, art of temple car molying, tribes and their herediscripts, art of temple car molying, tribes and their herediscripts, art of temple car molying, tribes and their herediscripts, art of temple car molying, tribes and their herediscripts, art of temple car molying, tribes and their herediscripts, art of temple car molying, tribes and their herediscripts, art of temple car molying, tribes and their herediscripts, art of temple car molying, tribes and their herediscripts, art of temple car molying, tribes and their herediscripts, art of temple car molying, tribes and their herediscripts, art of temple car molying, tribes and their herediscripts, art of temple car molying, tribes and their herediscripts, art of temple car molying, tribes and temple car molying, tris and temple car molying, tr														
Hero stone to modern sculpture - bronze icons - tribes and their handicrafts - art of temple car making massive terracotta sculptures, village deities, thiruvalluvar statue at kanyakumari, making of musical instruments - mridhangam, parai, veenai, yazh and nadhaswaram - role of temples in social and economic life of tamils.														
UNIT III     Folk and Martial Arts     3														
Therukoothu – kara and games of tami	agattam - villu pattu - kaniyan koothu – oyillattam - leather pup Is.	petry – si	lambattam –	valar	i - tig	er dar	ice - sports							
UNIT IV	Thinai Concept of Tamils						3							
Flora and fauna c education and liter overseas conquest	of tamils & aham and puram concept from tholkappiyam an racy during sangam age - ancient cities and ports of sangar t of cholas.	id sangar n age - e	n literature - export and im	arar nport	n cor durin	ncept g san	of tamils - gam age -							
UNIT V	Contribution of Tamils to Indian National Movement and	Indian Cu	ulture				3							
Contribution of tar movement - role of	nils to indian freedom struggle - the cultural influence of ta siddha medicine in indigenous systems of medicine – inscripti	mils over ons & ma	the other panuscripts – p	arts c rint hi	of ind story	ia – s of tan	self-respect nil books.							
							Total: 15							
TEXT BOOK:														
1. S.Muthura	malingam, M.Saravanakumar, Heritage of Tamils, Yes Dee Pu	blishing F	vt Ltd, 2023.											
REFERENCES:														
1. Historical I Tamil Stuc	Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thiruna Jies).	vukarasu)	(Published b	y : In	terna	tional	Institute of							
2. The Contr Studies).	ibution of Tamil of the Tamils to Indian Culture(Dr.M.Valarma	athi)(Pupl	ished by Inte	rnatio	onal I	nstitu	te of Tamil							
3. Keeladi – Tamilnadu	'Sangam City C ivilzation on the banks of river Vaigai; (Join Text Book and Educational Services Corporation, Tamilnadu).	ntly Publi	shed by: Dep	partm	ent o	f Arch	naeology &							
<b>i</b>														

COUR On cor	SE O mplet	UTCON	MES: the c	cour	se, the s	stude	nts will be	e able to	)						BT Map Highest	ped Level)
CO1	exp	lain val	uable	e cor	ncepts in	lang	uage and	literature	e of tam	ils.				Und	erstanding	g (K2)
CO2	illus	strate at	bout	the t	amils sc	ulptur	e and thei	r painting	gs.					Und	erstanding	g (K2)
CO3	sum	nmarize	abo	ut th	e tamils	folk a	nd martial	arts.						Und	erstanding	g (K2)
CO4	exp	lain the	thina	ai co	oncept of	tamil	6.							Und	erstanding	g (K2)
CO5	exp	lain the	cont	tribu	tion of Ta	amils	to the Indi	an Natio	onal Mov	/emen	t and Ind	lian cultu	ıre.	Und	erstandin	g (K2)
									0			•				
C0a/D		<b>DO1</b>		2	DO2								<b>DO11</b>	<b>DO1</b> 2	DSO1	DSO3
CUS/P	os	PUI	PU	12	P03	PU	4 PO5	PU0	P07	P06	PU9	PUIU	PUTT	PUIZ	P301	P302
001								3		3	2	2		3		
CO2	2							3		3	2	2		3		
CO3	3							3		3	2	2		3		
CO4	1							3		3	2	2		3		
CO5	5							3		3	2	2		3		
1 – Slig	ght, 2	– Mode	erate	, 3 –	- Substar	ntial, E	3T- Bloom	's Taxor	nomy			1			1	I
	-								-							
							ASSE	SSMEN	Τ ΡΑΤΊ	ERN -	- THEOF	RY				
Tes C	t / Bl ateg	oom's ory*		Rei	member (K1) %	ing	Underst (K2)	anding %	Apply (K3)	ying %	Analyz (K4) 9	ing %	Evaluating (K5) %	Cr (I	eating <6) %	Total %
	CAT	1			40		60	)								100
	CAT	2			40		60	)								100
	CAT	3			40		60	)								100
	ESI	E							1		NA	1		1		1
* ±3%	may I	be varie	ed (C	AT 1	1,2&3-	- 50 m	narks)									

		22TAM02 - தமிழரும் தொழில்	நுட்பமும்	נ											
		(Common to All Engineering and Techno	ology Brai	nches)	1										
Prog Brar	Programme & Branch       All BE/BTech Branches       Sem.       Category       L       T       P       Credit         Prerequisites       Nil       2 / 3       HS       1       0       0       1														
Prer	equisites	Nil	2/3	HS	1	0	0	1							
முல்	ானுரை	தமிழ் கலாச்சாரத்தோடு ஒன்றிய தொழில் நுட்	பங்கனை	ா பற்றிப் எ(	டுத்த	அரை	த்த	ັບ							
ച്ചപ	)கு – I	நெசவு மற்றும் பானை தொழில்நுட்பம்						3							
சங். கீறல	க காலத்தில் ( ல் குறியீடுகள்	நெசவு தொழில் – பானைத் தொழில்நுட்பம் க	ருப்பு சி	வப்பு பாண்	டங்	கள்	- ப	ாண்டகளில்							
அல சங்க வில வழி அம் சென கப்ப வரன தொ எலு அல கான செப வரன	சுக்கு கல்ப்படி மற்றும் கட்டுமானங்கள் & சங்க காலத்தில் வீட்டுப்பொருட்களில் வடிவமைப்பு – சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் & சங்க காலத்தில் வீட்டுப்பொருட்களில் வடிவமைப்பு – சங்க காலத்தில் கட்டுமான பொருட்களும் நடுகல்லும் – சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் – மாமல்லபுரச்சிற்பங்களும், கோவில்களும் – சோழர் காலத்து பெருங்கோயில்கள் மற்றும் பிற வழிபாட்டுத் தலங்கள் – நாயக்கர் காலக் கோயில்கள் –மாதிரிகட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் – செட்டிநாட்டு வீடுகள் – பிரிட்டிஷ் காலத்தில் சென்னை இந்தோ-சாரோசெனிக் கட்டிடக் கலை.           அலகு – III         உற்பத்தித் தொழில்துட்பம்         3           கப்பல் கட்டும் கலை – உலோகவியல் – இரும்புத் தொழிற்சாலை – இரும்பை உருக்குதல், எஃகு – வரலாற்றுச்சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் – நாணயங்கள் அச்சடித்தல் – மணி உருவாக்கும் தொழிற்சாலைகள் – கல்மணிகள் – கண்ணாடி மணிகள் – சுடுமண் மணிகள் – சங்கு மணிகள் – எலும்புத்துண்டுகள் – தொல்லியல் சான்றுகள் – சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.         3           அனை, ஏரி, குளங்கள், மதகு – சோழர்கால குமிழித் தாமிப்வி முக்கியத்துவம் – காலந்டை பராமரிப்பு – காலந்டைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் – வேளாண்மை மற்றும் வேளாண்மை சார்ந்த செயல்பாடுகள் – கடல்சார் அறிவு – மீன்வளம் – முத்து மற்றும் முத்துக்குளித்தல் – பெருங்கடல் குறித்த														
	ாடைய அறுவு - பாடைய அறுவு -	- அறுவுசார சமூகம். விலையல் தலில் மல் தனினிச்சலில்						3							
அறி மெ அக	வியல் தமிழிஎ ன்பொருட்கள் ராதிகள் சொ <u>ர்</u>	ு அறுவியல் தமிழ் மற்தும் கணாலாத்தமிழ் ன் வளர்ச்சி – கணினிதத்தமிழ் வளர்ச்சி – தமி உருவாக்கம் – தமிழ் இணையக் கல்விக்கழகம் றகுவைத் திட்டம்.	ிழ் நூல்ச – தமிழ் ι	ளை மின்ப மின் நூலகப்	பதிட் ம் – (	വ പ്ര ട്രുഞ	)சய் னய	தல் – தமிழ் த்தில் தமிழ் Total:15							
TEX															
1.	தமிழக வரல கல்வியில் பல	ாறு - மக்களும் பண்பாடும் - கே கே பிள்ளை (வெ னிகள் கழகம்), உலகத் தமிழாராய்ச்சி நிறுவனเ	iளியீடு த ம், சென்	நமிழ்நாடு ப னை, 2002	ாட	ரல்	மற்ற	فالإ							
2.	கணினிக்கமி	ிழ் முனைவர் இல. சுந்தரம், விகடன் பிரசுரம், 201	16												
REF	ERENCES:														
1.	கீழடி-வைகை	க நதிக்கரையில் சங்ககால நகர நாகரிகம்.(தொ	ல்லியல்	துறை வெஎ	ៅឃ(	ይ)									
2.	பொருநை-ஆ	ற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளி	யீடு)												
3.	3. Social Life of Tamils (Dr.K.K.Pillay) A joint Publication of TNTB & ESC and RMRL – (in print)														
4.	Social Life of the	e Tamils – The Classical Period (Dr.S.Sigaravelu) (Publish	ned by: Int	ernational Inst	titute	of Ta	amil S	Studies).							
5.	Historical Herita Tamil Studies)	ge of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunav	rukarasu) (	Published by	: Inte	ernatio	onal I	nstitute of							
6.	The Contribution	n of the Tamil to Indian Culture (Dr.M.Valarmathi) (Puplish	ned by Inte	rnational Insti	tute	of Ta	mil St	udies).							
7.	Keeladi – 'Sang Tamilnadu Text	am City Civilzation on the banks of river Vaigai; (Jointly P Book and Educational Services Corporation, Tamilnadu)	ublished b	y: Department	t of /	Archa	eolog	jy &							
8.	Studies in the H	listory of India with Special Reference to Tamilnadu (Dr.K.	K.Pillay) (I	Published by:	The	Autho	or)								
9.	Porunai Civilizat Corporation, Ta	tion (Jointly Published by: Department of Archaeology & T milnadu)	amilnadu	Textbook and	Edu	catio	nal Se	ervices							

10.	Journey of	Civilizati	ion Ir	ndus	to Vaigai	(R.Bala	ıkrishnaı	n) (Pub	lished by	: RMR	L) – Rei	erence E	Book.			
COUF	COURSE OUTCOMES: BT Mapped படிப்பை முடித்தவுடன், மாணவர்கள் (Highest Level)															
ЦЦЦ	ைப் முடித்	ந்துவுட <sub>6</sub>	о, ш	- - - - - - - - - - - - - - - - - - -	்	<u> </u>				_				(	nignest i	_evel)
CO1	தமிழ கலாசசாரம் மற்றும் தமிழ சமூகத்தினுடைய நெசவு மற்றும் பானை தொழில்நுட்பம் பற்றி விளக்க முடியும்.       Understanding (K2)         CO2       தமிழர்களின் வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்ப ஆற்றல் பற்றி விளக்க       Understanding (K2)															
CO2	CO2 தமிழர்களின் வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்ப ஆற்றல் பற்றி விளக்க முடியும். CO3 கமிமர்களின் உற்பக்கிக் தொழில்நுட்பம் பற்றி சுருக்கமாகக் கூற முடியும். Understanding (K2)															
CO3	CO3 தமிழர்களின் உற்பத்தித் தொழில்நட்பம் பற்றி சுருக்கமாகக் கூற முடியும். Understanding (K2)															
CO4	CO4 தமிழர்களின் வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில்நுட்பம் பற்றி விளக்க முடியும்.															
CO5	CO5 தமிழர்களின் அறிவியல் தமிழ் மற்றும் கணினித்தமிழ் பற்றி விளக்க முடியும். Understanding (K2)															
	ப்பிட்டு தய்யில் விற்காமல் தயிர் நிற்றாம் கண்ணு தற்று நிற்று விளக்க முக்கிற்கு பிருநிலும் (vz)															
	Mapping of COs with POs and PSOs															
CC	COs/POs     PO1     PO2     PO3     PO4     PO5     PO6     PO7     PO8     PO9     PO10     PO11     PO12     PS01     PS02															
	CO1         3         3         2         2         3         3         2         2         3         3         3         2         2         3         3         3         2         2         3         3         3         2         2         3         3         3         2         2         3         3         3         2         2         3         3         3         2         2         3         3         3         2         2         3         3         3         2         2         3         3         3         3         2         2         3         3         3         3         3         3         3         2         3															
	CO1     3     3     2     2     3       CO2     3     3     3     2     2     3															
	CO2     3     3     2     2     3       CO3     3     3     3     2     2     3															
	CO4							3		3	2	2		3		
	CO5							3		3	2	2		3		
1 – SI	ight, 2 – Mo	derate,	3 – S	Subst	tantial, BT	- Bloon	n's Taxo	nomy								
						ASS	ESSME		TTERN -	- THEC	ORY					
Test	/ Bloom's C	ategory	/*	Rem	nembering (K1) %	g Un	derstan (K2) %	ding	Applyin (K3) %	ng A	nalyzinę (K4) %	g Eva (K	luating (5) %	Crea (K6)	ting ) %	Total %
	CAT1				40		60									100
	CAT2				40		60									100
	CAT3				40		60									100
	ESE									N	A					
* ±3%	may be va	ried (CA	AT 1,	,2,3 -	- 50 mark	s)										

	22TAM02 - TAMILS AND TECH	NOLOGY											
	(Common to All Engineering and Techn	ology Brand	ches)	I	1								
Programm Branch	& All BE/BTech Branches	Sem.	Category	L	т	Ρ	Credit						
Prerequisi	es Nil	2/3	HS	1	0	0	1						
Preamble	This course aims to impart the essential knowledge on the tar	nil culture and	d related techno	logy									
UNIT – I	WEAVING AND CERAMIC TECHNOLOGY						3						
Weaving In	ustry during Sangam Age – Ceramic technology – Black and Red W	/are Potterie	s (BRW) – Graf	fiti on	Potte	eries.							
UNIT – II	DESIGN AND CONSTRUCTION TECHNOLOGY						3						
Designing stones of S Temples of Nayakar Ma	nd Structural construction House & Designs in household materia angam age – Details of Stage Constructions in Silappathikaram Cholas and other worship places – Temples of Nayaka Period – nal – Chetti Nadu Houses, Indo – Saracenic architecture at Madras	Is during Sa – Sculptures Type study ( during British	angam Age – B s and Temples (Madurai Meena n Period.	uildin of Ma akshi	g ma amal Temj	aterial lapura ole) –	s and Hero am – Great - Thirumalai						
UNIT – III	JNIT - III       MANUFACTURING TECHNOLOGY       3         Art of Ship Building - Metallurgical studies - Iron industry - Iron smelting, steel - Conner and gold - Coins as source of history												
Art of Ship Minting of ( evidences -	Art of Ship Building – Metallurgical studies – Iron industry – Iron smelting, steel – Copper and gold – Coins as source of history – Ainting of Coins – Beads making – industries Stone beads – Glass beads –Terracotta beads –Shell beads/ bone beats – Archeological avidences – Gem stone types described in Silappathikaram.												
UNIT – IV	NIT – IV AGRICULTURE AND IRRIGATION TECHNOLOGY 3												
Dam, Tank Agriculture Specific So	Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Period, Animal Husbandry – Wells designed for cattle use – Agriculture and Agro Processing – Knowledge of Sea – Fisheries – Pearl – Conche diving – Ancient Knowledge of Ocean – Knowledge Specific Society.												
UNIT – V	pecific Society.         INIT – V       SCIENTIFIC TAMIL & TAMIL COMPUTING       3												
Developme Academy –	t of Scientific Tamil – Tamil computing – Digitalization of Tamil Bramil Digital Library – Online Tamil Dictionaries – Sorkuvai Project.	ooks – Deve	lopment of Tan	nil So	ftwar	e – T	amil Virtual						
							Total:15						
TEXT BOO	S:												
1. Socia	Life of Tamils (Dr.K.K.Pillay) A joint Publication of TNTB & ESC and	d RMRL – (in	print)										
2. Socia	Life of the Tamils – The Classical Period (Dr.S.Sigaravelu) (Publish	ed by: Intern	ational Institute	of Ta	mil S	tudie	s).						
REFEREN	ES:												
1. தமிழ பண	க வரலாறு - மக்களும் பண்பாடும் - கே கே பிள்ளை (வெ கள் கழகம்), உலகத் தமிழாராய்ச்சி நிறுவனம், சென்னை	ளியீடு தமி எ, 2002	ழ்நாடு பாடந	ரல் ப ப	ற்ற	யம் ச	ல்வியில்						
2. கண	னித்தமிழ் முனைவர் இல. சுந்தரம், விகடன் பிரசுரம், 201	6											
3. கீழம	வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம்.(தொ	ல்லியல் து	றை வெளியீடு	9)									
4. பொ	நநை ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளிட	பீடு											
5. Histo Studi	<ul> <li>Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukarasu) (Published by : International Institute of Tamil Studies)</li> </ul>												
6. The C	ontribution of the Tamils to Indian Culture (Dr.M.Valarmathi)(Puplish	ed by Interna	ational Institute	of Tar	nil St	udies	s).						
7. Keela Text	li – 'Sangam City Civilzation on the banks of river Vaigai; (Jointly Pu ook and Educational Services Corporation, Tamilnadu)	Iblished by: [	Department of A	Archae	eolog	y & T	amilnadu						
8. Studi	s in the History of India with Special Reference to Tamilnadu (dr.K.K	K.Pillay) (Pub	lished by : The	Autho	r)								
9. Poru Corp	ai Civilization (Jointly Published by: Department of Archaeology & Taration, Tamilnadu)	amilnadu Tex	ktbook and Edu	cation	al Se	ervice	S						
10. Journ	y of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RM	RL) – Refere	ence Book.										

COUR On co	SE OUTCOMES: mpletion of the course, the students will be able to	BT Mapped (Highest Level)										
CO1	explain weaving and ceramic technology in tamil culture and tamil society.	Understanding (K2)										
CO2	Illustrate about the design and construction technology.	Understanding (K2)										
CO3	summarize about the manufacturing technology.	Understanding (K2)										
CO4	explain the agriculture and irrigation technology.	Understanding (K2)										
CO5	explain the significance of tamil in scientific and computing.	Understanding (K2)										
	Manning of COs with POs and PSOs											

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	P011	PO12	PSO1	PSO2
CO1						3		3	2	2		3		
CO2						3		3	2	2		3		
CO3						3		3	2	2		3		
CO4						3		3	2	2		3		
CO5						3		3	2	2		3		
1 – Slight, 2	2 – Mode	erate, 3 –	Substant	ial, BT- B	loom's Ta	axonomy								
	ASSESSMENT PATTERN – THEORY													

		////										
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %					
CAT1	40	60					100					
CAT2	40	60					100					
CAT3	40	60					100					
ESE				NA		-						
* ±3% may be va	* ±3% may be varied (CAT 1,2,3 – 50 marks)											

		2	2CYL2	2 –CHE	MISTRY	Y LABC	ORATO			IANICAL	SYSTEMS	;			
			(Con	nmon to	Mecha	nical, N	lechatro	nics an	d Autor	mobile br	anches)				
Progra Branch	ımme & n	B.E - brand	Mecha ches	nical, N	lechatr	onics a	and Aut	omobil	е	Sem.	Category	L	т	Ρ	Credit
Prereq	uisites	Nil								2	BS	0	0	2	1
Preaml	ble DF EXPERI	This calori analy Fe, N <b>MENTS</b>	course metric, tical ca i, S, Ca / EXER	aims pH met bability & Mg, I <b>CISES:</b>	to impa eric, po to engir DO, CO	art the otentiom neering D in me	basic netric, s student echanica	concep pectrop s. It als al applic	ts of whotome to aims cations.	volumetri etric expe to impar	c, conducto eriments and t the knowle	ometrie d there edge c	c, c eby on th	complex to impl he estin	cometric, rove the nation of
1	Determin	ation of s	strength	of an u	nknowr	n solutio	on using	pH me	ter.						
2.	Analysis	and com	parison	of the s	strength	of acid	s in the	given n	nixture	using cor	nductivity me	eter.			
3.	Potentior	netric ap	proach	using a	Pt elec	trode fo	or the es	timatior	n of iron	in the gi	iven sample				
4.	Spectrop	hotometi	ric meth	od for tl	ne detei	rminatic	on of Iro	n in stee	el.						
5.	Determination of molecular weight of a polymer / liquid by Ostwald viscometer.														
6.	Volumetric analysis of nickel by complexometric method.														
7.	Estimation of sulphur present in fuel using electro-analytical techniques.														
8.	Assessment of the given water sample for the suitability of drinking / industrial purpose by estimating the calcium,magnesium and total hardness by EDTA method.														
9.	Determin	ation of	dissolve	ed oxyge	en in the	e given	wastew	ater sar	mple.						
10.	Determin	ation of	COD of	the give	en wast	ewater	sample.								
11.	Electropla	ating pro	cess (D	emonst	ration).										
12.	Proximate coal (Der	e analysi nonstrati	is of Co on).	al - dete	ermine r	noisture	e, volatil	e matte	er and a	sh conte	nt of a giver	n samp	ole d	of	
															Fotal:30
REFER	RENCES/ N	IANUAL	/SOFT	WARE:											
1.	Palanisa Rajagana	ny P.N., apathy P	Manika ublisher	ndan P. s. Erod	., Geeth e. 2022	a A. an	ıd Manjı	ıla Rani	i K., "Cł	nemistry	Laboratory I	Manua	al", <sup>-</sup>	1 <sup>st</sup> Editio	on,
				-,	-,										
COUR On cor	SE OUTCO	OMES: f the co	urse. th	e stude	ents wil	l be ab	le to						E (Hi	3T Map ighest L	ped .evel)
CO1	estimate	the hard	ness, D	O and C	COD pre	esent in	the give	en wate	er samp	le.			A P	pplying recision	(K3), (S3)
CO2	analyze t	he amou	int of Fe	, Ni, co	nductivi	ty and p	oH of the	e given	solutio	n.			A	pplying recision	(K3), (S3)
CO3	demonsti sulphur c	ate the v	iscome	ter for tl	he dete	rminatic	on of mo	lecular	weight	of polym	er and		Al Pi	pplying recision	(K3), (S3)
					Марр	ing of (	Cos witl	h POs a	and PS	Os					
COs/P	s/POs PO1 PO2 PO3 PO4 PO5 PO6 PO7 PO8 PO9 PO10 PO11 PO12 PS01 PS02														
CO1	3	2	1	3			3								
CO2	2 3	2	1	3			3								
CO3	3 3	2	1	3			2			_					
1 – Slig	ght, <mark>2 – Mo</mark>	derate,	3 – Sub	stantial	, BT- B	loom's	Taxono	my			<u>.</u>				

		2	2EEL1	4 - ELE	CTRICA		ELEC	TRONIC	S ENG	INEER	ING LAE	BORATOR	Y			
Progra Branci	amme h	e &	B.E -	Mecha	nical E	nginee	ring				Sem.	Categor	y L	т	Ρ	Credit
Prerec	quisite	es	Nil								2	ES	0	0	2	1
Pream	ble		To pr	ovide kr	owledg	e about	basic o	concept	s in elec	ctrical a	nd electr	onics engi	neering	I		
LIST C	OF EX	PERIN	IENTS	/ EXER	CISES:											
1.	Resis	stor col	or codir	ng and v	verificati	on of O	hm's La	aw and	Kirchho	ff's Law	/S					
2.	Com	outatio	n of Cu	rrent in a	a Loop	using M	esh an	alysis								
3.	Spee	d cont	rol of D	C shunt	motor											
4.	Load	test or	n single	phase t	ransfor	ner										
5.	Load	test or	n three	phase ir	nduction	motor										
6.	Speed control of Three phase induction motor using PWM inverter															
7.	Characteristics of BJT															
8.	Implementation of Half wave and Full wave Rectifier with simple Capacitor Filter															
9.	Verification of logic gates															
10.	10. Op-amp based Inverting and Non-Inverting amplifiers															
															-	Fotal:30
REFE	RENC	ES/ M	ANUAL	/SOFT	WARE:											
1.	Lab	oratory	/ Manua	al												
COUR On co	SE O mplet	UTCO	MES: the co	urse. th	e stude	ents wil	l be ab	le to					BT (Higl	' Ma hes	apped t Level)	)
CO1	sele	ect and	apply v	arious l	aws for	the spe	cific ele	ectric cir	cuits				App Mar	lyin nipu	g (K3), lation (S	52)
CO2	perf	orm su	uitable t	ests and	d analyz	e the p	erforma	nce of r	otating	machin	es and		Ana Mar	Iyzi nipu	ng (K4) lation (S	, S2
CO3	nte	rpret tifier a	the open open of the open of the open open of the open	eration s)	and ch	aracter	istics c	of elect	ronic d	evices	(BJT, C	DP-AMP,	App Mar	lyin nipu	g (K3), lation (S	52
	Mapping of Cos with POs and PSOs															
COs/P	Os	PO1	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	PO11	PO12	2	PSO1	PSO2
CO1	1	3	2	1	1			3							2	3
CO2	2	2	3	2	2	1		3							3	2
CO3	3	3	2	1	1		, .	2							2	3
i – Slię	gnτ, 2		ierate, :	s – Sub	stantial	, вт-в	oom's	iaxono	my							

		22GCL11 – Foundation Laboratory - Manufacturing,	Design	and Roboti	cs									
Drogra		(Common to All BE/BTech branches	s)		1									
Brancl	imme& h	All BE/BTech branches	Sem.	Category	L	Т	Ρ	Credit						
Prereg	luisites	Nil	1/2	ES	0	0	6	3						
Pream	This course is designed to provide foundational knowledge on engineering with hands-on experier on developing a prototype model with the basic knowledge of Computer-aided Design, Manufactur Processes, 3D Printing Technology, Robotics and Embedded Control.													
LIST C	F EXPERIN	IENTS / EXERCISES:												
		PART A – Manufacturing (30 Hour	rs)											
1.	Selection of	of product, free hand sketching and detailing												
2.	Constructi	on of model using Arc/TIG/MIG/Gas/Spot welding operations	S											
3.	Enhancing the model with sheet metal         Creating the parts of the model using lathe													
4.	Creating the parts of the model using lathe													
5.	Creating the parts of the model using milling and drilling machines													
	PART B – Product Design and Development (30 Hours)													
1.	Free hand sketching and detailing of the component													
2.	Free hand sketching and detailing of the component         3D part modelling of the component using CAD software													
3.	3D part modelling of the component using CAD software         Engineering Analysis of the component model													
4.	Generate	the component using 3D printer												
5.	Value add router	dition to the produced component using CNC milling mac	hine, C	NC laser cu	tting	mac	hine	and CNC						
		PART C – Robotics (30 Hours)												
1.	Design of	electronic circuit and its debugging												
2.	Interfacing	g of sensors, actuators and wireless communion modules wit	th micro	controller										
3.	Assembly	of Tracker Robot with accessories												
4.	Developm	ent of control strategies for motion control, path planning an	d obsta	cle avoidance	e									
5.	Demonstr	ation and testing of Robot in static environment												
DEFE		ANULAL (2057)//105						Total:90						
	Laborator	ANUAL /SOFTWARE:												
2.	AutoCAD	2020 and SOLID WORKS 2018 Software												
COUR On col	SE OUTCOI	MES: the course, the students will be able to			E (	BT M High	appec est Le	l evel)						
CO1	1develop the prototype model using mechanical operations like welding, forming and machining processesApplying (K3), Precision (S3)													
CO2	sketch 3D model and enhance the prototype using modern machines like 3D printer, CNC milling machine, CNC Laser cutter and CNC RouterApplying (K3), Precision (S3)													
CO3	design and	d develop the autonomous robot for real-time applications			A F	Apply Precis	ing (K sion (S	3), 33)						

Mapping o	f COs v	with PO	s and F	SOs										
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3		2				3	2		2		
CO2	3	3	3		3				3	2		2		
CO3	3	3	3		2				3	2		2		
1 – Slight, 2	1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy													

22ITC32 - INTRODUCTION TO PYTHON											
(Common to Civil, Mechanical, Chemical& Automobile Engineering branches)											
Programme & BranchBE- Civil, Mechanical, Automobile & BTech – Chemical Engineering branchesSem.CategoryLTPCategory	edit										
Prerequisites         ProblemSolvingandProgramming in C         3/4         ES         3         0         2	4										
Preamble         This course deals with core python programming. It gives a comprehensive introduction to problem solving python constructs and libraries.	using										
Unit – I Introduction:	9										
Problem solving strategies – program design tools – Types of errors – Testing and Debugging- Basics: Literals – variables and identifiers – data types – input operation – comments – reserved words – indentation – Operators and Expressions – Decision C Statements: Introduction – conditional statement – iterative statements – Nested Loops – break, continue and pass statements - inloops.	ontrol - else										
Unit – II Lists, Tuples and Dictionary:	9 doloto										
operations, assignments, returning multiple values, nested tuples, index and count method – Dictionary: Create, access, a modify, delete, sort, looping, nested, built-in methods – list vs tuple vs dictionary.	idd and										
Unit – III Strings and Regular Expressions:	9										
Strings: Concatenation, append, multiply on strings – Immutable – formatting operator – Built-in string methods and functions	- slice										
finditer functions – flag options.											
Unit – IV Functions and Modules:	9										
Functions: Introduction – definition – call – variable scope and lifetime – return statement – function arguments – lambda fur documentation strings – programming practices recursive function- Modules: Modules – packages – standard library me functionredefinition.	nction – thods –										
Unit – V Object Orientation:	9										
Class and Objects: Class and objects – class methods and self – constructor – class and object variables – destructor – public a private data member. NumPy : NumPy Arrays – Computation on NumPy Arrays. Matplotlib : Line plots – Scatter Plots	ind										
LIST OF EXPERIMENTS / EXERCISES:											
1. Programs using conditional and looping statements											
2. Implementation of list and tuple operations											
3. Implementation of dictionary operations											
4. Perform various string operations											
5. Use regular expressions for validating inputs											
6. Demonstration of different types of functions and parameter passing											
7. Develop programs using classes and objects											
8. Perform computation on Numpy arrays											
9. Draw different types of plots using Matplotlib											
Lecture:45, Practical:30, Total:75											
TEXT BOOK:											
1. Reema Thareja., "Python Programming using problem solving approach", 3 <sup>rd</sup> impression, Oxford University Press., New 2017.	Delhi,										
REFERENCES/ MANUAL / SOFTWARE:											
1. Nageswara Rao, "Core Python Programming", 2 <sup>nd</sup> Edition, DreamTech Press, New Delhi, 2018.											
2. Jake Vander Plas, "Python Data Science Handbook Essential Tools for Working with Data", O'Reilly Publishe 1 <sup>st</sup> Edition,2016.	rs,										

COUR On cor	SE O mplet	UTCOM ion of t	IES: he cours	se, the st	udents	will be a	able to							BT Map (Highest	oped Level)
CO1	use	basic P	ython co	onstructs to	build s	imple pr	ograms							Applying Precisio	(K3), n(S3)
CO2	app	ly list, tu	iple, and	dictionary	to hand	dle a var	iety of d	ata.						Applying Precisio	(K3), n(S3)
CO3	app	ly string	s and re	gular expr	essions	for sear	ching ar	nd retrie	val					Applying Precisio	(K3), n(S3)
CO4	solv	e the pr	oblems u	using func	tions an	d modul	es.							Applying Precisio	(K3), n(S3)
CO5	CO5 apply object-oriented concepts and perform basic data science operations using Python Applying(K3), Precision(S3)														
	Menning of Coo with DOo and DOOo														
Cos/P	0	PO1	PO2	PO3	PO4				POS			PO11	PO12	PSO1	PSO2
003/1	<u>03</u>	2	2	1 03	104	105	100	107	100	103	1010	1011	1012	1001	1002
	/1 )2	3	2	1	1										
	<u>,</u> 3	3	2	1	1										
CC	)4	3	2	1	1										
CC	)5	3	2	1	1										
1 – Slig	ght, 2	- Mode	rate, 3 –	Substant	al, BT-	Bloom's	Taxono	my			1				1
						ASSE	SSMEN	IT PAT	FERN -	- THEO	RY				1
Tes	t/Ble	oom's	Re	memberi	ng U	Indersta	nding	Apply	/ing	Analyzi	ng	Evaluating	C	reating	Total %
C	atego	ory*		(K1) %		(K2)	%	(K3)	%	(K4) 🤋	%	(K5) %		(K6) %	
	CAT	1		10		15		75	5						100
		2		10		15		75	) -						100
		კ -		10		15		75	-						100
* . 20/ .	ESE			10	marka °	15	100 ma	/5 (ko)	)						100
±3%	may L	e vane		,∠,3 – 30	110115 0	LOE -	TUU mai	N3)							

## 22MEC31 - FLUID MECHANICS AND HYDRAULIC MACHINES

			1	Ι		1	1										
Program Branch	ime &	B.E. & Mechanical Engineering	Sem.	Category	L	т	Р	Credit									
Prerequi	isites	Physics for Mechanical Engineering	3	ES	3	0	2	4									
Preamble	I his course provides an introduction to the properties and behavior of fluids under static and dynamic conditions. It introduces dimensional analysis and performance analysis of hydraulic machines.																
Unit - I Fluid Properties and Statics 9																	
Fluid Properties: Definition of Fluid - Classifications - Properties - Mass Density - Specific Weight - Specific Gravity - Viscosity - Compressibility - Vapour Pressure - Surface Tension - Capillarity. Fluid Statics: Pascal's Law - Pressure Variation in a Fluid at Rest - Absolute Pressure - Gauge Pressure - Atmospheric Pressure - Vacuum Pressures - Simple Manometer - Differential Manometer - Hydrostatic Forces.																	
Unit - II Fluid Kinematics and Dynamics 9																	
<ul> <li>Velocity Potential Function and Stream Function. Fluid Dynamics: Momentum – Energy - Euler's Equation of Motion along a Streamline – Bernoulli's Equation and Applications – Venturimeter – Orificemeter - Pitot Tube.</li> </ul>																	
Unit - III Flow through Pipes and Dimensionless Number 9																	
Flow through Pipes: Flow of Viscous Fluid through Circular Pipe - Loss of Energy in Pipes Loss of Energy due to Friction (Darcy- Weisbach and Chezy's formula) - Minor Energy losses - Pipes in Series - Pipes in Parallel - Boundary Layer Concepts. DimensionlessNumber: Dimensional Analysis - Dimensionless Number.																	
Unit - IV	1	Impact of Jet and Hydraulic Turbines						9									
Impact of Jet: Impact of Jets - Work Done and Force Exerted by a Liquid on Moving Flat Vanes - Efficiency - Work Done and Force Exerted by a Liquid on Unsymmetrical Moving Curved Vane - Efficiency - Velocity Triangles. Hydraulic Turbines: Classifications - Design - Work Done and Efficiencies of Pelton Wheel Turbine - Francis Turbine - Kaplan Turbine - Velocity Triangles - Specific Speed of Turbines.																	
Unit – V Hydraulic Pumps 9																	
Definitions of Heads - Efficiencies and Work Done of a Centrifugal Pump - Velocity Triangles - Cavitation - Specific Speed of Pumps																	
- working Principles of Single Acting and Double Acting Reciprocating Pump - Basic Principles of Indicator Diagram.																	
LIST OF EXPERIMENTS / EXERCISES:																	
1.	Determination of Co-efficient of Discharge using Venturimeter.																
2.	Determination of Co-efficient of Discharge using Orificemeter																
3.	Identify Major / Minor Loss of Energy in Flow through Pipes																
4.	Performance Test on Pelton Turbine / Francis Turbine (constant head method).																
5.	Evaluate the Performance Characteristics of Reciprocating Pump.																
6.	Evaluat	e the Performance Characteristics of Centrifugal Pump.															
Lecture:45, Practical:30, Total:75																	
TEXT BOOK:																	
1.	Sukumar Pati. "Fluid Mechanics and Hydraulic Machines". 1 <sup>st</sup> Edition, Mc Graw Hill Education, Chennai, Reprint, 2018.																
REFERENCES:																	
1.	Subrar	nanya K., "Fluid Mechanics and Hydraulic Machines", 2 <sup>nd</sup> Edition	, Mc Grav	w Hill Education, C	henna	i, 202	.1.										
2.	Bansal	R.K., "Fluid Mechanics and Hydraulic Machines", 11th Edition, La	axmi Publ	ications, New Dell	ni, 202 <sup>-</sup>	1.											
COURS On com	SE OI	UTCOI on of th	MES: ne co	: urse	, the stud	ents wi	ll be able	e to							(1	BT Map Highest I	ped _evel)
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CO1	und	derstan	nd the	e fluic	d properti	es and	study the	e pressi	ure meas	surem	nents	6				Applying Precisior	(K3) (S3)
CO2	solv	ve the	probl	lems	related to	kinem	atics and	d dynam	nics of flu	uid flo	w.				M	Applying anipulatio	(K3) on (S2)
CO3	calo	culate	the e	nerg	y losses i	n flow	through p	oipes.							M	Applying anipulatio	(K3) on (S2)
CO4	inte	erpret t	he w	ork d	one and o	efficien	cies of v	arious h	ydraulic	turbir	nes.				M	Applying anipulatic	(K3) on (S2)
CO5	det	ermine	e the	work	done and	d efficie	encies by	the var	ious hyd	Iraulio	c pur	nps.			Ma	Applying anipulatio	(K3) on (S2)
	Mapping of COs with POs and PSOs       COs/POs     PO1     PO12     PSO1     PSO2																
COs/PC	Mapping of COs with POs and PSOs         COs/POs       PO1       PO2       PO3       PO4       PO5       PO6       PO7       PO8       PO9       PO10       PO11       PO12       PSO1       PSO2																
CO1	Ds         PO1         PO2         PO3         PO4         PO5         PO6         PO7         PO8         PO9         PO10         PO11         PO12         PS01         PS02           3         2																
CO2		3	2	2	3	3									2		
CO3	;	3	2	2	3	3									2		
CO4		3	2	2	3	3							1		2		
CO5	;	3	2	2	3	3							1		2		
1 – Slig	ht, 2	– Mod	erate	e, 3 –	Substant	tial, BT	- Bloom's	s Taxon	omy								
							ASS	ESSME		TERI	N – 1	THEORY					
Test Ca	t / Blo atego	oom's ory*		Re	memberi (K1) %	ng l	Jndersta (K2)	nding %	Applyi (K3)	ing %	Ana ۲)	alyzing <4) %	Evalı (K5	uating 5) %	Creat (K6)	ing %	Total %
	CAT	1			15		25		60								100
	CAT	2			15		25		60								100
	CAT	3			15		25		60								100
	ESE	Ξ			10		30		60								100
* ±3% n	nay b	e varie	ed (C	AT 1	,2,3 – 50	marks	& ESE -	- 100 ma	arks)								

	22MET31 - MANUFACTURING TEC	CHNOLOG	Y											
Programm Branch	e & B.E. & Mechanical Engineering	Sem.	Category	L	Т	Р	Credit							
Prerequisi	tes Physics for Mechanical Engineering	3	PC	3	0	0	3							
Preamble	To provide the basic concepts and techniques of metal casti processes and fundamentals of additive manufacturing proces	ing process sses.	ses, deformatior	n proce	esses,	specia	al welding							
Unit - I	Metal Casting Processes						9							
Introduction for Sand ( Alloys - D	n - Classification - Types of Casting Processes - Pattern: Types Casting - Properties - Cores: Types - Applications - Heating - P irectional Solidification - Design: Runner - Riser - Gate.	- Material · ouring - C	- Allowances - I ooling - Solidif	Moldin ication	g Sano of Pu	d - Pr ire Mi	eparation etals and							
Unit - II	Special Casting Processes						9							
Expendab – Plastic I Casting –	e Mold Casting Processes – Shell Molding – Vacuum Molding – E Aold Casting – Ceramic Mold Casting – Permanent Mold Castin Squeeze Casting – Slush Casting – Defects in Casting.	Expanded g – Die Ca	Polystyrene Pro asting – Centrif	ocess - lugal C	<ul> <li>Investant</li> </ul>	stmen I – Co	it Casting ontinuous							
Unit - III	Unit - III         Welding Processes         9           Introduction – Fusion Welding Processes: Arc Welding – Gas Welding – Resistance Spot Welding – Electron Beam Welding – Laser         9													
Introductio Beam We Welding –	n – Fusion Welding Processes: Arc Welding – Gas Welding – Resis ding – Electro Slag Welding – Thermit Welding – Solid State Diffusion Welding – Explosive Welding – Friction Welding – Ultras	stance Spo Welding onic Weldi	t Welding – Elec Processes: Frid ng – Soldering :	ctron B ction S and Br	eam V Stir We azing.	Veldin elding	ig – Laser – Forge							
Unit - IV         Metal Forming Processes         9           Pulk Deformation Processes         Hot Working and Cold Working Processes         Pulkage														
Closed Die Extrusion Sheet Met Operation	Bulk Deformation Processes – Hot Working and Cold Working Processes – Rolling Process – Types: Transverse Rolling – Thread Rolling – Shape Rolling – Ring Rolling – Tube Piercing – Skew Rolling. Forging Process – Types: Open Die Forging – Closed Die Forging – Upsetting - Swaging – Radial forging – Roll Forging. Extrusion Process – Types: Direct Extrusion – Indirect Extrusion – Hydrostatic Extrusion. Drawing Process – Types: Wire Drawing – Deep Drawing – Rod Drawing – Tube Drawing. Sheet Metal Operations: Shearing – Blanking - Punching – Slotting – Perforating – Notching –Trimming – Shaving – Bending Operations: Flanging – Hemming – Seaming – Curling – Ironing – Coining - Embossing.													
Unit - V	Fundamentals of Additive Manufacturing (AM)						9							
Introduction Application Laser Sint Direct Met	n to AM – Classification of AM Processes – Types of Material ns and Limitations of: Stereolithography – Fused Deposition Mod ering – Selective Laser Melting, Directed Energy Deposition bas al Deposition – Electron Beam Based Metal Deposition, Wire Arc	s Used in Ieling – La ed AM Pro <u>Additive M</u>	AM Processes minated Object ocesses: Laser anufacturing.	s – Pri t Manu Engin	inciple ifacturi eered	s, Pa ing – Net S	rameters, Selective Shaping –							
							Total:45							
TEXT BOC	K:					_								
1. R	ao P.N. "Manufacturing Technology - Foundry, Forming and Weldin d., New Delhi, 2017.	ıg", Volume	e - 1, 4 <sup>th</sup> Edition	, McGı	aw Hil	l Edu	cation Pvt							
REFEREN	CES:													
1. S N	erope Kalpakjian, Steven R. Schmid. "Manufacturing Engineering ar ew Delhi, 2019.	nd Technol	ogy", 7 <sup>th</sup> Edition,	Pears	on Ed	ucatio	n Limited,							
2. K	aushish J. P."Manufacturing Processes", 2 <sup>nd</sup> Edition, PHI Learning Pv	∕t. Ltd., Nev	w Delhi, 2014.											
3. S	harma P.C. "Manufacturing Technology - I", 5 <sup>th</sup> Edition, S. Chand and	d Company	Private Limited	, New I	Delhi, 2	2010.								
4. H P	ajraChoudhury S.K., Hajrachoudhury A.K., Nirjharroy "Elements or romoters & Publishers Private Limited, Mumbai, 2019.	of Worksł	nop Technology	- Vol.	I", 15 <sup>th</sup>	Editi	on, Media							
5. la D	n Gibson, David W Rosen, Brent Stucker, "Additive Manufacturing T igital Manufacturing", 2 <sup>nd</sup> Edition, Springer, New York, 2015.	echnologie	s: 3D Printing, F	Rapid F	Prototy	ping, a	and Direct							

COURS On com	SE O	UTCOI on of th	MES ne co	: ourse	e, the stu	dents	will b	e abl	le to								(⊦	BT Mappe lighest Le	ed vel)
CO1	exp	plain th	e pri	incip	les involv	ed in	metal	cas	ting pro	cesses							Une	derstanding	g (K2)
CO2	des	scribe t	he p	orinci	ples and	proc	esses	invol	lved in s	pecial c	astin	g pr	rocess				Und	derstanding	g (K2)
CO3	der	nonstra	ate t	he p	rinciples i	nvolv	red in	vario	ous welc	ling tech	nnique	es					Une	derstanding	g (K2)
CO4	illus	strate t	he n	nech	anisms ir	volv	ed in d	liffere	ent kind	s of met	tal for	min	ig proce	esses				Applying (ł	(3)
CO5	des	scribe t	he p	orinci	ples of di	ffere	nt addi	itive	manufa	cturing p	oroce	sse	s				Und	derstanding	g (K2)
	Mapping of COs with POs and PSOs           COs/POs         PO1         PO12         PSO1         PSO2																		
COs/POs         PO1         PO2         PO3         PO4         PO5         PO6         PO7         PO8         PO9         PO10         PO11         PO12         PS01         PS02																			
CO1	x03         x03																		
CO2		3		1															3
CO3		3		1															3
CO4		3		1															3
CO5		3						3										3	3
1 – Sligl	ht, 2	– Mod	erate	e, 3 -	- Substar	ntial,	BT- BI	oom	's Taxoi	nomy	1								
								ASS	SESSM	ENT PA	TTE	RN -	– THEO	ORY					
Test Ca	/ Blo atego	oom's ory*		Re	memberi (K1) %	ng	Unde (	ersta K2) <sup>(</sup>	nding %	Apply (K3)	ring %	Ar (	nalyzin (K4) %	g	Evaluatin (K5) %	g	Cr (	reating K6) %	Total %
	САТ	1			25			75											100
	CAT	2			25			75											100
	CAT	3			10			65		25									100
	ESE	8			10			70		20									100
* ±3% m	nay b	be varie	ed (C	CAT	1,2,3 – 50	) ma	'ks & E	ESE	– 100 m	narks)	1								

	22MET32 - ENGINEERING THER	MODYNAMI	cs												
Programme & Branch	B.E. & Mechanical Engineering	Sem	Category	L	т	Р	Credit								
Prerequisites	Nil	3	PC	3	1	0	4								
			1												
Preamble	This course aims to transfer the fundamental knowledge applications. In addition, this course covers the properties of	ge on therm of steam, gas	odynamic laws es and atmosphe	and the ric air.	ir rele	evan	t practical								
Unit - I	Basic Concepts and First Law of Thermodynamics						9+3								
Basic Concepts Isolated System Temperature an Thermodynamic (SFEE) with refe	Microscopic and Macroscopic Thermodynamics - Therm - Concept of Continuum - Property - State - Path - nd Heat - Specific Heat Capacities - Internal Energy - es. First Law of Thermodynamics: Law - Application to Clo rence to Thermal Equipments.	nodynamic S Process - C Enthalpy - sed and Op	System - Closed Cycle - Quasi-Sta Work - Modes en Systems - Sta	d Syster atic Pro of Wor eady Flo	m - C cess k - Z ow Er	pen - C erot ergy	System - oncept of h Law of v Equation								
Unit - II         Second Law of Thermodynamics         9+3           Kelvin-Planck Statement - Clausius Statement - Efficiency - Carnot Cycle - Carnot's Theorem - Heat Engine - Reversed Carnot Cycle -         9+3															
Kelvin-Planck St COP - Refrigera Concept of Entro	elvin-Planck Statement - Clausius Statement - Efficiency - Carnot Cycle - Carnot's Theorem - Heat Engine - Reversed Carnot Cycle - OP - Refrigerator - Heat pump - Reversibility - Irreversibility - Thermodynamic Temperature Scale - Inequality of Clausius. Entropy - concept of Entropy - Principle of Increase of Entropy - Absolute Entropy - Basic Concepts of Exergy.														
Unit - III	Init - III Properties of Pure Substances														
Unit - III         Properties of Pure Substances         9+3           Properties of Pure Substances - Thermodynamic Properties of Pure Substances in Solid Phase - Liquid Phase - Vapour phase — Gibbs         Gibbs           Phase Rule - p-v Diagram - p-T Diagram - T-s Diagram - h-s Diagram - pvT Surfaces. Steam - Formation of Steam - Thermodynamic         Gibbs           Properties of Steam - Use of Steam Tables and Mollier Chart - Calculations of Work Done and Heat Transfer in Non-Flow and Flow         Processes.															
Unit – IV	Ideal, Real Gases and Thermodynamic Relations						9+3								
Avogadro's Law Compressibility Differentials - To Kelvin Coefficien	<ul> <li>Concept of Ideal and Real Gases and its Properties -</li> <li>Compressibility Chart - Dalton's Law of Partial Pressu</li> <li>IS Equations - Difference and Ratio of Heat Capacities - Mat.</li> </ul>	Equation of re - Gas M xwell's Equa	State - Van der lixtures. Thermoo litions - Clausius-	Waals dynamic Clapeyre	Equa Rela on Eq	tion tions uatic	of State - s - Exact on - Joule-								
Unit – V	Psychrometry						9+3								
Definition - Prop Processes - Se Evaporative Coc	perties of Atmospheric Air - Calculations of Properties of Ainsible Heating - Sensible Cooling - Cooling and Dehumidif Ing - Basic Problems.	ir-Vapour Miz ication - Hea	xtures - Psychror ating and Humidi	netric C fication	hart - - Adia	Psy abati	chrometric c Mixing -								
			Lectu	re:45, T	utoria	al:15	, Total:60								
TEXT BOOK:															
1. Nag P.I	K., "Engineering Thermodynamics". 6 <sup>th</sup> Edition, McGraw Hill E	Education (In	dia) Pvt. Ltd., Che	ennai, 20	)17.										
REFERENCES:															
1. Claus E	Borgnakke, Richard E. Sonntag. "Fundamentals of Thermody	namics". 10 <sup>th</sup>	Edition, Wiley, U	.S., 201	9.										
2. Yunus J Hill Edu	A. Cengel, Michael A. Boles and Mehmet Kanoglu. "Thermod ication Pvt. Ltd.,New Delhi, 2019.	ynamics: An	Engineering App	roach".	9 <sup>th</sup> Ed	tion	, McGraw								

COURS On com	SE O	UTCOI	MES ne co	: ourse	, the stude	ents v	vill be abl	e to							BT Map (Highest	ped Level)
CO1	rec	cognize	the	basic	concepts	s of th	ermodyna	amic pro	cesses	and fi	rst law of	thermod	ynamics		Applyi	ng (K3)
CO2	sol	lve the	prob	lems	by applyi	ng the	e second	law of th	ermody	namio	s				Apply	ng (K3)
CO3	ар	ply the	therr	mody	namic pro	pertie	es of pure	substar	nces usii	ng ste	am table	•			Applyi	ng (K3)
CO4	dis	tinguis	h the	e beha	avior of re	al & i	deal gase	s and de	erive the	therr	nodynam	nic relatio	ns		Applyi	ng (K3)
CO5	ар	ply the	psyc	chrom	netric cond	cepts	in various	proces	ses						Apply	ng (K3)
	1															
Mapping of COs with POs and PSOs           COs/POs         PO1         PO1         PO12         PSO1         PSO2																
COs/PC	Os/POs         PO1         PO2         PO3         PO4         PO5         PO6         PO7         PO8         PO9         PO10         PO11         PO12         PS01         PS02           CO1         2															
CO1	1         3         1 <th1< th=""> <th1< th=""> <th1< th=""> <th1< th=""></th1<></th1<></th1<></th1<>															
CO2		3			3									2		3
CO3		3			3									2		3
CO4		3	2	2	1									2		3
CO5		3	2	2	3									2		3
1 – Sligl	ht, 2	– Mod	erate	e, 3 –	Substant	ial, B	T- Bloom'	s Taxon	omy							
							ASS	ESSME		TERI	N – THE	ORY				
Test Ca	/ Bl ateg	oom's ory*		Rei	nemberir (K1) %	ng	Underst (K2)	anding %	Apply (K3)	ing %	Analyz (K4) 9	ng %	Evaluatin (K5) %	g	Creating (Ke	i) Total %
	CAT	1			15		25		60							100
	CAT	2			15		25		60							100
	CAT	3			15		25		60							100
	ES	E			5		25	i	70							100
* ±3% m	nay I	be varie	ed (C	CAT 1	,2,3 – 50	mark	s & ESE -	– 100 ma	arks)			·		·		·

		22MET33 - STRENGTH OF MATERIALS						
Progra Branch	mme & 1	B.E. & Mechanical Engineering	Sem.	Category	L	т	Ρ	Credit
Prereq	uisites	Engineering Mechanics	3	PC	3	0	0	3
				I	1	1		
Pream	ole	The course provides the various properties of materials, defectively cylinders, spherical shells, types of beams, bending stresses and columns, torsion on circular shaft and springs.	ormable deflectio	bodies, biax on of beams.	kial It a	state Iso ir	of s nparts	tress, thin design of
Unit –		Deformation of Solids						9
Stabilit Diagra Plastic Therm	ty – Stre m of Cat s and Ru al Stress	ength – Stiffness – Tensile – Compressive and Shear stresse st iron – Steel – Aluminium – Copper – Brass – Al <sub>2</sub> O <sub>3</sub> – Glass ubber – Poisson's ratio –Lateral Strain – Simple andCompound es. Strain Energy: Uniaxial Loads – Gradually Applied Load – Sud	es – St – Com I bars – Idenly A	rain – Comp modity Plast Relation betv pplied Load a	oara ics veer nd l	tive – Hig n Ela: mpac	Stres Ih Pe stic C t Load	s – Strain rformance onstants – d.
Unit –		Analysis of State of Stress						9
Biaxial Stresse Stress	State of es at a Po	Stress – Thin Cylinders and Shells – Deformation in Thin Cylir oint on Inclined Planes – Principal Planes and Stresses – Mohr	nders ar 's Circle	d Spherical for Biaxial \$	She Stre	lls. E ss- N	laxial Iaxim	Stresses: um Shear
Unit –		Transverse Loading on Beams						9
Types and O Carryir	i – Trans verhangii ng Capac	verse Loading in Beams – Shear Force and Bending Moment ing Beams – Point of Contraflexure. Stresses in Beams: Theory o bity.	n Beam f Simple	s – Cantilev Bending – A	ers Ana	– Sir ysis	nply S of Str	Supported ess- Load
Unit –	IV	Deflection of Beams						9
Elastic Methoo Ratio -	Curve of d and Ma - Rankine	Neutral Axis of the Beam Under Normal Loads – Evaluation of Be caulay's Method. Columns: End Condition – Equivalent Length o s's Formula for Columns.	am Defl of Colun	ection and Sl nn – Euler's	ope Equ	– Do ation	uble   – Sle	Integration enderness
Unit –	V	Torsion on Circular Shafts and Springs						9
Torsion Steppe Stiffne	n – Shea ed Shaft. ss and D	r Stress Distribution – Hollow and Solid Circular Section – Torsion Torsion on Springs: Wahl's Correction Factor of Springs Stresse eflection of Springs Under Axial Load.	nal Rigid es in He	ity – Torsiona lical Springs	al S Uno	tiffne der T	ss – 7 orsior	Forsion on n Loads –
								Total:45
TEXT E	BOOK:							
1.	Rajput F	R.K. "Strength of Materials". 7 <sup>th</sup> Edition, S.Chand & Co., New Delhi, 2	2018.					
REFER	ENCES:							
1.	Rattan S	S.S. "Strength of Materials". 3 <sup>rd</sup> Edition, Tata McGraw Hill Education	Private I	td., New Del	hi, 2	016.		
2.	Timoshe 2010.	enko S.P. "Elements of Strength of Materials". 10th Edition, Tata M	McGraw	Hill Publishir	ng C	omp	any, N	New Delhi,

COUR On cor	SE O	UTCON on of the	IES: e cours	se, the stu	dents v	vill be abl	e to						(	BT Mapp Highest L	oed .evel)
CO1	cal	culate th	ne stre	ss, strain a	nd stra	ain energ	/ of simpl	e bars						Applyin	ig (K3)
CO2	ana	alyze the	e biaxia	al state of	stresse	es at a po	nt in a bo	ody, thin	cylind	ers and	spherica	l shells		Analyzir	ng (K4)
CO3	cor bea	nstruct th ams	he she	ar force a	id ben	ding mom	ent diagr	ams an	d analy	ze the b	ending s	tresses of		Analyzir	ng (K4)
CO4	esti	imate th	ie slop	e and the	deflect	ion of bea	ms and s	strength	s of the	e column	IS			Analyzir	ng (K4)
CO5	ana	alyze the	e torsic	nal behav	ior of s	hafts and	coil sprir	ngs						Analyzir	ng (K4)
	Mapping of Cos with POs and PSOs														
COs/F	Mapping of Cos with POs and PSOs         COs/POs       PO1       PO2       PO3       PO4       PO5       PO6       PO7       PO8       PO9       PO10       PO11       PO12       PS01       PS02														
CO	CO1         3         2         1         Cos         FO6         FO7         FO6         FO3         FO10         FO11         FO12         FS01         FS02           C01         3         2         1														
CO	2	3	2	3									1		3
CO	3	3	2	3									1		3
CO	4	3	2	3									1		3
CO	5	3	2	3									1		3
1 – Slię	ght, 2	- Mode	erate, 3	<ul> <li>Substa</li> </ul>	ntial, B	T- Bloom	s Taxono	omy							
						ASSE	SSMENT	PATTE	ERN –	THEOR	(				
Tes C	t / Ble atege	oom's ory*	F	Remembe (K1) %	ring	Unders (K2	tanding 2) %	Apply (K3)	ying ) %	Analyz (K4) 9	ing %	Evaluating (K5) %	) C	reating (K6) %	Total %
	CAT	1		10		1	0	50	)	30					100
	CAT	2		10		1	0	50	D	30					100
	CAT	3		10		1	0	50	)	30					100
	ESE	Ξ		10		1	0	50	)	30					100
* ±3%	may t	be varie	d (CAT	1,2,3 – 5	) mark	s & ESE ·	– 100 ma	rks)							

		22MNT31 - ENVIRONMENTAL SCIEN	CE												
		(Common to All BE/BTech branches)													
Progra Branch	mme & 1	All B.E/B.Tech Branches	Sem.	Category	L	Т	Ρ	Credit							
Prereq	uisites	Nil	3/6	MC	2	0	0	0							
Preamb	ble	This course provides an approach to understand the variou pollution control & monitoring methods for sustainable life a awareness for engineering students on biological sciences.	is natura and also	I resources, to provide I	ecos	syster ledge	m, bio e and	o-diversity, to create							
Unit – I		Environmental Studies and Natural Resources						5							
Introdu resourc	ction to Envin	onmental Science – uses, over-exploitation and conservation c lies	of forest,	water, miner	al, fo	ood, e	energy	/ and land							
Unit – I	1	Ecosystem and Biodiversity						5							
Ecosys Food w and Co	Cosystems: concept and components of an ecosystem -structural and functional features – Functional attributes (Food chain and Food web only). Biodiversity: Introduction – Classification – Bio geographical classification of India- Values of biodiversity – Threats and Conservation of biodiversity - case studies.         Unit – III       Environmental Pollution       5         Environmental Pollution: Definition – causes, effects and control measures of: (a) Air pollution - Climate change, global warming.														
Unit – I	Unit – III         Environmental Pollution         5           Environmental Pollution: Definition – causes, effects and control measures of: (a) Air pollution - Climate change, global warming,														
Enviror acid rai	Environmental Pollution: Definition – causes, effects and control measures of: (a) Air pollution - Climate change, global warming, acid rain, ozone layer depletion (b)Water pollution (c) Soil pollution - Role of an individual in prevention of pollution - case studies.														
acid rain, ozone layer depletion (b)Water pollution (c) Soil pollution - Role of an individual in prevention of pollution - case studies.Unit – IVEnvironmental Monitoring5															
Sustain - Introc (prever	Unit – IV         Environmental Monitoring         5           Sustainability -three pillars of sustainability- factors affecting environmental sustainability-approaches for sustainable development         -           - Introduction to EIA - objectives of EIA - environment protection act – air (prevention and control of pollution) act – water (prevention and control of pollution) act.         -														
Unit – V	V	Introduction to Biological Science						5							
Functio nucleus & meios	ons of Carbol s- Heredity an sis - Cell cycl	hydrates, lipids, proteins and nucleic acids - Cells and its organd DNA - organization of DNA in cells - Genes and chromosom e and molecules that control cell cycle.	anelles - es- Cell	plasma men division -Typ	nbrar es of	ne, m cell	itocho divisio	ondria and on- mitosis							
								Total:25							
TEXT E	BOOK:														
1.	Anubha Ka Internationa	ushik, and Kaushik C.P., "Environmental Science and Eng I Pvt. Ltd., New Delhi, 2018, for Unit-I, II, III, IV.	lineering	", 6th Multic	olou	r Edi	tion,	New Age							
2.	Rastogi.SC 2008, for Ur	"Cells and Molecular Biology", 2 <sup>nd</sup> Edition, reprint, New Age Ir it-V.	nternatio	nal (P) Limite	ed Pu	ublish	ers, N	New Delhi,							
REFER	ENCES:														
1.	Palanisamy Education, I	P.N., Manikandan P., Geetha A., Manjula Rani K., Kowsh New Delhi, Revised Edition 2019.	alya V.N	I., "Environm	enta	l Sci	ence"	, Pearson							
2.	Mukhtar Ah	mad, "Text book of modern biochemistry", Volume I & II, Oxford	& IBH Pu	ublishing Co.	Pvt.	LTD,	Delhi	i, 1995.							
L L															

COUR On co	SE O mplet	UTCON	IES: the cou	rse, the st	udent	s will be a	able to						(	BT Mapp Highest L	oed evel)
CO1	illus	trate the	e variou	s natural re	sourc	es and rol	e of indi	vidual f	or its c	onservat	tion		Ur	nderstandii	ng (K2)
CO2	elab	orate th	ne featu	res of ecos	ystem	and biodi	versity t	o find th	ne nee	d for con	servatio	า.	Ur	nderstandii	ng (K2)
CO3	mar	nipulate	the sou	rces, effect	s and	control m	ethods of	of variou	us envi	ronment	al polluti	on.		Applying	(K3)
CO4	mak	ke use c	of the kn	owledge of	EIA a	ind enviro	nmental	legislat	ion lav	vs toward	ds sustai	nability.		Applying	(K3)
CO5	expl	ain the	functior	s of carbol	nydrat	es, lipids,	proteins	, nuclei	c acids	s, Cells a	ind its or	ganelles	Ur	nderstandii	ng (K2)
						Mannin	a of CO	s with	POs a	nd PSO	8				
COs/F	POs PO1 PO2 PO3 PO4 PO5 PO6 PO7 PO8 PO9 PO10 PO11 PO12 PS01 PS02														
CO	1	2	1					3							
CO	2	2	1					3							
CO	3	3	2	1				3							
CO	4	3	2	1				3							
CO	5	3	1												
1 – Slię	ght, 2	– Mode	erate, 3	- Substanti	al, BT	- Bloom's	Taxono	my							
						40050					,				
Tes	st / Bl	oom's	R	ememberi	na	ASSES Understa	anding		vina		ina	Evaluating	n C	reating	Total
C	Catego	ory*		(K1) %		(K2)	%	(K3)	%	(K4)	%	(K5) %		(K6) %	%
	CAT	1		25		35		40	)						100
	CAT	2		25		35		40	)						100
	CAT	3		NA											
	ESE	Ξ		NA											

\* ±3% may be varied (CAT 1, 2 – 50 marks)

	22ME	L31 - MANUFACTURING TECHNOLOGY AND MATERIA		ERTY TEST	ING L	ABOR	ATORY	1					
Progra Branc	amme & h	B.E. & Mechanical Engineering	Sem.	Category	L	т	Р	Credit					
Prerec	quisites	Nil	3	PC	0	0	2	1					
Pream	ble	This course imparts hands-on training to various meta essential mechanical properties of various materials	al additi	on, forming	proce	sses a	nd dete	ermination of					
		MANUFACTURING TECHNOLOGY L	ABORA	TORY									
LIST C		MENTS / EXERCISES:											
1.	Prepare a	Mold by using Solid /Split/Loose-piece Patterns and Mold for	or Hollov	w Objects wit	h the	help of	Core.						
2.	Produce D	Different Weld by Gas Tungsten Arc Welding (GTAW)/ Gas	Metal Ar	c Welding (G	MAW	) Opera	ations.						
3.	Perform G	Bas Cutting and Produce Different Weld by Gas Welding and	d Spot W	elding Operation	ations								
4.	Make a Square/Rectangular Rod by Hand Forging Operation.												
5.	Demonstrate The Injection Molding Operation by Producing Different Plastic Components.												
		MATERIAL PROPERTY TESTING L	ABORA	TORY									
1.	Tension T	est of Mild Steel and Aluminium Specimens.											
2.	Double Sh	near Test of Mild Steel and Aluminium Specimens.											
3.	Torsion Te	est of Mild Steel Specimen.											
4.	Deflection	Test of Cantilever Beam and Simply Supported Beam (Alu	minium,	Steel and W	ood).								
5.	Test on He	elical Springs (Open and Closed Coil).											
								Total:30					
REFE	RENCES/ M	IANUAL /SOFTWARE:											
1.	HajraChou Promoters	udhury S.K. ,Hajrachoudhury A.K., Nirjharroy "Elements s & Publishers Private Limited, Mumbai, 2008.	of Work	shop Techn	ology	- Vol.l'	', 14 <sup>th</sup> E	dition, Media					
2.	Rajput R.ł	K. "Strength of Materials". 7 <sup>th</sup> Edition, S.Chand & Co., New I	Delhi, 20	18									
3.	Laboratory	y Manual.											

COURSE	OUTCO	MES:											BT Map	bed	
On compl	etion of t	ne course	e, the st	udents	will be a	able to							(Highest L	.evel)	
CO1	select s	uitable p	aramete	ers and	prepare	mould	and we	ld joints	6.				Applying Manipulatio	(K3) n (S2)	
CO2	perform	metal fo	rming p	rocesse	es, prod	uce me	tal parts	and pl	astic co	mponent	S.		Applying Manipulatic	(K3) on (S2)	
CO3	determi	ne the te	nsile an	d doubl	e shear	test of	various	s materi	ials.				Applying Manipulation	(K3) on (S2)	
CO4	CO4estimate the torsion and deflection test of various materials.Applying (K3) Manipulation (S2)														
	Manipulation (S2)														
					Ма	pping c	of COs v	with PC	)s and	PSOs					
COs/PO	s PO	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	
CO1	1	2		3					3	2				3	
CO2	1	2		3					3	2				3	
CO3	1	2		3					3	2				3	
CO4	1	2		3					3	2				3	
1 – Slight	, 2 – Moc	erate, 3	- Subst	antial, E	BT- Bloc	m's Ta	xonomy	,							

		2	2MEL3	2 - MA		DRAWI	NG US	SING AU	TOCA	D LABO	RATORY				
Programm Branch	e &	B.E. &	Mecha	nical E	ngineer	ring				Sem.	Category	L	т	Р	Credit
Prerequisi	tes	Nil								3	PC	0	0	2	1
Preamble		This c commu compo	ourse i inicate nents.	mparts the neco	the kr essary f	nowledg technica	je on l al inform	National nation re	and equired	Internati I for mar	onal Standa nufacture an	ard o Id ass	f dra emb	awing Iy of n	and to nachine
LIST OF EX	<b>XPERIN</b>	IENTS /	EXERC	ISES:											
1. Stu	idy of G	D&T Sys	stems w	ith BIS	Standa	rds and	Types	of Keys,	Pins u	ised in N	lachines.				
2. Dra	aw the C	Conversi	on of Iso	ometric	View to	Orthog	raphic	View of S	Simple	Machine	e Componen	its.			
3. Dra	aw Orth	ographic	views	of Squa	re and I	Hexago	nal Bolt	and Nut							
4. Dra	aw the A	Assemble	ed Secti	onal vie	ews of G	Bib and	Cotter	Joint.							
5. Dra	aw the A	Assemble	ed Secti	onal vie	ws of K	lnuckle	Joints.								
6. Dra	aw the A	Assemble	ed Secti	onal vie	ws of F	lange c	oupling	•							
7. Dra	aw the A	Assemble	ed Secti	onal vie	ews of S	imple E	ccentri	С.							
8. Dra	aw the A	Assemble	ed Secti	onal vie	ews of N	lachine	Vice.								
9. Dra	aw the F	-lange C	oupling	front vi	ew, side	e view a	nd top	view usir	ng Auto	DCAD.					
10. Dra	. Draw the Knuckle Joint front view, side view and top view using AutoCAD.														
	Total:30														
REFEREN	CES/ M	ANUAL	/SOFTV	VARE:											
1. Bh	att N. D	., Panch	al V.M.,	"Machi	ne Drav	wing", 4	0 <sup>th</sup> Editi	on, Char	otar P	ublishing	g House P∨t.	Ltd.,	Guja	irat, 20	)16.
2. Sic 20	lheswar 04.	<sup>-</sup> N., Kar	naiah F	P., Sast	ry V.V.	, "Mach	ine Dra	awing",27	<sup>7th</sup> Rep	orint, Tat	a-McGraw I	Hill Ed	ducat	tion, C	hennai,
3. Na Pu	rayana blishers	K. L., ł Limited,	Kannaia NewDe	h P., a elhi, 201	and Red 19.	ddy K.\	/enkata	"Machi	ne Dra	awing",	6 <sup>th</sup> Edition,	New	Age	Interr	national
COURSE C	OUTCO	MES:											BT	Марр	bed
On complet	tion of t	ne cours	e, the st	tudents	will be a	able to							(Hig	hest L	.evel)
CO1 de	monstra	ate the b	asic cor	ncepts a	Ind BIS	conven	tions of	machine	e drawi	ng			Apply Manip	ving (K pulatio	3) n (S2)
CO2 de	monstra	ate and e	evaluate	the pro	jections	s, sectio	ning, lin	nits, fits a	and tole	erance		/	Apply Manir	ving (K oulatio	3) n (S2)
CO3 co	nstruct nventio	assemble ns	ed secti	onal vie	ws of m	iechanio	cal com	ponents	confor	ming to I	BIS	Aj M	oplyir anipu	ng (K3 ulation	) (S2)
					Mappir	ng of C	os with	POs an	d PSC	)s					
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	? P	SO1	PSO2
CO1	3				3				3			·		3	2
CO2	3				3				3					3	2
CO3	3				3				3					3	2
CO3 C0 CO3 C0 CO5/POS CO1 CO2 CO3	nstruct and an	assemble ns PO2	PO3	onal vie	Ws of m Mappir PO5 3 3 3	ng of C PO6	os with	POs an	conform d PSC PO9 3 3 3 3	ming to I Ds PO10	BIS P011	P012	Manip polyir anipu 2 P	pulation ng (K3 ulation SO1 3 3 3	n (S2) ) (S2) PSO2 2 2 2 2

			22EGL31 -	COMMU	NICATION	SKILLS D	EVELOPN	IENT LA	BORATOR	Y			
			(0	Common to	o All Engin	eering and	Technolog	gy Branch	es)				
Program Branch	me &	All B.E.	/B.Tech B	ranches			Se	em.	Category	L	т	Р	Credit
Prerequi	sites	Nil					3	/ 4	HS	0	0	2	1
Preamble	9	This cou professi	urse is desi onal comm	igned to im nunication	npart neces skills.	ssary skills	to listen, s	peak, rea	d and write	in order	to ob	tain be	tter
LIST OF	EXPERIM	IENTS / EX	XERCISES	6:									
1.	Self I	ntroductio	n & Mock I	nterview									
2.	Job	Applicatior	n letter with	Resume									
3.	Pres	entation: A	Technical	topic / Pro	oject report	& a Case	study						
4.	Situa	tional Dial	ogues / Te	lephonic C	conversatio	ons							
5.	Grou	p Discussi	on										
6.	Read	ling Aloud											
7.	Liste	ning Comp	rehension										
8.	Writi	Writing Company Profiles											
9.	Prep	Preparing reviews of a book/product/movie											
10.	Pron	Pronunciation Test											
													Total: 30
REFERE	NCES/ M	ANUAL /S	OFTWARE	:									
1.	Lab	oratory Ma	anual										
2.	Ore	II Digital La	anguage La	ab Softwar	re								
0011505		450											
On com	bletion of	₩E5: the cours	e. the stud	lents will	be able to					н (Н	31 Ma iahes	apped st Leve	D
CO1	enha	nce effecti	ve listening	g and read	ing skills					Und	erstar	nding (k	(2),
CO2	acqu	ire profess	ional skills	required for	or workpla	ce/higher e	ducation			A Nat	pplyir uraliz	ng (K3) ation (S	, 35)
CO3	use E	English lan	guage skill	s effective	ly in variou	is situation	S			A	pplyir	ng (K3)	, ,
										Ar	licula	tion (54	+)
				Ма	pping of C	COs with P	Os and P	SOs					
COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	F	PO11	PO12
CO1									2	3			3
CO2									2	2			2
CO3									2	2			2
1 – Sliaht	t, 2 – Mod	erate, 3 –	Substantia	l, BT- Bloo	m's Taxon	omy	I	1		1			1

	22MAT41 - NUMERICAL METHODS FOR ENG	SINEERS					
	(Common to Civil, Mechanical, Mechatronics, Automobileand Foo	d Techno	ology Branches	5)			
Programme & Branch	BE - Civil,Mechanical,Mechatronics, Automobile and BTech - Food Technology Branches	Sem.	Category	L	Т	Р	Credit
Prerequisites	Nil	4	BS	3	1	0	4
Preamble	To impart knowledge in interpolation, numerical differentiation and i algorithms to identify roots of algebraic and transcendental equatior and partial differential equations.	ntegratior	n. Also develop Ive linear syste	skill em of	s to a equa	pply n tions,	umerical ordinary
Unit – I	Solution to Algebraic and Transcendental Equations:						9+3
Iteration method – elimination method	Method of false position – Newton-Raphson method – Solution of lin and Gauss – Jordan method – Iterative methods: Gauss Jacobi and G	ear syste auss – Se	m of equation eidel methods.	s – C	Direct	metho	ods: Gauss
Unit – II	Interpolation:						9+3
Interpolation with e forward and backw difference formula.	qual intervals: Newton's forward and backward difference formulae - ard interpolation formulae – Interpolation with unequal intervals: Lag	<ul> <li>Central grange's</li> </ul>	difference int interpolation f	erpola ormu	ation Ia – I	formul Newto	ae: Gauss n's divided
Unit – III	Numerical Differentiation and Integration:						9+3
Differentiation using rule – Simpsons 3/8	Newton's forward, backward and divided difference formulae – Nume <sup>th</sup> rule – Double integrals using Trapezoidal and Simpson's rules.	erical integ	gration: Trape	zoida	l rule	– Sim	osons 1/3rd
Unit – IV	Numerical Solution of First order Ordinary Differential Equation	ns:					9+3
Single step method methods: Milne's pr	s: Taylor series method – Euler method – Modified Euler method edictor corrector method – Adam's Bashforth method.	<ul> <li>Fourth</li> </ul>	order Runge	Kutta	a met	hod –	Multi step
Unit – V	Solutions of Boundary Value Problems in PDE:						9+3
Solution of one din equation – Solution	ensional heat equation – Bender –Schmidt recurrence relation – Co of two dimensional Laplace equations – Solution of Poisson equation.	rank – Ni	icolson metho	d – C	Dne d	imensi	onal wave
			Lectur	e:45	, Tuto	orial:1	5, Total:60
TEXT BOOK:							
1. Veerarajar	T, Ramachandran T., "Numerical Methods", 1 <sup>st</sup> Edition, McGraw Hill E	Education	,Chennai, 201	9.			
REFERENCES:							
1. Sankara R	ao. K., "Numerical Methods for Scientists and Engineers", 3 <sup>rd</sup> Edition, P	Prentice H	all of India Pvt	. Ltd,	New	Delhi,	2007.
2. Steven C.	Chapra, Raymond P. Canale., "Numerical Methods for Engineers", 7 <sup>th</sup> E	Edition, M	cGraw-Hill Ed	ucatio	on, 20	)14.	
3. Sastry, S.S	, "Introductory Methods of Numerical Analysis", 5 <sup>th</sup> Edition, PHI Learnir	ng Pvt. Lto	d, 2015.				
4. Ramana B	V, "Higher Engineering Mathematics", 1 <sup>st</sup> Edition, Tata McGraw-Hill Po	ublishing	Company Limi	ted, I	New [	Delhi, 2	2006.
l							

COURS On cor	SE Ol nplet	UTCOM ion of th	ES: ne course	e, the stud	lents wi	ll be able	to							BT Mapp (Highest L	ed evel)
CO1	app	ly variou	is numerio	cal techniq	ues to s	olve alge	braic and	d transce	endenta	l equatio	ons.			Applying	(K3)
CO2	perf	form inte	rpolation	on given d	ata usin	g standaı	d numer	rical tech	niques					Applying	(K3)
CO3	und	erstand	the conce	epts of num	nerical d	ifferentiat	ion and i	integratio	on					Applying	(K3)
CO4	com	npute the	e solution	of first ord	er ordina	ary differe	ential equ	uations b	y nume	erical tecl	hnique	S		Applying	(K3)
CO5	арр	ly variou	is numerio	cal techniq	ues for s	solving p	artial diff	ferential	equatio	ns.				Applying	(K3)
						Маррі	ng of Co	os with	POs an	d PSOs					
Cos/P	Os	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1	0 PO11	PO	12 PSO1	PSO2
CO	1	3	2	1											
CO2	2	3	2	2											
CO	3	3	3	2											
CO4	4	3	2	1											
CO	5	3	3	3											
1 – Slig	ht, 2	– Moder	rate, 3 – S	Substantial	, BT- Blo	om's Tax	konomy					L		<u>.</u>	
						ASSE	SSMENT	PATTE	RN – T	HEORY					
Tes	st / Bl Categ	oom's orv*	Re	memberii (K1) %	ng	Understa (K2)	inding %	Apply (K3)	/ing %	Analyzi (K4) 9	ing %	Evaluating (F	(5)	Creating (K6) %	Total %
	CAT	1		10		10		80	)	-		-		-	100
	CAT	2		10		10		80	)	-		-		-	100
	CAT	-3		10		10		80	)	-		-		-	100
	ESI	E		10		10		80	)	-		-		-	100
* ±3% r	may b	e varied	I (CAT 1,2	2,3 – 50 ma	arks & E	SE – 100	marks)	·					·		- ·

			22MET41 -	THERM	AL ENGINEEI	RING								
	(Use of Steam Table and Refrigeration Table are permitted for the End Semester Examination)  Programme & D.F. & Machanizat Engineering													
Progra Branci	nmme & h	B.E. & Mecha	nical Engineering				Sem.	Category	L	т	Ρ	Credit		
Prereq	uisites	Engineering Hydraulic Mae	Thermodynamics, chines	Fluid	Mechanics	and	4	PC	3	0	0	3		
Pream	ble	This course p combustion er along with the	rovides an extensive ngines, boilers, nozzlo performance calculation	knowle es, turbii ons. And	dge on the w nes, air comp also it provide	orking ressors	of diffe and re nowledg	rent thermal frigeration & le on gas and	utilit air-o vap	ies s condi cur p	uch a tioning ower	as internal g systems cycles.		
Unit –		Internal Comb	oustion Engines									9		
Classif Engine Detona EGR -	ications - - Valve ation - Pe SCR – DI	Internal Combu Timing and Po erformance Calc PF - DOC.	ustion Engine Compo rt Timing Diagrams sulations - Exhaust Ga	nents ar - Injectio as Analys	nd their Functi on - Ignition - sis - Pollution	ons - <sup>-</sup> Lubric Contro	Two Stro cation and I Norms	oke - Four S nd Cooling S and Method	troke Syste s - C	- Pe ems - ataly	etrol a Kno tic Co	and Diesel cking and onverters -		
Unit - II         Gas Power Cycles and Vapour Power Cycle         9           Gas Power Cycles: Otto Cycle - Diesel Cycle - Dual Cycle - Brayton Cycle - Calculation of Mean Effective Pressure and         9														
Gas P Air Sta	Gas Power Cycles: Otto Cycle - Diesel Cycle - Dual Cycle - Brayton Cycle - Calculation of Mean Effective Pressure and Air Standard Efficiency - Actual and Theoretical p-v Diagrams. Vapour Power Cycle: Rankine Cycle - Reheat - Regeneration.													
Unit –	=	Steam Boilers	s, Nozzles and Turbir	nes:								9		
Steam Boilers: Classification - Fire Tube and Water Tube Boilers - Mountings and Accessories - High Pressure Boilers - Types - Supercritical Boilers. Steam Nozzles: Flow of Steam through Nozzles - Shapes of Nozzle - Effect of Friction - Critical Pressure Ratio and Supersaturated Flow. Turbines: Impulse and Reaction Principles - Compounding and its Types - Velocity Diagrams for Single Stage Turbines - Governing of Turbines and its Types.														
Unit –	IV	Air Compress	or									9		
Classi Efficie Comp	fications ncies of I ressor - F	and Working P Reciprocating A Rotary Compres	rinciple of Reciproca ir Compressors - Mu sors - Types - Worki	ting Air Iltistage ng Princi	Compressor - Air Compress ple (Elementa	- Work or with iry Trea	Done v Inter C atment C	vith and with ooling - Wor Only) - Applic	out k Do atior	Cleai ne oi is.	ance n Mul	- Various tistage Air		
Unit –	V	Refrigeration	and Air-Conditioning	9								9		
Refrige Perfor (Eleme (AHU) Condit	eration: manceCa entary tre - Conce tioning).	Working Princ alculations - Wo eatment only). ept of RSHF -	iple of Vapour Co orking Principle of Va Air-Conditioning: Typ GSHF - ESHF - Co	mpressio pour Ab bes - Wo boling L	on Refrigerat sorption Refri orking Princip oad Calculati	tion S geratio le of a ons (B	ystem in Syste air-condi Basic Pro	- Superhea m - NH <sub>3</sub> -H <sub>2</sub> C tioning Syst oblems in S	ting ) and ems umn	and d LiB - Air ner a	Sub r-H₂C Han nd W	cooling - 9 Systems dling Unit /inter Air-		
												Total:45		
TEXT	TEXT BOOK:													
1. Rajput R.K. "Thermal Engineering". 11 <sup>th</sup> Edition, Laxmi Publications, New Delhi, 2020.														
REFEF	RENCES:													
1.	Ballaney	y P.L., "Thermal	Engineering". 25th Edi	ition, Kha	inna Publisher	, New D	Delhi, 20	18.						
2.	Mahesh	M. Rathore. "Th	nermal Engineering". 1	<sup>st</sup> Editior	, McGraw Hill	Publica	ations, N	ew Delhi, 20 <sup>-</sup>	0.					
3.	Yunus / McGraw	A. Cengel, Mich	ael A. Boles, and Me	ehmet K	anoglu. "Theri	nodyna	amics: A	n Engineerin	g Ap	proa	ch". 9	<sup>th</sup> Edition,		
	Mediaw		VI. LIU., New Deini, Zu	019.										

COUR	SE O	UTCON	IES:											BT Mapp	bed
On cor	npletio	on of th	e course	, the stude	ents w	ill be able	to							(Highest L	evel)
CO1	expl estir	ain the	working e perforr	principle	of a	n internal	combus	stion en	igine v	vith its s	ubsyste	ms and al	so	Applyin	g (K3)
CO2	appl T-s a	ly the co and h-s	oncept o diagran	f thermody ns	rnami	c processe	es in gas	s and va	ipour p	ower cy	cles by u	sing p-v,		Applyin	g (K3)
CO3	unde	erstand	the worl	king of boil	ers a	nd determi	ine the p	performa	ance o	f nozzles	and turk	oines		Applying	g (K3)
CO4	calc	ulate th	e perforr	mance of a	air cor	npressors								Applying	g (K3)
CO5	appl calc	ly the ulations	concept 3.	s of them	mody	namics in	R&AC	syster	ns an	d perfor	m the	cooling lo	ad	Applyin	g (K3)
Mapping of COs with POs and PSOs															
COs/F	s/POs PO1 PO2 PO3 PO4 PO5 PO6 PO7 PO8 PO9 PO10 PO11 PO12 PS01 PS02														
CC	01	3	2	3									1		3
CC	)2	3	2	3									1		3
CC	03	3	1	2									1		3
CC	)4	3		3									1		3
CC	)5	3	1	2									1		3
1 – Sliç	ght, 2	– Mode	erate, 3 -	Substanti	al, BT	- Bloom's	Taxono	my		·					
						ASSES	SMENT	PATTE	RN –	THEORY	,				
Tes C	t / Blo atego	oom's ory*	Re	ememberi (K1) %	ng	Understa (K2)	anding %	Apply (K3)	/ing %	Analyzi (K4) %	ing l %	Evaluating (K5) %	) (	Creating (K6) %	Total %
	CAT	1		15		40		45	5						100
	CAT	2		15		40		45	5						100
	CAT	3		15		40		45	5						100
	ESE 5 40 55 100														
* ±3%	may b	oe varie	d (CAT 1	,2,3 – 50	marks	& ESE –	100 mai	rks)							

			22MET	42 - MACHINING	G AND MEASURE	MENTS					
Progra Branci	nmme &	B.E. & Mechani	ical Engineeri	ing		Sem.	Category	L	т	Ρ	Credit
Prereq	uisites	Engineering Technology	Practices	Laboratory,	Manufacturing	4	PC	3	0	0	3
Pream	ble	This course dep working princip measurements a	picts the meta les of various and measurem	al cutting princip s unconventiona nent devices.	les, machine tools al machining proc	s and its esses.	s parts, com It also provi	oonent des th	s ma ne fu	aterial Indan	s and the nentals of
Unit –		Theory of Meta	I Cutting:								9
Eleme Milling Diagra Metal	nts of Cu Tool – D am – Cutt <u>Machinin</u>	itting Process – ( Drilling Tool. Mec ting Force Calcul g – Machinability	Classification on hanics of Metal lation – Cuttin 7.	of Cutting Tools tal Cutting: Chip g Fluids – Tool	<ul> <li>Tool Materials</li> <li>Formation and i</li> <li>Wear – Tool Life</li> </ul>	– Nome its Type – Taylo	nclature of S s – Chip Br or's Tool Life	ingle I eakers Equat	Point – N ion –	Cutti Ierch - Eco	ng Tool – ant Circle nomics of
Unit –		Machining with	Single Point	Tool:							9
Lathe Attach Turnin	Construc ments – g – Mach	ction – Specificat Tool Holders – V nining Time – Pov	tion – Types Vork Holders wer Estimatior	of Lathe – Ce – Special Attac – Tooling Layou	ntre Lathe – Turi hments. Lathe Op ut – Automatic Lath	ret – Ca perations ne.	apstan Lathe s: Thread Cu	e – La itting -	the - Me	Acce thods	ssories & of Taper
Unit –		Machining with	Multi Edged	Tools:							9
Drilling Proces Broach Truing	Machine ses – Op ning Metho – Loadino	es: Types — Ope perations – Types ods. Grinding Ma g – Selection of G	erations – Wo of Milling Cut chines: Specif Grinding Whee	rk Holders – To ters. Broaching ication of Grindii el – Finishing (	ool Holders. Milling Machines: Types - ng Wheel – Workii Operations.	g Machi – Broach ng Princ	nes: Types - n Constructio iple – Cylindi	- Fund n – Ty ical G	lame pes ( rindir	entals of Op ng – E	of Milling erations – Dressing –
Unit –	IV	Unconventiona	I Machining F	Processes:							9
Need Materi Water Machi	for Uncor als – App Jet Mac ning – Pla	nventional Machi olications – Adva chining – Ultras asma Arc Machin	ining Process intages & Lim onic Machinii ning – Laser B	es – Classificat itations – Effec ng – Electro C Beam Machining	tion Based on Na t of Process Para Chemical Machinir J.	nture of Imeters ng – C	Energy – In of Abrasive hemical Mill	iroduc Jet Ma ing –	tion achin Elec	– Equ ing – stric I	Abrasive Discharge
Unit –	V	Fundamentals	of Metrology:								9
Measu Charao Micron Angle	rement - cteristics neter – In Dekkor –	<ul> <li>Definition and of instruments – nside Micrometer Optical Flat – Fo</li> </ul>	<ul> <li>Methods –</li> <li>Introduction</li> <li>Bore Gauger</li> <li>mm measuren</li> </ul>	Generalized M to Transducers ge – Comparato nent – External	Measurement Sys – Gauge Types or types – Angle r Thread – Straight	stem – – Leng neasure ness – F	Units and th measuren ement – Beve Flatness.	Stand nents - el Prot	ards - Ve racto	– C rnier or – S	Calibration Caliper – Sine bar –
											Total:45
TEXT	BOOKS:										
1.	Kaushis	h J.P., "Manufactu	uring Processe	es", 2 <sup>nd</sup> Edition, P	PHI Learning Pvt. L	td., Delh	ii, 2014 for Ui	nits I, II	, III,	IV.	
2.	Rajput F 2013 for	R.K., "Mechanical <sup>.</sup> Unit V,.	Measurement	s and Instrument	tation", 2 <sup>nd</sup> Edition,	S.K.Kat	aria & Sons F	Publish	ers,	New [	Delhi,
REFEF	RENCES:										
1.	Paul De & Sons,	Garmo E., Black New Delhi, 2011.	J.T. and Rona	lld A.Kohser, "M	laterials and Proce	sses in I	Manufacturing	<b>]</b> ". 11 <sup>th</sup>	Editi	on, Jo	ohn Wiley
2.	Rao P.N	I., "Manufacturing	Technology",	Volume-2, 4 <sup>th</sup> Ed	ition, Tata McGraw	v Hill, Ne	wDelhi,2018				
									_		

	SE O			a the stur	lants w	ill he ahl	e to						l (H	BT Mappe	ed vel)
CO1	des	cribe th	e basic ( s.	concepts	of meta	al cutting	and per	form cu	tting fo	rce and	tool life		A	pplying (K	3)
CO2	den calo	nonstrat culate m	te the sir	ngle point g time.	cutting	tool ope	rations ι	using va	arious la	athe ma	chines a	nd	A	pplying (K	3)
CO3	dep	ict the f	undame	ntal conce	epts of	machinir	ig with n	nulti poi	nt tools	6.			A	pplying (K	3)
CO4	den pro	nonstrat cesses.	te the fu	ndamenta	l princi	ples of m	aterial r	emoval	in unco	onventio	nal mac	hining	A	pplying (K	3)
CO5	inte inst	rpret the	e basic o s.	concept of	fmeas	urement	system,	calibrat	ion and	d charac	teristics	of	Unde	erstanding	(K2)
Manning of COs with POs and PSOs															
Mapping of COs with POs and PSOs															
COs/F	Os/Pos         PO1         PO2         PO3         PO4         PO5         PO6         PO7         PO8         PO9         PO10         PO11         PO12         PS01         PS02											PSO2			
CO.	1	3	2												3
CO	2	3	2												3
CO	3	3	2												3
CO4	4	3	2			1									3
CO	5	3	2			1								3	3
1 – Slię	ght, 2	– Mode	erate, 3 -	- Substar	tial, B1	- Bloom'	s Taxon	omy	L					1	
						ASSE	SSMEN	Τ ΡΑΤΤ	ERN –	THEOR	Y				
Tes C	t / Bl ateg	oom's ory*	Re	memberi (K1) %	ng	Understa (K2)	anding %	Apply (K3)	ying ) %	Analyz (K4) <sup>o</sup>	ing %	Evaluating (K5) %	Creat	ing (K6) %	Total %
	CAT	1		25		65		10	0						100
	CAT	2		25		65		10	)						100
	CAT	3		20		60		20	)						100
	ESE	Ξ		20		60		20	)						100
* ±3%	may l	be varie	d (CAT	1,2,3 – 50	) marks	& ESE -	- 100 ma	arks)			I		_I		

		22MET43 - CAD/CAM/CIM FOR AUTOM/	ATION					
Programr Branch	ne &	BE & Mechanical Engineering	Sem.	Category	L	т	Ρ	Credit
Prerequis	sites	Engineering Drawing, Machining and Measurements	4/5	PC	3	0	0	3
Preamble		This course imparts knowledge of CAD with 2D and 3D transfor codes, various CIM technologies and robotics technology with visi	rmations ion syste	, CNC techr ems.	nology	/ with	G co	des and M
Unit – I		Computer Aided Design (CAD)						9
The Design Drawing A Homogen	gn Pro Igorithr eous C	cess and Role of CAD - Introduction to Computer Graphics - Or ns - Parametric Equations for Line and Circle - 2D & 3D Trans oordinate.	utput Pr formatio	imitives - Br ns - Transla	resen ation	ham's - Sca	s Line Iling -	and Circle Rotation –
Unit – II		Computer Aided Manufacturing (CAM)						9
CAM: CN Structural Fundamer (CL) Data	C Tech Memb ntals of a and T	nology - Classification - Contouring - Interpolators - Open Loop a ers of CNC Machines - Function of Ball Screws - Automatic Part Programming - Geometric Codes (G Codes) and - Misco ool Path. Code Generation from 3D Solid Models Using Master CA	and Clos c Tool ( ellaneou M Softw	sed Loop Sy Changer (A1 s Codes (M vare.	rstem FC) - 1-Cod	- CN Fee es) -	IC Cor dback Cutte	ntroller and Devices - r Location
	(i.e. i ti e.e.	Computer Integrated Manufacturing (CIM)	Carran					9
Variant ar Systems	nd Gen - FMS	erative Approaches – FMS - Components of FMS – Types - FMS Layout – Application and Benefits.	- Comp S Works	tation - Mate	erial	Hand	ling Ar	(CAPP) – nd Storage
Unit – IV		Robot Technology						9
Robot Ana Effectors and Actua	atomy - - Sens ators: H	<ul> <li>Joints and Links – Common Robot Configurations – Robot Contr ors in Robotics. Robot Programming Methods: On-Line and off-Line ydraulic – Pneumatic and Electric Drives.</li> </ul>	rol Syste Method	ms - Accura Is. Introductio	acy ar on of	nd Re Robo	epeatat tic Driv	oility - End ve Systems
Unit – V		Robotic Vision Systems						9
Imaging – Assembly Represen	Sensii and In tation u	ng and Digitization, Image Processing Techniques - Robot Industr spection. Introduction to Kinematics: Position and Orientation of Ob sing Homogeneous Transformation Matrix.	rial Appli bjects -	cations: Mate Rotation - E	erial I Euler	-landl Angle	ing, Pr es - R	ocessing - igid Motion
								Total:45
TEXT BO	OKS:							
1. Zeid Units	lbrahin s I,II,III.	n & Siva Subramanian., "CAD/CAM Theory and Practice", 2 <sup>nd</sup> Editio	on, McGr	aw Hill Educ	ation,	New	Delhi,	2009 for
2. Groo New	over M. / Delhi,	P., "Automation, Production System and Computer Integrated Mar 2022 for Units IV,V.	nufacturi	ng", 4 <sup>th</sup> Edit	ion, F	Prentio	ce-Hall	of India,
REFEREN	ICES:							
1. Hea	rn Dona	ald & Baker M. Pauline., "Computer Graphic", 2 <sup>nd</sup> Edition, Uttar Prad	lesh Pea	irson, New D	elhi, :	2022.		
2. Rajp	out. R. k	K, "Robotics and industrial automation" 1 <sup>st</sup> Edition, S. Chand publish	er, New	Delhi, 2009.				

COUR: On con	SE OUTCOMES: npletion of the course, the students will be able to	BT Mapped (Highest Level)
CO1	demonstrate the modeling algorithms and 2D & 3D transformations	Applying (K3)
CO2	demonstrate components of CNC and code generation using software	Applying (K3)
CO3	demonstrate the concepts of FMS - CAPP implementations	Understanding (K2)
CO4	demonstrate the different robot anatomy and programming methods	Understanding (K2)
CO5	applying the different robotic vision system	Applying(K3)

Mapping of COs with POs and PSOs														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1			3								3	2
CO2	1	3			3								3	2
CO3	1	3			3								3	2
CO4	3				3								3	2
CO5	1	3			3								3	2
			<b>.</b>			-								

1 - Slight, 2 - Moderate, 3 - Substantial, BT- Bloom's Taxonomy

	ASSESSMENT PATTERN - THEORY													
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %							
CAT1	20	40	40				100							
CAT2	20	60	20				100							
CAT3	20	40	40				100							
ESE	20	40	40				100							
* ±3% may be varied (	* ±3% may be varied (CAT 1, 2 & 3 – 50 marks & ESE – 100 marks)													

	22MET44 - KINEMATICS OF MAC	HINERY											
Programme & Branch	B.E. & Mechanical Engineering	Sem.	Category	L	т	Р	Credit						
Prerequisites	Engineering Drawing, Engineering Mechanics	4	PC	3	0	0	3						
					•								
Preamble	The course provides the analysis of velocity, acceleration and sy deals withvarious cam profile generations and studies on gears ar	nthesis nd gear t	of various sir rains.	nple	med	hanis	ms. It also						
Unit – I	Basics of Mechanisms						9						
Classification c Criterion - Grul Positions - Mec - Indexing Mec	of Mechanisms - Basic Kinematic Concepts and Definitions - oler's Criterion - Grashof's Law - Kinematic Inversions of Four - chanical Advantage - Transmission Angle - Description of Comm hanisms - Ratcheting.	Degree Bar Ch on Mech	of Freedom ain and Slid nanisms - Qu	n - er ( iick	Mobi Crank Retu	lity - Cha rn Me	Kutzbach ins - Limit echanisms						
Unit – II	Kinematics of Mechanisms						9						
Velocity and A Centre Method	cceleration of Simple Mechanisms by Relative Velocity Metho - Klien's Construction for Slider Crank Mechanism - Coriolis Acco	od - Ve eleration	locity Analys Component	sis	using	Insta	antaneous						
Unit – III	Synthesis of Mechanisms						9						
Synthesis of Mo of Slider Crank using Freudens Commercial So	Synthesis of Mechanism - Classification of Synthesis - Function Generation by Relative Pole Method - Graphical Synthesis f Slider Crank and Four bar Mechanisms for Two and Three Positions - Computer Aided synthesis of four bar mechanism sing Freudenstein's Equation - Analytical Solution for Velocity and Acceleration of Slider Crank Mechanism - Introduction to Commercial Software Packages for the Development of Kinematic Models.												
Unit – IV	Kinematics of CAM						9						
Cams - Types Acceleration ar Followers - Kni Pressure Angle	of Cams and Followers - Displacement - Velocity and Acceler and Retardation - SHM and Cycloidal Curves - Layout of Plate fe - Edge Follower - Roller and Flat Faced Followers. High Spe and Undercutting.	ation Cu Cam Pr ed Cam	irves for Uni ofile - Recip s: Circular A	forr roca .rc a	n Vel ating and T	ocity and ( ange	- Uniform Oscillating nt Cams -						
Unit – V	Kinematics of Gears						9						
Theory of Gea Contact - Veloc Gear Trains.	ring - Gear Nomenclature - Law of Gearing - Tooth Forms - ity and Torque Calculation - Contact Ratio and Interference. Gea	Minimun ar Trains	n Number To s: Types - Pa	eeth Irall	n - Lo el Ax	ength is and	of Arc of Epicyclic						
							Total:45						
TEXT BOOK:													
1. Rattan S	S.S. "Theory of Machines". 5 <sup>th</sup> Edition, McGraw Hill Publishing Comp	any, Che	ennai, 2019.										
REFERENCES:													
1. Shigley	J.E., Uicker J.J. "Theory of Machines and Mechanisms". 5th Edition,	Oxford	University Pre	ess,	New	Delhi,	2017.						
2. Bevan	Thomas. "Theory of Machines". 3 <sup>rd</sup> Edition, C B S Publishers & Distri	butors, N	lew Delhi, 20	05.									

COUR On cor	SE O	UTCON on of th	<b>IES:</b> e cou	rse,	the stude	ents w	ill be able	e to						(	BT Mapp Highest L	oed evel)
CO1	expl	lain the	basic	cor	ncepts of I	kinem	atics and	working	principl	e of si	mple me	chanism	6		Applyin	g (K3)
CO2	com	pute th	e velo	city	and acce	lerati	on of sim	ple mech	anisms						Applyin	g (K3)
CO3	synt	thesize	simple	e m	echanism	s and	understa	ind the b	asics of	comp	uter aide	d analys	is		Analyzir	ng (K4)
CO4	port	ray the	basic	cor	cepts of o	cam fo	ollower sy	stem an	d desigi	n of pl	ate cam p	orofiles			Applyin	g (K3)
CO5	des	cribe th	e basi	ic co	oncepts in	kine	matics of	gearing a	and ana	lyze tł	ne variou	s types o	of gear train	s	Applyin	g (K3)
	Mapping of COs with POs and PSOs         Ds/POs       PO1       PO12       PSO1       PSO1															
COs/F	Mapping of COs with POs and PSOs           Ds/POs         PO1         PO2         PO3         PO4         PO5         PO6         PO7         PO8         PO9         PO10         PO11         PO12         PS01         PS02           CO1         2         3         2         0         0         0         0         0         2															
CO	s/Pos         Po1         Po2         Po3         Po4         Po5         Po6         Po7         Po8         Po9         Po10         Po11         Po12         PS01         PS02           C01         2         3         2               3         3															
CO	2	2	3		2											3
CO	3	2	3		2											3
CO	4	2	3		2											3
CO	5	2	3		2											3
1 – Sli	ght, 2	– Mode	erate,	3 –	Substanti	al, B1	- Bloom'	s Taxono	my		1	1	1			
							ASSE	SMENT	PATTE	RN –	THEOR	(				
Tes C	st / Ble Catego	oom's ory*		Re	memberi (K1) %	ng	Unders (K2	tanding ) %	Apply (K3)	ying %	Analyz (K4) 9	ing %	Evaluating (K5) %	C	reating (K6) %	Total %
	CAT	1			10		2	5	65	5						100
	CAT	2			10		2	5	50	)	15					100
	CAT	3			10		2	5	65	0						100
	ESE	=			10		2	5	50	)	15					100
* ±3%	mav b	be varie	d (CA	T 1.	,2,3 – 50 i	marks	& ESE -	- 100 ma	rks)							

		2	22MEL4	1 - THE	RMAL	ENGIN	EERING	G AND	RENEW	/ABLE	ENERG		TOR	1		
Progra Branch	mme & N	k	B.E. &	Mechar	nical Er	igineer	ing				Sem.	Category	L	т	P	Credit
Prereq	uisites		Engine	ering T	hermoo	dynami	CS				4	PC	0	0	2	1
Preamb	ole		This co	ourse p I combu	rovides stion er	practic	al expo reciproo	osure o cating a	n fuel ir comp	propert ressor a	ies mea and sola	surement, r / wind ene	perfo erav s	rma vste	ance ana ems.	alysis of
LIST O	F EXPE	ERIM	IENTS /	EXERC	SISES:	.gee,		outing a				.,	o.gj o	<i>,</i>		
					Tł	IERMA	L ENG	INEERI	NG LAE	BORAT	ORY					
1.	Draw	a Va	lve Tim	ing and	Port Tir	ning Dia	agram f	or Four	Stroke	and Tw	o Stroke	Engines.				
2.	Deter	mina	tion of F	-lash an	d Fire F	Point of	given F	uels usi	ing Ope	n and C	Closed C	up Apparat	us.			
3.	Deter	mina	tion of \	/iscosity	of give	n Oils u	using Re	edwood	and Sa	ybolt Vi	scomete	rs.				
4.	Perfor Electr	rman ical I	ice Test _oading	: on Sing	gle Cylir	der Fo	ur Strok	e Diese	el Engino	e by Me	chanical	/ Hydraulio	c / Edd	ly C	Current /	
5.	Heat I Electr	Balaı ical I	nce Tes ₋oading	t on Sin	gle Cyli	nder Fo	our Strol	ke Dies	el Engin	e by Me	echanica	l / Hydrauli	c / Ed	dy (	Current /	
6.	5. Heat Balance Test on Single Cylinder Four Stroke Diesel Engine by Mechanical / Hydraulic / Eddy Current / Electrical Loading.     6. Performance Test on Multistage Reciprocating Air Compressor. <b>RENEWABLE ENERGY LABORATORY</b> 1. Analyze the Effect of the Variation of Speed, Tip Speed Ratio on the Coefficient of Power of Wind Turbine.     2. Determination of the Thermal Energy Gain at the Focal Point of a Concentrating Collector.     3. Determination of the Efficiency of Solar (Liquid / Air) Collector.     4 Plot the Effect of Variation of Tilt Angle on the Photovoltaic Module Output															
	Electrical Loading.     Performance Test on Multistage Reciprocating Air Compressor.     RENEWABLE ENERGY LABORATORY     Analyze the Effect of the Variation of Speed, Tip Speed Ratio on the Coefficient of Power of Wind Turbine.     Determination of the Thermal Energy Gain at the Focal Point of a Concentrating Collector.     Determination of the Efficiency of Solar (Liquid / Air) Collector.     Plot the Effect of Variation of Tilt Angle on the Photovoltaic Module Output.															
1.	Analy	ze th	e Effec	t of the V	Variatio	n of Spe	eed, Tip	Speed	Ratio o	n the C	oefficien	t of Power	of Wir	nd T	Turbine.	
2.	Deter	mina	tion of t	he Ther	mal Ene	ergy Ga	in at the	e Focal	Point of	a Conc	centrating	g Collector.				
3.	Deter	mina	tion of t	he Effici	ency of	Solar (	Liquid /	Air) Co	llector.							
4.	Plot th	ne Ef	fect of \	/ariatior	n of Tilt	Angle o	n the P	hotovoli	taic Mod	dule Ou	tput.					
5.	Study	on F	Rooftop	Solar P	hotovoli	aic Plai	nt and V	Veather	Monito	ring Sta	ation.					
0.	Perio	rman	ice rest	on 5018	ar Evaci	lated 1	upe								т	otal:20
																01a1.30
REFER		s/ m/	ANUAL	/SOFT\	VARE:											
1.	Labo	rator	y Manu	als.												
2.	Rajpu	ut R.I	۲. "Ther	mal Eng	gineerin	g". 10 <sup>th</sup>	Edition	, Laxmi	Publica	tions, N	lew Delh	i, 2018.				
COUR			MEG.													
		ofth		e the s	tudents	will be	ahle to							i (H)	ighest L	evel)
CO1	analyz	ze th	ie chara	acteristi	cs of th	ne fuels	s and	test an	d plot t	the per	formance	e curves o	on	Ar	nalyzing	(K4), n (S2)
CO2	exami	ne th	ne perfe	ormance	and h	eat bal	ance st	tudy of	various	IC en	gines un	der differe	nt	Ar	nalyzing	(K4),
	loadin	gcon nino		formon	no of S	olor on	orav o	(otomo	and an		o doto	from rooffe		Ma	nipulatio	n (S2) (K4)
CO3	solar l	nine PV pl	lant	normano		olar en	ergy sy	/stems	and an	aiyze tr	ie data		p	Ma	nipulatio	(K4), n (S2)
CO4	analyz	ze the	e effect	of vario	us para	meters	in wind	turbine						Ar Ma	nalyzing nipulatio	(K4), n (S2)
I																
						Маррі	ng of C	Os with	n POs a	nd PSC	Ds					
COs/P	Os P	01	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO1	2	PSO1	PSO2
CO1		1	2		3					3	3			1		3
CO2		1	2		3					3	3			$\uparrow$		3
CO3		1	2		3	2				3	3				2	3
CO4		1	2		3	2				3	3			$\uparrow$	2	3
1 – Slig	ht, 2 –	Mod	erate, 3	– Subsi	tantial, I	BT- Blo	om's Ta	axonom	y			<u> </u>				1

				22	MEL42	- MACH	HINING		IEASUR	REMEN	TS LAB	ORATORY				
Progra Branch	imme 1	&	B.E. 8	& Mecha	anical E	Inginee	ering				Sem.	Category	L	Т	Р	Credit
Prereq	uisite	S	Physi	cs for I	Mechan	ical En	gineeri	ng			4	PC	0	0	2	1
Pream	ble		This opera linear,	course tions. Tl , angula	imparts his cour ir, etc.	s the b se prov	asic ki ides the	nowledg e practi	ge and cal knov	provid vledge/	es hand mechani	ls-on trainin sm behind tl	g to ne va	var ariou:	ious r s meas	netal removal surements like
LIST O	FEXF	PERIM	IENTS /	EXER(	CISES:											
					MAC	CHINING	g and	MEASL	JREME	NTS LA	BORAT	ORY				
1.	Carr	yout K	nurling	and Tap	per Turr	ning Ope	erations	s using (	Centre L	athe.						
2.	Exec	cute Ex	kternal -	Thread	Cutting	Operati	on in C	entre La	the.							
3.	Obta	in a D	ovetail/	Keyway	Shape	using S	haping	Machin	e.							
4.	Perfo	orm Gi	rinding	Operatio	on on th	e Flat a	nd Cylir	ndrical V	Vork Pie	eces us	ing Surfa	ace and Cylir	ndrica	al Gr	inding	Machines.
5.	Make	e a Ho	le and t	thread o	n Flat S	Surface	using D	rilling a	nd Tapp	oing Too	ols.					
6.	Make	e a Sp	ur Gear	/Keywa	y/Conto	our Shap	pe using	g Milling	Machir	ies.						
7.	Prepare a Convex Shape in a Flat Metal Work Piece using Slotting Machine.         MEASUREMENTS LABORATORY         Calibration of Linear Instrument with Sliding Principle and Measurement of the given Component by using Vernier Caliper and Vernier Height Gauge															
	Calibration of Linear Instrument with Sliding Principle and Measurement of the given Component by using Vernier     Calibration of Mechanical and Electrical Comparator and Check the Dimensional Tolerance using Dial Gauge and LVDT															
1.	Calibration of Linear Instrument with Sliding Principle and Measurement of the given Component by using Vernier Caliper and Vernier Height Gauge         Calibration of Mechanical and Electrical Comparator and Check the Dimensional Tolerance using Dial Gauge and LVDT.         Calibration of Linear Instrument with Bolt and Nut Principle and Measurement of given Component by using Outside Micrometer and Depth Micrometer.															
2.	Calibration of Mechanical and Electrical Comparator and Check the Dimensional Tolerance using Dial Gauge and LVDT. Calibration of Linear Instrument with Bolt and Nut Principle and Measurement of given Component by using Outside Micrometer and Depth Micrometer.															
3.	Calibration of Mechanical and Electrical Comparator and Check the Dimensional Tolerance using Dial Gauge and LVDT.     Calibration of Linear Instrument with Bolt and Nut Principle and Measurement of given Component by using Outside     Micrometer and Depth Micrometer.     Measurement of Angle of given Component by using Sine Bar and Bevel Protractor.     Calibration of Onticel Instrument and Macaurement of given Component by using Profile Protector.															
4.	Mea	surem	ent of A	Angle of	given C	Compon	ent by ι	using Si	ne Bar a	and Bev	vel Protra	actor.				
5.	Calil	bration	of Opti	ical Inst	rument	and Me	asurem	ent of g	iven Co	mpone	nt by usi	ng Profile Pro	oject	or.		
6.	A St	udy/D	emonst	ration E	xperime	ent on F	latness	and Str	aightne	ss Che	cking by	using Autoco	ollima	ator.		
7.	<ol> <li>Measurement of Angle of given Component by using Sine Bar and Bevel Protractor.</li> <li>Calibration of Optical Instrument and Measurement of given Component by using Profile Projector.</li> <li>A Study/Demonstration Experiment on Flatness and Straightness Checking by using Autocollimator.</li> <li>A Study/Demonstration Experiment on Measuring Cylinder and Cone Dimensions using Coordinate Measuring Machine.</li> </ol>															
8.	A St	udy/D	emonst	ration E	xperime	ent on M	leasurir	ng the S	urface I	Roughn	ess of M	laterials using	g Su	rface	Roug	hness Tester.
																Total:30
REFER	RENCE	ES/ M/	ANUAL	/SOFT	WARE:											
1.	Hajra Prom	aChou noters	dhury S & Publi	S.K. ,Haj shers P	iraChou rivate L	dhury A imited, I	A.K., Ni Mumba	rjharroy i, 2010.	"Eleme	ents of	Worksho	op Technolog	gy - \	/ol.ll'	", 15 <sup>th</sup> I	Edition, Media
2.	Rajp Delh	ut R.K i, 2013	., "Mec 3	hanical	Measur	ements	and In	strumer	ntation",	2 <sup>nd</sup> Ed	ition, S.k	K.Kataria & S	Sons	Publ	lishers	, New
3.	Labo	ratorv	Manua	ls												
COUR	SF OL	ITCON	MES:												BT M	apped
On con	npletio	on of th	ne cours	se, the s	tudents	will be	able to							(	Highe	st Level)
CO1	prod	uce dit hining	fferent p	orofiles	on meta	l parts b	by lathe	, milling	, drilling	j, shapi	ng and s	lotting		Ν	Apply Janipu	ing (K3), lation (S2)
CO2	perfo	orm gri	inding o	peration	ns on ci	rcular ai	nd flat n	netal pie	ece to e	nhance	surface	finish			Apply Apply	ing (K3),
CO3	calib	orate th	ne meas	suring in	strumer	nts and	measur	re the di	mensio	n of the	compon	ients		N	Apply	ing (K3),
CO4	dete	rmine	the cha	racteris	tics of ir	strume	nts								Apply	ing (K3),
				_		Ма	oping c	of Cos v	vith PO	s and F	PSOs			N	vianipu	iation (S2)
COs/P	Os	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO1	2 F	PSO1	PSO2
CO1		3	1							2				$\top$		3
CO2	2	3	1							2				+		3
CO3	3	3	1			1				2				+	3	3
CO4		3	. 1			1				2					3	3
1 – Slic	uht. 2 -	– Mode	erate. 3	– Subs	tantial	BT- Blo	om's Ta	axonom	V	2					5	5

				22N	1EL43 -	SOLID	MODE	LING L	ABOR	ATORY					
Progra Branci	mme & n	B.E. 8	Mecha	nical Ei	ngineer	ing				Sem.	Category	L	т	Ρ	Credit
Prereq	uisites	Engin Labor Streng	eering E atory, I gth of M	Drawing Engine aterials	g, Mach ering M S	ine Dra Iaterial	wing a ls and	nd Auto Metall	oCAD urgy,	4	PC	0	0	2	1
Pream	ole	This c compo experi	ourse ponent de ence and	rovides sign ar d detern	the prand the performination	actical k prming of esse	nowled basic m ential me	ge on l nodeling echanic	now to of co al prop	use the mponent erties of	computer a ts and also various mate	aided provie erials.	tools des tl	in di ne ha	afting a ands on
LIST O	FFXPFF			CISES:	SOLIE	D MODE	ELLING	LABO	RATOR	Υ Υ					
1.	Perform	ing 2D Sl	ketching	using D	oifferent	Genera	alized Co	onstrain	ts.						
2.	Practice	for datur	n plan, a	xis, poi	nt and c	oordina	ite syste	ems.							
3.	3D Part	Modeling	Options	s, Protru	sion and	d Cut (E	Extrude)	. Exerc	ises: Fl	ange Co	upling.				
4.	3D Part	Modeling	Options	s, Protru	sion and	d Cut (F	Revolve)	. Exerc	ises: S	crew jacl	ĸ				
5.	3D Part Exercise	Modeling es: Machi	Options ne Vice,	s – Protr Knuckle	usion a Joint.	nd Cut	(Sweep,	Blend,	Helica	l Sweep)					
6.	Feature Exercise	s Creation e: Simple	n with Ec Eccentri	diting Op c.	peration	s – Mov	ve, Patte	ern, Mir	ror, Rou	und, Cha	Imfer and Ri	b.			
7.	Assembly – Creating Assembly from Individual Parts – Imposing Assembly Constraints – Mass Property Calculation.         Conversion of 3D Solid Model to 2D Drawing – Different Views – Sections – Isometric View and Annotation														
8.	Calculation. Conversion of 3D Solid Model to 2D Drawing – Different Views – Sections – Isometric View and Annotation Creation.														
9.	Manufa	cturing Pr	ototype o	of a Sim	ple Med	chanica	I Compo	onent u	sing 3D	Printer.					
															Total:30
REFEF	RENCES/	MANUAI	_/SOFT	WARE:											
1.	Sham T	ickoo, "P <sup>-</sup>	FC Creo	Parame	etric 2.0	for Des	signers",	, 6 <sup>th</sup> Edi	tion, C/	AD / CIM	Technologi	es, Ne	w De	lhi.	
2.	Online [	Document	ation for	CREO	8.0, SO		ORKS-2	020 and		4 V5-6 R	2015.				
3.	Laborat	ory Manu	al for So	lid Mode	eling.										
COUR: On con	SE OUTO	OMES:	se, the s	students	s will be	able to							BT (High	Map est I	ped _evel)
CO1	model t	ne mecha	nical cor	nponen	ts using	param	etric mo	deling,	asseml	bly and c	Irafting	P	Appl Appl	ying ulatio	(K3), on (S2)
CO2	Apply b	asic featu	re and e	diting of	peration	s assoc	ciated w	ith mod	eling ar	nd assen	nbly		Appl Appl	ying ulatio	(K3), (S2)
CO3	apply th	e advanc	ed featur	re creati	ion cond	cept of (	CAD for	Modeli	ng, Ass	embly a	nd Drafting	ſ	Appl /anip	ying ulatio	(K3), on (S2)
					Manul	na cí O	0			0-					
COs/P	Os PO	1 PO2	PO3	PO4	PO5	PO6	PO7	POS a	PO9	PO10	P011	PO12	P	SO1	PSO2
CO1	3	1	+		3				2					3	2
CO2	3	1	1		3				2					3	2
CO3	3	1			3				2					3	2

		22GEL41 - PROFESSIONAL SKILLS TRA	AINING -	I										
		(Common to All BE/ BTech Engineering and Tech	nology b	ranches)										
Program Branch	mme &	All BE/ BTech Engineering and Technology branches	Sem.	Category	L	т	Ρ	Credit						
Prerequ	22GEL41 - PROFESSIONAL SKILLS TRAINING - I         ICcommon to All BE/ BTech Engineering and Technology branches)       Sem.       Category       L       T       P       Credit         requisites       Nil       4       EC       0       0       80       2         amble       This subject is to enhance the employability skills and to develop career competency       20       20         amble       This subject is to enhance the employability skills and to develop career competency       20       20         is skills and its importance: Pleasure and pains of transition from an academic environment to work environment-Need for nge- Fear, stress and competition in the professional world-Importance of positive attitude- Self motivation and continuous whedge upgradation-Self-confidence. Professional grooming and practices: Basics of octoprotate culture-Key pillars of business uetre- Basics of etiquette-Introductions and greetings-Rules of the handshake, earning respect, business manners-Telephone uetre-Body Language.       30         iette: Body Language.       30       30         jem solving level I: Number System-LCM & HCP-Divisibility test-Sura and indices-Logarithms- Ratio-proportions and ation-Partnership-Time speed and distance-Data interpretation-data representation. Logical reasoning: Family tree-uctions-Logical connectives-Biany logic Linear arrangements- Circular and complex arrangement       30         1 - III       Written Communication & Verbal Aptitude       Stemmes and coword substitution of Technical Data nacoding in spropriate article													
Preamb	ble	This subject is to enhance the employability skills and to deve	elop care	er competend	су									
Unit – I		Soft Skills – I :						20						
change knowled etiquette	<ul> <li>Fear, stre</li> <li>dge upgrada</li> <li>e- Basics of</li> <li>e- Body Lan</li> </ul>	tion-Self-confidence. Professional grooming and practices: Ba etiquette-Introductions and greetings-Rules of the handshake guage.	positive a asics of c e, earnin	attitude- Self orporate cultu g respect, bu	moti ire-K sines	vation ey pi ss ma	and co lars of b inners-T	ontinuous usiness elephone						
Problem	n solvina le	evel I: Number System-LCM &HCF-Divisibility test-Surds	and ind	ices-Logarith	ns-	Ratic	-proport	ions and						
variation	it - I       Soft Skills - I :       20         ft skills and its importance: Pleasure and pains of transition from an academic environment to work environment-Need for ange- Fear, stress and competition in the professional world-Importance of positive attitude- Self motivation and continuous owledge upgradation-Self-confidence. Professional grooming and practices: Basics of corporate culture-Key pillars of business quette- Basics of etiquette-Introductions and greetings-Rules of the handshake, earning respect, business manners-Telephone quette- Body Language.       30         it - II       Quantitative Aptitude and Logical Reasoning - I:       30         wblem solving level I: Number System-LCM &HCF-Divisibility test-Surds and indices-Logarithms- Ratio-proportions and iation-Partnership-Time speed and distance-Data interpretation-data representation. Logical reasoning: Family tree-ductions-Logical connectives-Binary logic Linear arrangements- Circular and complex arrangement													
Deduction	ons-Logical	connectives-Binary logic Linear arrangements- Circular and co	omplex a	rrangement										
Unit – II	11	Written Communication & Verbal Aptitude						30						
Writing Professi (Transco Phrases Spotting Rearran	Skills: Writin ional e-mail oding) Writi s Paired wo g Errors Sen nging Jumble	ng strategies and formats Importance of Résumés Writing a Writing Responding to e-mails and business letters Technica ang One-page Essays. Verbal Aptitude Synonyms Antonyms rds Analogies Spelling test Cloze test using suitable verb fo tence Correction and Formation Grammar Based questions (T ad Sentences & Jumbled paragraphs, Identifying Facts, Inferer	Cover le al Report s Homon orms usir fransform nces and	tter -Respond writing Inter yms One wo g appropriate nation : Active Judgements	ding preta ord s e arti e-Pas state	to Jo ition d ubstit icles ssive ement	b Advert of Techn ution Idi and pre & Direct	isements ical Data oms and positions; -Indirect);						
								Total:45						
TEXT B	BOOK:													
1.	Edgar Thor Services P	be and Showick Thorpe, "Objective English for Competitive Ex t Ltd, 2017.	aminatio	n", 6th Editio	ı, Pe	arsor	ı India E	ducation						
1. REFER	Edgar Thor Services Py ENCES:	be and Showick Thorpe, "Objective English for Competitive Ex rt Ltd, 2017.	kaminatio	n", 6th Editio	n, Pe	arsor	ı India E	ducation						
1. <b>REFER</b>	Edgar Thor Services P ENCES: Stephen Ba	be and Showick Thorpe, "Objective English for Competitive Ex t Ltd, 2017. iley, "Academic Writing: A practical guide for students", Routle	kaminatio	n", 6th Edition w York, 2011.	n, Pe	arsor	n India E	ducation						
1. <b>REFER</b> 1. 2.	Edgar Thor Services Po ENCES: Stephen Ba Meenakshi University F	pe and Showick Thorpe, "Objective English for Competitive Ex t Ltd, 2017. iley, "Academic Writing: A practical guide for students", Routle Raman and Sangeeta Sharma. "Technical Communication- Pr Press, New Delhi, 2022.	kaminatio edge, Nev rinciples	n", 6th Edition w York, 2011. and Practice"	n, Pe	Editio	n India E	ducation						

COUR On co	SE O mplet	UTCON tion of	MES: the cou	Irse, the s	studen	ts will b	e able to	D					(	BT Mapped Highest Lev	l el)
CO1	dev indi	elop the viduala	e soft sl nd as a	kills of lea team	rners	to suppoi	rt them	work ef	ficiently	y in an c	organiza	tion as an		Applying (K3 Precision (S3	), 3)
CO2	solv	/e real t	ime pro	blems usi	ng num	nerical ab	ility and	logical	reasor	ning				Applying (K3 Precision (S3	), 3)
CO3	App writ	oly comi ten disc	municat courses	ion skills ( grammati	effectiv cally w	ely to un ith accura	derstand acy	d and de	eliver ir	oformatio	on in var	ious		Applying (K3 Precision (S3	), 3)
						Марр	ing of C	Os wit	h POs	and PS	Os				
COs/P	COs/POs         PO1         PO2         PO3         PO4         PO5         PO6         PO7         PO8         PO9         PO10         PO11         PO12         PS01         PS02           CO1         3         2														
CO	1	3	2				3	3		3		3	2		
CO2	2	3	2				3	3		3		3	2		
COS	3		2				3	3		3	3	3	2		
1 – Slię	ght, 2	– Mode	erate, 3	- Substa	ntial, B	T- Bloom	's Taxoi	nomy							-
						ASSE	SSME	IT PAT	TERN	- THEOF	RY				1
Tes C	t / Blo atego	oom's ory*	Re	emember (K1) %	ing	Understa (K2)	anding %	Apply (K3)	ying ) %	Analyz (K4) <sup>o</sup>	ing E %	valuating (K5) %	Creat	ing (K6) %	Total %
	CAT	1		2	)	50		30							100
	CAT	2				50		50							100
	CAT	3				50		50							100
	ESE	=							NA	4					100
* ±3%	may l	be varie	ed (CAT	1,2,3 - 50	) marks	s)									

		22MEC51 - HEAT AND MASS TR	ANSFER												
		(Use of HMT Data Book and Steam Table are permitted for	the End S	emester Exam	inatio	า)									
Progr Branc	amme & ch	BE & Mechanical Engineering	Sem.	Category	L	т	Ρ	Credit							
Prere	quisites	Engineering Thermodynamics, Thermal Engineering	5	PC	3	0	2	4							
Droor	nhla	Last and Mass Transfer source is designed to import h	o o ulo da o	an three mod	aa of	haat	tranat	or pomoly							
Flear	line	conduction, convection and radiation. This course also helps	to understa	and the experir	nental	heat	transfe	er methods							
		used for calculating the heat transfer characteristics.		•											
Unit -	-1	Conduction Heat Transfer				_		9							
Fourie One E Wall a	er's Law of ( Dimensional and Cylinder	Conduction-Thermal Conductivity – Three Dimensional Heat Conduction through Plane Wall, Cylinder a	onduction I nd Sphere	=quation in Ca – Critical Radi and Sphere	rtesiai us of	n Coo Insula	rdinate tion –	e System – Composite							
Unit -	- II	Convection Heat Transfer		and opnere.				9							
Newto	on's Law of	Cooling - Boundary Layer Profiles of Flow over Flat Plate an	d Flow thre	ough Pipes - F	orcec	I Conv	vectior	–External							
Flow:	Flow over	Flat Plate and Sphere, Flow across Bank of Tubes – Interna	al Flow – F	ree Convectio	on: Flo	ow ov	er Ver	tical Plate,							
Horizo	ontal Plate a	nd Sphere. Radiation Heat Transfer						٥							
Electr	tro Magnetic Spectrum – Thermal Radiation - Concept of Black Body - Basic Laws of Black Body Radiation – Absorptivity, lectivity and Transmissivity – Kirchoff's Law of Radiation – Shape Factor and its Algebra – Radiosity and Irradiation – Electrical alogy – Two and Three Surfaces Interaction – Radiation Shields – Introduction to Gas Radiation.														
Reflec	A reduction reduction reduction reduction of the sector Magnetic Spectrum – Thermal Radiation - Concept of Black Body - Basic Laws of Black Body Radiation – Absorptivity, flectivity and Transmissivity – Kirchoff's Law of Radiation – Shape Factor and its Algebra – Radiosity and Irradiation – Electrical alogy – Two and Three Surfaces Interaction – Radiation Shields – Introduction to Gas Radiation.           it – IV         Phase Change Heat Transfer and Heat Exchangers         9														
Analo	nit - III       Radiation Heat Transfer       9         ectro Magnetic Spectrum – Thermal Radiation - Concept of Black Body - Basic Laws of Black Body Radiation – Absorptivity,       effectivity and Transmissivity – Kirchoff's Law of Radiation – Shape Factor and its Algebra – Radiosity and Irradiation – Electrical halogy – Two and Three Surfaces Interaction – Radiation Shields – Introduction to Gas Radiation.       9         nit – IV       Phase Change Heat Transfer and Heat Exchangers       9         nase Change Heat Transfer: Boiling – Pool boiling: Nucleate Boiling and Film boiling – Flow Boiling – Condensation –       Drop-														
Unit -	Ectro Magnetic Spectrum – Thermal Radiation - Concept of Black Body - Basic Laws of Black Body Radiation – Absorptivity, flectivity and Transmissivity – Kirchoff's Law of Radiation – Shape Factor and its Algebra – Radiosity and Irradiation – Electrical alogy – Two and Three Surfaces Interaction – Radiation Shields – Introduction to Gas Radiation.           it – IV         Phase Change Heat Transfer and Heat Exchangers         9           ase Change Heat Transfer and Heat Exchangers         9														
Phase wise	and Film-wi	eat Transfer: Boiling – Pool boiling: Nucleate Boiling and Film ise Condensation – Correlations in Boiling and Condensation	boiling – F on Heat F	low Boiling – ( xchangers: Ti	vonde voes (	ensation of Heat	on – at Exc	Drop- hangers –							
Logar	ithmic Mear	n Temperature Difference (LMTD) Method – Effectiveness –	- Number	of Transfer U	nits (N	ITU)	Metho	d –Fouling							
Facto	rs.														
Unit -	- V Tranafari M	Mass Transfer and Latest Trends in the field of Heat trans	ster on Fauin	olor Counter	D:#	<u></u>	Convo	9 otivo Mooo							
Trans	fer – Heat	and Mass Transfer Analogy. Latest Trends: Nano Fluids for	Heat Trar	nsfer – Coolin	a of E	Electro	nic Co	omponents							
Thern	nal Manager	nent in Electric Vehicles using IoT.			0										
LIST	OF EXPERI	MENTS / EXERCISES:													
1.	Determinat	tion of Thermal Conductivity of the given Insulating Material.													
2.	Experimen	tal Study on Transient Heat Conduction.													
3.	Determinat	tion of Convective Heat Transfer Co-efficient in Natural and For	rced Conve	ection modes.											
4.	Determinat	tion of the Fin Effectiveness and Efficiency in Free and Forced	Convectior	n Heat Transfe	r mod	es.									
5.	Determinat	tion of Stefan-Boltzmann Constant using Stefan-Boltzmann Ap	paratus.												
6.	Determinat Measurem	tion of Emissivity of the given Test Specimen at vario ent Apparatus.	us Tempe	eratures using	the	Emis	sivity								
7.	Determinat Exchanger	tion of Heat Transfer rate and Effectiveness of the given De	ouble Pipe	Heat Exchan	ger a	nd Sh	ell &	Tube Heat							
8.	Performan	ce Test on Vapour Compression Refrigeration Test Rig.													
9.	Performan	ce Test on Air-Conditioning Test Rig.													
10.	Data study	from Infra-Red Thermography Images.													
				Lectur	re:45,	Pract	ical:3	), Total:75							
TEXT	BOOK:		<b>6</b> 11 4 at -												
1.	Sachdeva New Delhi,	R.C., "Fundamentals of Engineering Heat and Mass Trans, 2017.	ster", 1 <sup>st</sup> E	dition, New A	.ge In	ternat	ional I	Jublishers,							
REFE	RENCES/ N	IANUAL / SOFTWARE:													
1.	Holman.J.I	P., Souvik Bhattacharyya,"HeatTransfer",10 <sup>th</sup> Edition, McGraw-	Hill Educat	ion, India,2017	<u>.</u>										
2.	Yunus A. C India, 2020	Cengel, AfshinJ.Ghajar,"Heat and Mass Transfer: Fundamentals ).	and Appli	cations", 6 <sup>th</sup> Ed	ition, I	McGra	aw Hill	Education,							
3.	D.K. Dixit,	"Heat and Mass Transfer", 1 <sup>st</sup> Edition, McGraw Hill Education, I	India, 2015												
4.	Heat Trans	sfer Laboratory Manual.													

COUR	SE OUTC	OMES:											BT Mapped	1
On cor	npletion of	the co	urse, the	student	s will be	able to						(H	ighest Lev	el)
CO1	recogniz	e the b	asic con	cepts a	nd evalu	uate the	e rate of	conduc	ctive he	at transfer	under	An	alyzing (K4	),
001	steady s	tate and	d transie	nt								Pi	recision (S3	)
CO2	apply fre	e and f	orced co	nvective	heat tra	ansfer co	orrelatio	n to inte	rnal and	d external f	ows	A	Applying (K3	3)
	,											P	recision (Sa	3) N
CO3	apply lav	vs of ra	diation in	calcula	ting hea	t transfe	er betwe	en two s	surfaces	3		F	Precision (S	s) 3)
004	design a	nd cond	duct the t	est on h	eat excl	nanger a	and estir	mate the	heat tr	ansfer co		An	alyzing (K4	),
CO4	efficient	and effe	ectivenes	s of the	heat ex	change	r.					Pi	recision (S3	)
COF	apply dif	fusive a	ind conv	ective m	ass tran	sfer cor	relations	s to solv	e mass	transfer		A	pplying (K3)	)
005	problems Precision (S3) Mapping of COs with POs and PSOs													
	-				Мар	ping of	COs w	ith POs	and PS	SOs		1		
COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	In of the course, the students will be able to       (Highest Legrize the basic concepts and evaluate the rate of conductive heat transfer under dy state and transient       Analyzing (Highest Legrize)         grize the basic concepts and evaluate the rate of conductive heat transfer under dy state and transient       Analyzing (Highest Legrize)         grize the basic concepts and evaluate the rate of conductive heat transfer under dy state and transient       Analyzing (Highest Legrize)         grize and forced convective heat transfer correlation to internal and external flows       Applying (Iighest Legrize)         y free and forced convective heat transfer correlation to internal and external flows       Applying (Iighest Legrize)         y laws of radiation in calculating heat transfer between two surfaces       Applying (Iighest Legrize)         grize and conduct the test on heat exchanger and estimate the heat transfer correlations to solve mass transfer       Applying (Iighest Legrize)         ent and effectiveness of the heat exchanger.       Precision (Signet)       Precision (Signet)         y diffusive and convective mass transfer correlations to solve mass transfer       Applying (Iighest Legrize)       Applying (Iighest Legrize)         lems       Mapping of COs with POs and PSOs       PO1       PO11       PO12       PSO1         2       3       2       2       1       3       2       2         2       3       2       2       1		2	3									
CO2	2		MES:         BT Mapped (Highest Level)           the basic concepts and evaluate the rate of conductive heat transfer under te and transient         Analyzing Precision (S3)           and forced convective heat transfer correlation to internal and external flows         Applying (K3) Precision (S3)           of radiation in calculating heat transfer between two surfaces         Applying (K4), Precision (S3)           I conduct the test on heat exchanger and estimate the heat transfer co deflectiveness of the heat exchanger.         Applying (K4), Precision (S3)           sive and convective mass transfer correlations to solve mass transfer         Applying (K3) Precision (S3)           Mapping of COs with POs and PSOs         PO2           PO3         PO4         PO5         PO6         PO7         PO8         PO9         PO10         PO11         PO12         PSO1         F           3         3         2         1         3         2         2           3         3         2         1         3         2         2           3         3         2         1         3         2         2           3         3         2         1         3         2         2           3         2         2         1         2         2         2         2 <td>3</td>				3							
CO3	2		3				2		1	1		2	2	3
CO4	2		3	3	2		2		1	3		2	2	3
CO5	2		3		2		2			1		2	2	3
1 – Slig	ght, 2 – Mo	oderate	, 3 – Sub	stantial,	BT- Blo	om's Ta	axonomy	ý						
					ASS	SESSME	ENT PA	TTERN	- THEC	DRY				
CO1       Analyzing (K4), Precision (S3)         CO1       Analyzing (K4), Precision (S3)         CO2       apply free and forced convective heat transfer correlation to internal and external flows       Analyzing (K4), Precision (S3)         CO3       apply free and forced convective heat transfer correlation to internal and external flows       Applying (K3) Precision (S3)         CO3       apply laws of radiation in calculating heat transfer between two surfaces       Analyzing (K4), Precision (S3)         CO4       design and conduct the test on heat exchanger and estimate the heat transfer correlations to solve mass transfer correlations to solve mass transfer       Applying (K3) Precision (S3)         CO5       apply diffusive and convective mass transfer correlations to solve mass transfer       Applying (K3) Precision (S3)         CO5       PO1       PO2       PO3       PO6       PO7       PO8       PO9       PO10       PO11       PO1       P S01       PS02         CO5       PO1       PO1       PO1       PO12       PS01       PS02 <th< td=""></th<>														
Ca	tegory*		(K1)	%		(K2) %	)	(K3)	%	(K4) %	۲)	(5) %	(K6) %	%
(	CAT1		10			20		4(	)	30				100
	CAT2		20			30		50	)					100
(	CAT3		10			20		40	)	30				100

 ESE
 10
 20

 \* ±3% may be varied (CAT 1, 2 3 – 50 marks & ESE – 100 marks)

		22MEC52 - DYNAMICS OF MA	CHINE	RY				
Progra Brancł	mme &	BE & Mechanical Engineering	Sem.	Category	L	т	Р	Credit
Prereq	uisites	Engineering Mechanics, Kinematics of Machinery, Strength of Materials	5	PC	3	0	2	4
Pream	ble	This course provides the theoretical as well as practical kill members, balancing of rotating & reciprocating masses in va fluctuation in speed of governors, gyroscopic effect on variou vibration in various systems.	nowledg rious typ us mode	e on force a bes of engine s of transpor	inalys es. It a t syst	sis of also e tems,	variou mphas impac	s static & dynamic sis on analyzing the t of free and forced
Unit –		Force Analysis						9
Static Princip of Ener <b>Unit –</b>	Force An le – Inerti gy of Rec <b>II</b>	alysis – Free Body Diagrams, Conditions of Two, Three and a Force Analysis in Reciprocating Engines – Crank Shaft Torqu ciprocating Engine Mechanisms – Coefficient of Fluctuation of E Balancing	d Four F le. Flywh inergy al	Force Member neels – Turnir nd Speed – N	ers. Ir ng Mo Weigh	nertia oment nt of F	Force Diagra	s and D'Alembert's ams and Fluctuation <u>el Required.</u> <b>9</b>
Static a – Balar	and Dyna ncing of R	mic Balancing – Balancing of Rotating Masses – Balancing a S Radial Engine – Direct and Reverse Crank Method.	Single C	/linder Engin	e – B	alanc	ing Mu	lti Cylinder Engines
Unit –		Governors and Gyroscope			0			9
I ypes Contro	– Centrifi Ilina Forci	ugal Governors – Gravity Controlled and Spring Controlled Cer e. Gvroscopes – Gvroscopic Couples – Gvroscopic Effects in A	ntrifugal utomobil	Governors – es. Ships and	Chai d Aer	racter oplan	istics - es.	- Effect of Friction –
Unit –	IV	Free Vibration				001011		9
Basic F by Ene Dampir Freque <b>Unit –</b>	Features of ergy Mething – Free ency of Tw V	of Vibratory Systems – Types – Single Degree of Freedom Syst nod – Dunkerley's Method - Critical Speed - Damped Free e Vibration with Viscous Damping – Critically Damped Syste vo and Three Rotor Systems. Forced Vibration	tem – Tr Vibration em, Unc	ansverse Vib n of Single I ler Damped	ratior Degre Syste	n of Bo e Fre em. T	eams - edom orsiona	- Natural Frequency System - Types of al Systems: Natural <b>9</b>
Respor	nse to Pe	riodic Force – Harmonic Force – Force caused by Unbalance	– Supp	ort Motion - I	_ogar	ithmic	Decre	ement Magnification
Factor	<ul> <li>Vibratic</li> </ul>	on Isolation and Transmissibility.						
LIST O	F EXPER	RIMENTS / EXERCISES:						
1.	Draw the	Force and Couple Polygon for Static and Dynamic Balancing of	Rotatin	g Masses.				
2.	Determin	e the Characteristics of Porter governor using Universal Govern	or Appa	ratus.				
3.	Determin	e the Loss of Couple due to Friction using Gyroscopic Couple A	pparatus	S.				
4.	Determin	e the Natural and Critical Frequency of given Shaft using Whirlin	ng of Sha	aft Apparatus	i.			
5. I	Determin	e the Natural Frequency of given Spring using Spring Mass Sys	tem.					
6.	Determin	e the Transmissibility Ratio of given Eccentric Mass in Vibration	Table.					
7.	Determin	e the Damping Ratio of Single Rotor System with Viscous Damp	oing.					
8.	Determin	e the Natural Frequency of Free - Free Beam.						
9.	Determin	e the Forced Frequency of Cantilever Beam.						
10.	Determin	e the Natural frequency of Double Rotor System.						
11.	Simulatio	n Models using MATLAB.					45 D-	
TEXT	BOOK:				ec	Jure:	40, Pra	autical.30, 10tal:75
1.	Rattar	S.S., "Theory of Machines", 5 <sup>th</sup> Edition, McGraw Hill Education	n Publish	ing Company	y Ltd.	, New	Delhi,	2022.
REFER	RENCES/	MANUAL / SOFTWARE:						
1.	Labor	atory Manual.						
2.	Khurn	ni R.S. and Gupta J.K., "Theory of Machines", 14 <sup>th</sup> Edition, S. Cl	nand & (	Co. Ltd., New	Delh	i, 202	0.	
3.	Sadhu	J Singh, "Theory of Machines", 3 <sup>rd</sup> Edition, Pearson Education Ir	ndia, Ne	w Delhi, 2012	2.			

COURS On comp	E OU	TCOM	ES: course,	the stude	ents will	be able t	0							BT Maj (Highest	pped Level)
CO1	solv chai	e and racteris	apply the stics of s	e effect of tatic syste	static a	nd dynan balancing	nic force	s acting	on diffe	erent mee	chanisms	, evaluate tł	ne I	Applying Manipulat	j (K3), ion (S2)
CO2	solv	e and	plot the	static and	dynami	c balanci	ng of vai	rious me	echanic	al system	าร		ſ	Applying Manipulat	j (K3), ion (S2)
CO3	appl auto	ly and pmobile	solve the	e fluctuation and s	on effec ship app	ts in gove lications	ernors ar	nd the ef	ffects o	f gyrosco	pic coupl	e in	ſ	Applying Manipulat	j (K3), ion (S2)
CO4	appl med	ly and chanica	solve the	e impact o Is	of free vi	brations	and anal	yze its c	characte	eristics in	the desig	gn of	ſ	Applying Manipulat	j (K3), ion (S2)
CO5	appl med	ly and chanica	solve the	e impact o Is	of the for	ced vibra	ations an	d analyz	ze its cł	naracteris	stics in the	e design of	ſ	Applying Manipulat	j (K3), ion (S2)
	Mapping of COs with POs and PSOs           s/Pos         PO1         PO2         PO3         PO4         PO5         PO6         PO7         PO8         PO9         PO10         PO11         PO12         PS01         PS02														
COs/PC	Ds/POs         PO1         PO2         PO3         PO4         PO5         PO6         PO7         PO8         PO9         PO10         PO11         PO12         PS01         PS02           CO1         3         3         3         2         2         3														
CO1	Os/POs         PO1         PO2         PO3         PO4         PO5         PO6         PO7         PO8         PO9         PO10         PO11         PO12         PS01         PS02           CO1         3         3         3             2            3         3														
CO2		3	3		3					2					3
CO3		3	3		3					2					3
CO4		3	3		3					2					3
CO5		3	3		3					2					3
1 – Sligh	nt, 2 –	Moder	rate, 3 –	Substanti	al, BT- I	Bloom's T	Taxonom	iy		1		1	1	1	
								•							
						ASSE	ESSMEN	IT PATT	ERN -	THEOR	(				
Test Ca	/ Bloo tegor	om's ′y*	Re	memberi (K1) %	ng l	Jndersta (K2)	nding %	Apply (K3)	ying %	Analyzi (K4) 9	ing %	Evaluating (K5) %	Cr (ł	eating (6) %	Total %
	CAT1			10		10		80	)						100
	CAT2			10		10		80	)						100
	САТЗ			10		10		80	)						100
	ESE			10		10		80	)						100
* ±3% m	ay be	varied	I (CAT 1,	2 3 - 50	) marks	& ESE –	100 mar	ks)			· · ·				

		22MET51 - OPERATIONS RESEARCI	Н					
Progra Branch	mme & n	BE & Mechanical Engineering	Sem.	Category	L	т	Ρ	Credit
Prereq	uisites	Numerical Methods for Engineers	5	PC	3	1	0	4
Preamb	ble	This course provides an in-depth insight into the concepts, theo It also emphasis the role of operation research in planning, contro be successfully used for optimizing the managerial decisions.	ories and olling an	d techniques d enhancing	of C perfe	)pera ormai	tions nce w	Research. hich could
Unit –		Linear Models						9+3
Introdu Solutio	iction - Pha ns to LPP	ases of Operations Research Study – Formation of Linear Program	ming Pro iique - Bi	blem (LPP) - ig M Method	Car - Tw	nonic o Pha	al forn ase M	n of LPP – ethod.
Unit –	1	Transportation Problems, Assignment Problems and Sequen	cing Pro	oblems				9+3
Transp Method Assign Sequer 2 Jobs	ortation Pr d (LCM)–V ment Prob ncing Prob 'M' Machir	oblems: Mathematical Formulation-Basic Feasible Solutions – Nort ogels Approximation Method (VAM). Optimality Test – Modified Dis lems: Mathematical Formulation –Hungarian Algorithm. lems:1 Job' M' Machine, 'N' Jobs 1 Machine, 'N' Jobs 2 Machines, ne Problems.	h-West ( tribution N' Jobs	Corner (NWC (MODI) Tech 3 Machines, '	;) me nniqu N' Jo	ethod ie. obs M	– Lea 1 Mac	ist Cost hine and
Unit –		Network Models and Project Management						9+3
Networ Project (PERT)	k Models: Managem & Critical	Shortest Route - Minimal Spanning Tree - Maximum Flow Models. ent: Construction of Networks - Activity and Event Based Diagrams Path Method (CPM) Problems – Cost Analysis and Crashing of Ne	s – Progi tworks.	ram Evaluatic	on ar	nd Re	view <sup>·</sup>	Technique
Unit –	IV	Inventory Models						9+3
Types Invento	of Invento bry Models	<ul> <li>ry – Economic Order Quantity (EOQ) - Deterministic Inventory</li> <li>Multi Item Deterministic Models - Selective Inventory Control Tec</li> </ul>	Models hniques.	- Price Brea	ık Pi	roblei	ms -	Stochastic
Unit – '	V	Queuing Models and Replacement Models						9+3
Queuin -Expon Replac Replac	g Models: ential Serv ement Moo ement Poli	Queuing Systems and Structures - Notations - Parameter - Single ice - Constant Rate Service - Infinite Population. dels: Replacement of Items Due to Deterioration with and without Ti cy.	Server a ime Valu	nd Multi serv	er M Indi <sup>,</sup>	odels vidua	- Poi I and	sson Input Group
				Lecture:	45, <sup>-</sup>	Tutor	ial:15	i, Total:60
TEXT E	BOOK:							
1.	Gupta P.I	K. & Hira D.S., "Operations Research", 7 <sup>th</sup> Edition, S. Chand Publis	hing, Ne	w Delhi, 2014	4.			
REFER	RENCES:							
1.	Taha & H	Hamdy A., "Operations Research: An Introduction", 10 <sup>th</sup> Edition, Pe	arson E	ducation, Che	enna	i, 201	17	
2.	Hiller Fre	ederick S. , Lieberman Gerald J., Bodhibrata Nag & Preetam Bas McGraw-Hill Education, Bengaluru, 2017,	u, "Intro	duction to Op	perat	tions	Rese	arch", 10 <sup>th</sup>

COURS On com	SE OU	JTCON on of the	IES: e course,	, the stude	ents will	be able	to						(	BT Mapp Highest L	oed evel)
CO1	form	ulate a	ind solve	linear pro	grammi	ng prob	lems							Applying (	K3)
CO2	deve	elop ad	vanced s	olutions i	n transp	ortation,	assigni	ment an	d seque	encing p	problems			Applying (	K3)
CO3	cons	struct n	etworks a	and analy	ze optim	nality for	Industri	al appl	ication				/	Analyzing	(K4)
CO4	CO4       compare various inventory module including EOQ and select appropriate inventory control       Analyzing (K4)         CO5       measure queuing characteristics and compute the optimum replacement period for capital       Analyzing (K4)														
CO5	CO5     measure queuing characteristics and compute the optimum replacement period for capital equipment's and items that fail unexpectedly     Analyzing (K4)														
	equipment's and items that fail unexpectedly														
			-	1	1	Mappin	g of CC	s with	POs an	d PSO	S		1		1
COs/P	Os	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	P011	PO12	PSO1	PSO2
CO1		2	3	1										3	1
CO2	2	2	3	1										3	1
COS	3	1	3									2		3	1
CO4	ŀ	2	3	1										3	1
CO5	5	2	3	1										3	1
1 – Slig	ht, 2 -	- Mode	erate, 3 –	Substant	ial, BT- I	Bloom's	Taxono	my							

ASSESSMENT PATTERN – THEORY											
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %				
CAT1	20	30	50				100				
CAT2	20	20	30	30			100				
CAT3	20	20	30	30			100				
ESE	10	20	35	35			100				
* ±3% may be varied (CAT 1, 2 & 3 – 50 marks & ESE – 100 marks)											

22MET52 - ARTIFICIAL INTELLIGENCE IN MECHANICAL SYSTEMS												
Program	nme &											
Branch	B.E. & Mechanical Engineering	Sem.	Category	L	Т	Р	Credit					
Prerequi	isites Nil	5/7	PC	3	0	0	3					
Preamble	This course gives a brief introduction about Artificial Intelligence (AI) and the types of data used in mechanical systems. This course also provides detailed description about the usage of AI in mechanical systems. In addition, provides the role of AI in global business.											
Unit - I	Artificial Intelligence (AI) in Manufacturing:						9					
Overviev Shortcor as a Key	<ul> <li>N, Need and Application of AI in Manufacturing – Advantage</li> <li>mings - Risk Associates with AI. AI in Process Capabilities: In</li> <li>Component of Future Manufacturing.</li> </ul>	ges – AI as a C nprovement at Pr	atalyst to Smart ocess Level – B	Manufa enefits a	cturing t Orgar	<ul> <li>Advant</li> <li>izational I</li> </ul>	tages and Level – Al					
Unit - II	Data Types and its Preparation:						9					
Data Types – Structured – Unstructured – Static – Streamed – Attitudinal – Behavioral – Demographic - Data Driven Analytics - User Driven Analytics - Data Validity – Variety - Velocity of Constantly Changing – Attributes - Converting Raw Data into Matrix - Data Clustering - K means Algorithm - Nearest Neighbors - Identifying Objective of Data - Cleaning the Data - Structuring the Data – Data Preparation – Normalization - Binning – Sampling.												
Unit - III	AI and Predictive Analytics:						9					
Introduction, Enabling Technologies for Industry 4.0 - Data Technologies (DT): Data Pre-processing, Feature Engineering, Data-driven Analytics, Cyber Physical Production systems and Digital Twin - Platform Technologies (PT) - Operations Technology (OT): Product Lifecycle Management (PLM), Enterprise Resource Planning (ERP), Manufacturing Execution System (MES), Customer Relationship Management (CRM), Supply Chain Management (SCM) - Case study: Intelligent Bandsaw System & Challenges.												
Unit – IV	Unit – IV AI on Global Business and Sustainability: 9											
Introduction – Need for AI in Global Business – Future Impact of AI in Global Business Practices, Achieving Sustainability – Smart Manufacturing – Futuristic Agriculture – Transforming Construction – Revolutionizing Manufacturing – Strategic Retailing – Revamping Media and Entertainment – Remodelling Financial Services – Reshaping Education, Adverse Impacts of AI in Sustainability.												
Unit - V	Unit - V Smart Applications of Al: 9											
Smart Agriculture – Smart Healthcare – Smart Education – Smart Grids – Smart Transportation and Autonomous Vehicles – Smart Homes – Smart Cities – Al in metal cutting.												
							Total:45					
TEXT BO	DOKS:											
1. Stuart J. Russell and Peter Norvig, "Artificial Intelligence A Modern Approach", Prentice Hall, 2010 for Units I,III												
2. Kaushik Kumar, Divya Zindani, Paulo Davim, "Artificial Intelligence in Mechanical and Industrial Engineering", 1 <sup>st</sup> Edition, CRC Press, New York, 2021 for Unit II												
3. Geeta Rana, Alex Khang, Ravindra Sharma, Alok Kumar Goel, Ashok Kumar Dubey, "Reinventing Manufacturing and Business Processes Through Artificial Intelligence", 1 <sup>st</sup> Edition, CRC Press, New York, 2022 for Unit IV												
4.	4. Masoud Soroush, Michael Baldea, Thomas F. Edgar, "Smart Manufacturing Concepts and Methods", 1 <sup>st</sup> Edition, Elsevier, United States, 2020 for Unit V											
REFERE	ENCES:											
1.	John D. Kelleher, Brian Mac Namee, Aoife D'Arcy, "Fundamentals of Machine Learning for Predictive Data Analytics", 2 <sup>nd</sup> Edition, MIT Press, Cambridge, 2020.											
2.	U. Dinesh Kumar, "Business Analytics The Science of Data-driven Decision Making", Wiley India, 2017.											

COURS	E OUTC	OMES:	the stude	onts will	he able	e to							BT Mapp Highest L	ed evel)	
CO1 explain the need for AL in manufacturing sector															
001											U	Understanding(K2)			
CO2	O2 identify and prepare data for predictive analytics												Applying(K3)		
CO3	CO3 illustrate the concepts of industrial AI and predictive analytics												Applying(K3)		
CO4	describe the various concepts of AI in global business and its sustainability											U	Understanding(K2)		
CO5	CO5 explain the different types of smart applications using AI											U	Understanding(K2)		
Mapping of COs with POs and PSOs															
COs/PO	s PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	
CO1	2	1			1	1			2				1	2	
CO2	3	2	1		2	1			2				2	3	
CO3	3	2	1		2	1			2				2	3	
CO4	2	1			1	1			2				1	2	
CO5	2	1			1	1			2				1	2	
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy															
ASSESSMENT PATTERN - THEORY															
Test / Bloom's Category*		Remembering (K1) %		Un	Understanding (K2) %		App (K3	lying 3) %	Analyzing (K4) %		Evaluating (K5) %	Creating (K6) %		Total %	
CAT1			20		50		:	30						100	
CAT2			20		50		:	30						100	
CAT3 30		30		70									100		
ES	ESE 10			60		:	30						100		
* ±3% m	ay be va	ried (CAT	1, 2 & 3 – 5	50 mark	s & ESI	E – 100	marks)		•						
	22MEL51 - CAM AND ROBOTICS LABORATORY														
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Progra Branch	mme & N	B.E. &	Mechar	nical Er	gineer	ing				Sem.	Category	L.	ГР	Credit	
Prereq	uisites	Manufa Machir	acturing ne Draw	g Tech ing and	nology d AutoC	/, Eng CAD La	ineerin borator	g Dra 'y	wing,	5	PC	0	0 2	1	
Preamb	ble	This co interfact operation	ourse pr e with r ons.	ovides nachine	hands-o s. Also	on expe offers l	erience knowlec	in CAD Ige in th	) / CAN ne virtua	/I softwa al reality	re, generatic software, inc	on of m dustrial	nachine c robots a	odes to nd CNC	
LIST O	F EXPERI	MENTS	EXER	CISES:											
1.	Study of (	G codes	and M c	odes fo	r machi	ning ce	ntre and	d turning	g centre	<b>)</b> .					
2.	Part prog	ram gene	eration a	and mac	hining o	of given	compo	nent us	ing CN	C Turnin	g Centre (JO	BBER	XL).		
3.	Part prog	ram gene	eration a	and mad	chining o	of given	compo	nent us	ing CN	C Vertica	al Milling Cen	tre (L N	/ill 55).		
4.	Simulate to CNC M	a given F 1achining	Part and Center	Genera	ate CNC	code f	or a giv	en Com	ponent	using M	ASTER CAN	1 (Mill)	and inter	acing it	
5.	Simulate it to CNC	a given F Turning	Part and Center.	Genera	ate CNC	code f	ior a giv	en Com	ponent	using M	ASTER CAN	1 (Lathe	e) and int	erfacing	
6.	Manufact	uring a N	lodel of	Mechar	nical Co	mpone	nt using	CNC L	aser Cu	utting Pro	ocess.				
7.	Performir	ng Engrav	ving Op	eration	of a sim	ple art o	or detail	s over a	a compo	onent us	ing CNC Las	er Eng	raving Ma	achine.	
8.	Point to F	Point Prog	grammir	ng for a	given a	pplicatio	on using	g 6 Axis	Articula	ated Arm	Robot.				
9.	Continuo	us Progra	amming	for a giv	ven app	lication	using 6	3 Axis A	rticulate	ed Arm F	Robot.				
10. Robot programming using Virtual Reality software for a given application (Identification of colours in pallet).															
11.	Robot pro	ogrammir	ng using	Virtual	Reality	softwar	re for a	given ap	oplicatio	on (Pick	and Place ap	plicatio	ons).		
													-	Fotal:30	
REFER	ENCES/ N	IANUAL	/SOFT	NARE:											
1.	Laborator	ry Manua	ls.												
2.	Master C	AM X5 so	oftware.												
3.	Groover Hall of In	M. P, "A dia, New	utomati Delhi, 2	on, Pro 2016.	duction	Syster	n and (	Compute	er Integ	grated N	lanufacturing	", 3 <sup>rd</sup> E	Edition, P	rentice-	
COURS On com	SE OUTCO	DMES: the cours	se, the s	tudents	will be	able to						()	BT Map lighest L	ped _evel)	
CO1	develop L Mill 55	CNC pro	ogram f	or diffe	rent op	erations	s and p	oroducti	on with	n JOBE	BER XL and	N	Applying lanipulati	(K3), on (S2)	
CO2	simulate	using CA	M packa	age and	linterfa	ce the c	develop	ed prog	ram wit	h the CN	IC machine.	N	Applying	(K3),	
CO3	develop r	obot prog	grammir	ng for in	dustrial	operati	on usin	g virtual	reality	software	).	Ma	Applying anipulatic	(K3), on (S2)	
	Manning of Cos with POs and PSOs														
COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	
CO1	2	1			3				2				3	2	
CO2	2	1			3				2				3	2	
CO3	2	1			3				2				3	2	
1 – Slio	iht. 2 – Mo	derate, 3	- Subs	tantial. I	BT- Blo	om's Ta	axonom	v							

	22MEL52 - SURFACE AND SHEET METAL DESIGN LABORATORY														
Progra Branci	amme h	&	BE &	Mechai	nical Er	gineer	ing				Sem.	Category	L	ТР	Credit
Prereq	luisite	s	Engin Auto(	eering	Draw borator	ving, Y	Machin	e Dr	awing	and	5	PC	0	0 2	1
						_									
Pream	ble		This c and a	ourse p dvanced	rovides I modeli	the praing of co	actical kr ompone	nowled nts.	ge on u	sing the	e CAD to	ools for draft	ing a	componer	nt design
LIST O	F EXF	PERIN	IENTS	EXER(	CISES:										
1.	Crea	ate a S	imple S	Surface V	with Ger	neral Op	otion Ext	rude, F	Revolve	, Sweep	o and Ble	end.			
2.	Perfo	orming	g Surfac	e Trim,	Merge,	Extend	, Project	, Fill ar	nd Mirro	r option	is to Cre	ate Complex	Surfa	ces.	
3.	Crea	ating A	Surfac	e with B	oundary	/ Blend	And Va	riable S	Section	Sweep	Operatio	ins.			
4.	Conv	verting	the Su	rfaces i	nto a Sc	lid Com	nponent	Using	Thicken	and So	olidify.				
5.	Crea	ating a	Simple	Surface	e with F	reestyle	option.								
6.	Intro	ductio	n and C	reating	Primary	Sheet	Metal W	all feat	tures.						
7.	Crea	ating S	econda	ry Shee	t Metal	Wall fea	atures w	ith Flar	nge.						
8.	Crea	ating B	ending	and Unl	pending	in Shee	et Metal	Walls.							
9.	Conv	versio	n from S	Solid Mo	del to S	heet M	etal Moc	lel and	Develo	ping the	e Surface	es.			
10.	10. Creating a Simple Bracket with Gusset Design and Punch Form.														
11.	11. Creating a Hopper and Developing the Surfaces for Sheet Cutting Operations.														
															Total:30
REFER	RENC	ES/ M	ANUAL	/SOFT	WARE:										
1.	Shar	n Tick		C Creo	Parame	etric 6.0	for Desi	gners"	, 6 <sup>th</sup> Edi	tion, CA	AD CIM	Technologies	s, Nev	/ Delhi.	
2.	CRE	O 9.0	, SOLID	WORK	S-2020	, CATIA	V5-6 R	2015.							
3.	CAD	LAB	Manual.												
COUR	SE OL	лтсо	MES:											BT Map	ped
On con	npletic	on of th	ne cours	se, the s	tudents	will be	able to							(Highest	Level)
CO1	apply	y the c	concept	of CAD	parame	etric with	n advano	ced sur	face cre	eating o	ptions			Applying Manipulat	) (K3), ion (S2)
CO2	appl desig	y the c gns	concept	of wall of	creation	to mak	e the sir	nple sh	ieet me	tal brac	kets and	mounting		Applying Manipulat	g (K3), ion (S2)
CO3	appl	y the	develop	ment pr	ocess t	o deterr	nine the	shape	and sh	eet req	uired for	fabrication	ſ	Applying /anipulatio	(K3), on (S2)
						Mana	na cí O		<b>DO</b>		20			•	. /
COc/P	0		PO2	PO3	PO4				POS 2		DS PO10	PO11	PO12	<b>D6</b> 01	<b>Deu</b> s
CO3/P		3	102	1	104	3	100	101	100	2	1010	FUT	2	3	2
CO2	2	3		. 1		3				2			2	3	2
CO3	3	3		1		3				2			2	3	2
1 – Slig	ght, 2 -	– Mod	erate, 3	– Subs	tantial,	BT- Blo	om's Ta	xonom	у	1		<u>i</u>			1

		22GEL51 -	PROFESSION	AL SKILLS TRA	INING -	II				
		(Common to All BE	/ BTech Engine	eering and Techr	ology bra	anches)				
Progra Branc	amme & h	All BE/ BTech Engineering a	nd Technolog	y branches	Sem.	Category	L	т	Ρ	Credit
Prerec	luisites	Nil			5	EC	0	0	80	2
Pream	ble	This subject is to enhance the	employability sl	kills and to devel	op caree	r competency	, ,			I
Unit –	I	Soft Skills – II :								20
Group of a te Facing Comm intervie	discussions eam, why tea g an interviev unication sk ews.	Advantages of group discussion m-Elements of leadership, disa r: Foundation in core subject- i Ils-Activities before Interview,	ons-Structured advantages of a industry orienta upon entering	GD- Team work: a team, stages o ation / knowledge g interview room	Value of f team fo e about th n, during	rmation- Gro rmation- Gro ne company- the intervie	n org up de prof w ar	janiza evelo essio nd at	ations- L pment a nal pers	Definition activities. sonality- nd Mock
Unit –		Quantitative Aptitude and Lo	ogical Reasoni	ing – II:						30
Proble and p Probat reason reason	m solving le olynomial e bility-Statistic ing: Conditic ing- Quant b	vel II: Money related problems quations-Special, equations-Ine s-Data sufficiency- Geometry-Ti nality and grouping-Sequencing ased reasoning-Flaw detection-	-Mixtures-Syml equalities-Sequ rigonometry-He g and schedulir Puzzles-Crypta	bol base probler ence and serie eights and distan ng- Selections-N arithms.	n-Clocks s-Set th ces-Co-c etworks:-	and calenda eory-Permuta ordinate geon Codes; Cube	ars-S ations netry es-Ve	imple s and -Men: enn di	linear-c comb suration iagram i	quadratic inations- . Logical n logical
Unit –	III	Reading & Speaking Skills	**							30
Readir Identify compro of an Readir Sharin Preser Speak Teleph	ng: Reading ying and low ehension / so argument – ng notices an g of Real T ntation on Va ing; Pair Dis- nonic Conver	comprehension – Effective Read ating factual information within canning for specific information dentifying the writer's attitude id book reviews –Interpreting g ime Experience; Conversation rious Topics – Technical / Non- cussion – Group Discussion – T sations & Skills – Negotiating Ski	ding strategies in a text – gl – detailed com and opinions – graphic data & a nal Practices – -Technical Topi The process of C kills.	<ul> <li>Descriptive, Ir</li> <li>lobal reading/ski</li> <li>prehension / interprehension / interprehension</li> <li>Reading news</li> <li>Advertisements.</li> <li>Role Play – Shics – Project Rev</li> <li>Group Discussion</li> </ul>	nferential imming f ensive rea articles i Speaking nort Talks view Pres n – Strate	, & Argumen or general u ading – under in business r g: Mock Inter s / TED Tal entation – O egies to be ac	tative inder stan naga views ks – rator lopte	e read stand ding t zines s –Se Exter y and d – S	ding pas ding – s the deve s, newsp elf-Introc npore; ( l Effectiv skills Ass	ssages – selective elopment oapers – duction – Giving a ve Public sessed –
										Total:45
TEXT	BOOK:									
1.	Edgar Tho Services P	pe and Showick Thorpe, "Objec /t Ltd, 2017.	tive English for	Competitive Exa	mination	", 6th Edition	Pea	rson	India Ec	lucation
REFE	RENCES:									
1.	Aruna Kon	ru, "Professional Speaking Skill	ls," Oxford Univ	versity Press Indi	a, New D	elhi, 2015.				
2.	Thorpe, Sh	owick and Edgar Thorpe, "Winn	ing at Interview	s," 5th edition, P	earson E	ducation, Ind	ia, 20	013.		
3.	Rizvi, Ashr	of M, "Effective Technical Comm	nunication," 2nd	d Edition, McGrav	w Hill Edu	ication India,	2017	<b>7</b> .		

COUR On co	SE OUTCOMES: mpletion of the course, the students will be able to	BT Mapped (Highest Level)
CO1	develop the soft skills of learners to support them work efficiently in an organization as an individualand as a team	Applying (K3), Precision (S3)
CO2	solve real time problems using numerical ability and logical reasoning	Applying (K3), Precision (S3)
CO3	apply reading and speaking skills effectively for various academic and professional purposes	Applying (K3), Precision (S3)

	Mapping of COs with POs and PSOs													
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2				3	3		3	0	3	2		
CO2	3	2				3	3		3	0	3	2		
CO3		2				3	3		3	3	3	3		

		ASSESSMENT	PATTERN	THEORY			
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	40	40				100
CAT2		50	50				100
CAT3		50	50				100
ESE				NA			
* ±3% may be varied	(CAT 1,2 & 3 – 50 m	arks)					

		22MET61 - DESIGN OF MACHINE ELEME	ENTS										
(Use	of PSG D	esign Data book / Machine Design Data book by V.B.Bhandari is p	ermitted	for the End S	Seme	ester	Exam	ination)					
Prograi Branch	mme &	BE & Mechanical Engineering	Sem.	Category	L	т	Ρ	Credit					
Prerequ	uisites	Engineering Mechanics, Strength of Materials	6	PC	3	1	0	4					
Preamb	ble	This course imparts the design of machine components like brac failure criteria to meet the desired needs. It also explores the design	ckets, sh gn of thre	haft, coupling eaded fasten	, spr ers a	ings, and w	bear elded	ing and its joints.					
Unit – I		Steady Stresses and Variable Stresses in Machine Members						9+3					
Introduc Direct B – Facto Relation	ction to the sending an r of Safety ns.	<ul> <li>Design Process – Factor influencing Machine Design - Selection</li> <li>d Torsion Stress Equations – Calculation of Principal Stresses for</li> <li>/ Theories of Failure – Stress Concentration – Design for Variable</li> </ul>	of Mater various L e Loadir	rials based or ₋oad Combina ng – Soderbe	n Me atior rg, (	is- E Good	ical P ccent man a	roperties – ric Loading and Gerber					
Unit – I	- II     Design of Shafts and Couplings     9+3												
Design Couplin	of Solid a igs.	nd Hollow Shafts based on Strength and Rigidity – Design of Keys	and Ke	y Ways – De	sign	of R	igid ar	nd Flexible					
Unit – I	11	Design of Fasteners and Welded Joints						9+3					
Threade Unsymr Moment	ed Fastene metrical W t. Descript	ers – Design of Bolted Joints Including Eccentric Loading – Design elded Joints - Eccentric Load in the Plane of Welds - Welded Joint ion on Designing of Riveted Joints.	of Welde Subjecte	ed Joints – Ax ed to Bending	kially Moi	Loa ment	ded and T	wisting					
Unit – ľ	V	Design of Springs and Power Screws						9+3					
Design of Cond Screw	of Helical centric Sp Jack and F	and Leaf Springs - Theory of Disc and Torsional Springs under Corrigs and Belleville Springs. Power Screws: Torque requirement Recirculating Ball Screw.	onstant l t – Desię	Loads and va gn of Screw	and	g loa Nut	ds – [ – Des	Description scription of					
Unit – \	/	Design of Bearings						9+3					
Design Design Bearing	of Bearing of Journa Failure C	Is - Preloading, Design of Rolling Contact Bearings - Load Carryin I Bearings - Mckee'S Equation - Calculation of Bearing Dimensia auses and Remedies.	g Capac ions – E	ity – Bearing Bearing Mate	Life rials	- Cu – Lւ	bic Me Ibricat	ean Load - ting Oils –					
				Lecture:	45, <sup>-</sup>	Tuto	rial:15	5, Total:60					
TEXT B	BOOK:												
1.	Bhandari	V.B., "Design of Machine Elements", 5th Edition, Tata McGraw-Hill,	New De	elhi, 2020.									
REFER	ENCES:												
1.	Shigley New Yor	J.E. and Mischke C.R., "Mechanical Engineering Design", 11 <sup>th</sup> k, 2020.	Edition,	McGraw Hill	Inte	ernati	onal	Education,					
2.	Robert L	. Norton., "Machine Design", 5 <sup>th</sup> Edition, Pearson, Chennai, 2018.											

COUR: On con	SE O	UTCON on of th	<b>IES:</b> e course	, the stude	ents w	ill be able	to							BT Mapı Highest L	oed .evel)
CO1	desi load	ign the ling cor	machine iditions	compone	nts su	bjected to	steady	stress a	nd var	iable stre	ess unde	er various		Applying (	K3)
CO2	sele	ct and	design th	ie shafts a	nd co	uplings for	differer	nt applic	ations					Applying (	(K3)
CO3	desi	ign the	screw fa	steners an	d weld	ded joints	for diffe	rent app	olicatio	ns				Applying (	K3)
CO4	desi	ign the	helical, le	eaf springs	and	oower scre	ews for o	different	t applic	ations				Applying (	K3)
CO5	CO5 identify, design and predict the life of bearings for different applications Applying (K3)														
		1	1		1	Mappin	g of CC	s with	POs a	nd PSO:	S			1	
COs/F	Os	PO1	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO	1	2	2												3
CO	2	2	2												3
CO	3	2	2												3
CO	4	2	2												3
CO	5	2	2												3
1 – Slig	ght, 2	– Mode	erate, 3 -	Substant	ial, BT	- Bloom's	Taxono	my		-1		L		1	
						ASSES	SMENT	PATTE	ERN - T	THEORY	,				
Tes C	t / Blo atego	oom's ory*	Re	ememberi (K1) %	ng	Understa (K2)	anding %	Apply (K3)	ying ) %	Analyz (K4) 9	ing   %	Evaluating (K5) %	g C	reating (K6) %	Total %
	CAT	1		15		15		70	)						100
	CAT	2		15		15		70	)						100
	CAT	3		15		15		70	)						100
	ESE	Ξ		15		15		70	)						100
* ±3%	may b	e varie	d (CAT 1	, 2 & 3 – 5	50 ma	rks & ESE	– 100 r	narks)	1						

	22MET62 - FINITE ELEMENT ANALYS	SIS					
Programme & Branch	BE & Mechanical Engineering	Sem.	Category	L	т	Ρ	Credit
Prerequisites	Strength of Materials, Heat and Mass Transfer	6	PC	3	0	0	3
Preamble	This course provides the knowledge on finite element modelin for solving the governing equations over the given discretized and loads. The course deals with the solving the various 1D and aspects and introduces advanced concepts.	g techni d domair 2D engir	ques and us with the pro neering proble	e of oper ems t	num boun or sti	nerica Idary Tuctura	I methods conditions al, thermal
Unit – I	Fundamental of Finite Element Analysis						9
Historical Backg General Procedu Techniques – We	round – Matrix Approach – Coordinates – Numerical Simulatior re – Basic Element Shapes – Discretization Process – Node sighted Residual Method – Applications of FEA.	n – Gau e Numbe	ss Eliminatio ering Schemo	n Ba ə —	ased Inter	Solve polati	ers – FEA on – Ritz
Unit – II	One Dimensional Problems						9
One Dimensiona Element Equatio	I Finite Element Modeling – Element Types – Linear Elements n – Galerkin's Method – Solid Mechanics – Heat Transfer – Fin F	s – Line Pin and C	ar Element S Composite Wa	Shap all –	be Fu Bean	inctio n Eler	n – Finite nent.
Unit – III	Two Dimensional Problems						9
Introduction to 2- Strain Displacem	D Finite Element Modeling – Constant Strain Triangular – Finit ent and Stress Strain Relationship Matrix – Plane Stress and Pla	te Eleme ane Stra	ent Formulati in – Tempera	on – iture	Sha Effe	pe Fu cts.	unctions –
Unit – IV	Axisymmetric Continuum						9
Axisymmetric Fo Calculations – Bo	rmulation – Element Stiffness Matrix and Force Vector – Bod undary Conditions – Applications to Cylinders under Internal or Ex	y Forces sternal Pi	s and Tempe ressure.	eratu	ire E	ffects	<ul> <li>Stress</li> </ul>
Unit – V	Iso-parametric Elements for Two Dimensional Continuum						9
Natural Co-ordin Stiffness Matrix a Introduction to Fir	nate Systems – Iso-parametric Elements – The Four Node C Ind Force Vector – Jacobian Matrix – Stress Calculations – Num- nite Element Analysis Programming.	Quadrilat erical Int	eral – Shap tegration – G	e Fi auss	unctio s Qua	ons – adratu	Element
							Total:45
TEXT BOOK:							
1. Logan L.	Daryl, "A first course in the Finite Element Method", 5th Edition, C	engage	Learning India	a Pv	t. Ltd	., Dell	ni,2012.
REFERENCES:							
1. Rao S. S Elsevier	S., "The Finite Element Method in Engineering", 5 <sup>th</sup> Edition, But India P∨t. Ltd., New Delhi, 2013.	tterworth	-Heinemann	(An	impr	int of	Elsevier),
2. Reddy J.	N., "An Introduction to the Finite Element Method", International E	dition, M	cGraw Hill, N	ew D	elhi,	2005.	

COUR On cor	SE OUTCOMES: npletion of the course, the students will be able to	BT Mapped (Highest Level)
CO1	apply the finite element theory procedures for various applications	Analyzing (K4)
CO2	analyze 1D structural and thermal problems with various boundary conditions	Analyzing (K4)
CO3	analyze the 2D problems with various boundary conditions	Analyzing (K4)
CO4	analyze the 2 D axisymmetric problem with various boundary conditions	Analyzing (K4)
CO5	apply the concepts of Iso-parametric formulation in 2D problems	Applying (K3)

	Mapping of COs with POs and PSOs													
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	1											3
CO2	2	3	1											3
CO3	2	3	1											3
CO4	2	3	1											3
CO5	2	3												3
1 – Slight, 2	– Mode	erate, 3 –	Substant	ial, BT-	Bloom's	Taxono	my							

ASSESSMENT PATTERN - THEORY													
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %						
CAT1	10	10	40	40			100						
CAT2	10	10	40	40			100						
CAT3	10	10	40	40			100						
ESE	10	10	40	40			100						
* ±3% may be varied (C	* ±3% may be varied (CAT 1, 2 & 3 – 50 marks & ESE – 100 marks)												

				2	2MEL6	1 - SIM	ULATIC	N LAB	ORAT	ORY					
Progran Branch	mme &	BE & N	lechani	cal Eng	ineerin	g				Sem.	Category	L	т	Ρ	Credit
Prerequ	uisites	Streng Machir	th of Ma les,Hea	aterials t and M	, Fluid ass Tra	Mecha ansfer	nics ar	nd Hydi	raulic	6	PC	0	0	2	1
Preamb	le	This co enginee	ourse pr ering pr	ovides oblems	the bas in stru	sic knov cture, t	wledge hermal	of deriv and flo	ving the ow. It a	e bounda Ilso prov	ary conditio rides the bo	ns of est wa	eal y of	time f redu	practical cing the
LIST OF	F EXPERI	MENTS	EXER(	CISES:		10.									
1.	Stresses	and Defl	ections	of Differ	ent Typ	es of B	eams W	/ith Vari	ous Ty	pes of Lo	oads.				
2.	Deflection	ns of Diffe	erent Tv	pes of 7	Fruss W	ith Poir	nt Loads			·					
3.	Applicatio	on of Plar	ne Stres	s and P	lane St	ain Cor	nditions								
4.	Modelling and Analysis of Tapered Structures.														
5.	Deflection of Tensile and Compressive Springs.														
6.	Axisymm	etric App	lication.												
7.	Heat Con	duction a	and Con	vection	Applica	tions.									
8.	Couple F	ield Anal	ysis (Th	ermo –	Structu	ral Ana	lysis).								
9.	Contact A	Analysis o	of Two E	Bodies.											
10.	Modal An	alysis of	Structu	ral Mem	bers.										
11.	Harmonic Response of Structural Members.														
12.	Bimetallic	c Layered	l Cantile	ver Plat	e with S	Structur	al Loadi	ng.							
13.	Flow Three	ough Pipe	es using	Fluent.											
14.	Incompre	ssible Fl	uid Flow	Analys	is with a	and with	nout Obs	stacles.							
															Total:30
REFER	ENCES/ N	ANUAL	/SOFT	WARE:											
1.	ANSYSI	aborator	v Manua	al.											
2.	Rao S. S	. "The Fir	nite Eler	nent Me	thod in	Engine	erina". (	5 <sup>th</sup> Editi	on. But	terworth-	Heinemann	Ltd., l	JSA	. 2010	
0	Robert D	. Cook,	Malkus	Witt 8	Plesh	a, "Cor	ncepts a	and Ap	plicatio	ns of Fi	nite Elemer	nt Ana	ysis	s", 4 <sup>th</sup>	Edition,
3.	Wiley Ind	lia Pvt. L	td.,India	, 2007.									,	,	,
COURS	E OUTCO	OMES:											B	Т Мар	ped
On com	pletion of	the cours	se, the s	tudents	will be	able to							(Hig	hest l	_evel)
CO1	analyze th	ne deflect	tions an	d stress	ses of v	arious	structur	al probl	ems wi	th differe	ent boundar	у	An	alyzing	g (K4),
(	conditions	using fir	ite elem	ient me	inod								viar	ipulati	on (S2)
CO2	analyze ti problomo	he mech	ianisms	of hea	it trans	ter mo	dal and	harmo	onic of	varying	engineerin	g	An Mor	alyzing	g (K4),
		using ini so fluid fl			iou in vori		plication	o with	and wit	hout oh	ta alaa wain	a .	A pc	Inpulat	$(K_4)$
CO3	analyze the huid flow phenomena in various applications with and without obstacles using Analyzing (K4), Manipulation (S2)														
														Palatt	(52)
					Маррі	ng of C	cos with	POs a	nd PS	Os					
COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	PO11	PO12	F	PSO1	PSO2
CO1	2		1		3				2					3	3
CO2	2		1		3				2				+	3	3
CO3															
000		dorato 2	L I Suba	tantial		om'e Ta	yonom	,	2					J	<u> </u>

Program BranchB & Mechanical EngineeringSem.Sem.CategoryLTPCredityProcefundamental knowley or Design, Marufacturing and forwal Engineering6BC0084Procefundamental knowley or Design, Marufacturing and forwal Engineeringfundamental knowley or Design, Marufacturing and social constructions6BC0084Procefundamental knowleyfundamental knowleyfundamental knowleyfundamental knowleyfundamental knowleyfundamental knowleyProcefundamental knowleyfundamental knowleyfundamental knowleyfundamental knowleyfundamental knowleyfundamental knowleyProce <t< th=""><th colspan="14">22MEP61 - PROJECT WORK I</th></t<>	22MEP61 - PROJECT WORK I																				
Prerequisites         Fundamental knowledge on Design, Manufacturing and Thermal Engineering         6         EC         0         0         8         4           Preamble         This course deals with identifying technical problems and formulate remeredial solutions through fabrication of novel prototypes or upgradation of existing products under the basic principles of design, manufacturing and thermal sciences.         Fabrication of novel prototypes or upgradation of existing products under the basic principles of design, manufacturing and thermal sciences.         Fabrication of design, manufacturing and thermal sciences           Project Work I         Identifying project area based on the research interest         Identifying project area based on the to selected area or undergo field trip to industries         Identifying tripication and thermal sciences           Identifying tropicet area based on the basic principles and new advancements in design, manufacturing and thermal sciences         Prepare detailed methodology         Perform test runs and analyze the results           Preform test runs and analyze the results         Exhibit the models in technical forums and disseminate the creation across technical community         Total:120           Fabricate         COUROSE OUTCOMES: 0 no completion of the course, the students will be able to 0 completion of the course, the students will be able to 0 conceptual and detailed design using modern engineering tools         Creating (K6)           CO2         prepare detailed work flow chart 0 develop a conceptual and detailed design using modern engineering tools         Creating (K6)	Programme & Branch	BE & Me	chanical E	Enginee	ering					Sem.	Category	L	т	Ρ	Credit						
Preamble         This course deals with identifying technical problems and formulate remedial solutions through fabrication of novel prototypes or upgradation of existing products under the basic principles of design, manufacturing and thermal sciences.           Project Wrk I           • Identifying project area based on the research interest         • Perform literature survey related to selected area or undergo field trip to industries           • Identify a technical problem         • Perform literature survey related to selected area or undergo field trip to industries           • Perform literature survey related to selected area or undergo field trip to industries         • Perform solutions based on the basic principles and new advancements in design, manufacturing and thermal sciences           • Perform test runs and analyze the results         • Perform test runs and analyze the results         • Total:120           Fabricate new models         • Exhibit the models in technical forums and disseminate the creation across technical community         • Total:120           Fabricate new models         • Exhibit the models in technical forums and disseminate the creation across technical community         • Understanding (K2)           CO2         prepare detailed work flow chart         • Understanding (K2)         • Understanding (K2)           CO2         prepare detailed work flow chart         • Creating (K6)         • Creating (K6)           CO3         gevelop a conceptual and detalled design using modern engineering tous	Prerequisites	Fundame Thermal	ental knov Engineeri	vledge ing	on Desi	gn, Mar	nufactu	ring an	d	6	EC	0	0	8	4						
Preamble       This course deals with identifying technical problems and formulate remedial solutions through fabrication of novel prototypes or upgradation of existing products under the basic principles of design, manufacturing and thermal sciences.         Project Work I       Identifying project area based on the research interest       Identifying troject area based on the basic principles and new advancements in design, manufacturing and thermal sciences         Identify a technical problem       Formulate solutions based on the basic principles and new advancements in design, manufacturing and thermal sciences         Prepare detailed methodology       Perform comprehensive design based on the engineering Inputs.         Fabricate new models       Fabricate new models         Exhibit the models in technical forums and disseminate the creation across technical community       BT Mapped (Highest Level)         CO1       select domain centric industrial or social problems       Understanding (K2)         CO2       prepare detailed work flow chart       Understanding (K2)         CO3       develop a conceptual and detailed design using modern engineering tools       Creating (K6)         CO4       fabricate new project models       Evaluating (K5)         CO2       prepare met strue and explore the findings in technical forum       Evaluating (K2)         CO3       develop a conceptual and detailed design using modern engineering tools       Creating (K6)         CO4       fabricate new project													•								
Project Work 1 <ul> <li></li></ul>	Preamble	This cour novel pro thermal se	se deals totypes or ciences.	with ide r upgrad	ntifying dation of	technica f existin	al probl g produ	ems an Icts und	d formuler the	ulate ren basic pri	nedial solut inciples of	tions t desigr	hrou n, m	igh fab anufact	rication of uring and						
• Exhibit the models in technical forums and disseminate the creation across technical community       Total:120         Total:120         Fabricate         Total:120         COURSE OUTCOMES:       BT Mapped (Highest Level)         C01       select domain centric industrial or social problems       Understanding (K2)         C02       prepare detailed work flow chart       Understanding (K2)         C03       develop a conceptual and detailed design using modern engineering tools       Creating (K6)         Cos/Pos       PO1       PO2       PO3       PO6       PO7       PO8       PO1       PO12       PS01       PS02         C01       3       1       1       3       3       2       3       2       3       3         Cos/Pos       PO1       PO2       PO6       PO7       PO8       PO1       PO12       PS01       PS02         Cos/Pos       PO1       PO2       PO6       PO7       PO8       PO1       PO12       <	Project Work I <ul> <li>Identifying p</li> <li>Perform liter</li> <li>Identify a teo</li> <li>Formulate so</li> <li>Prepare deta</li> <li>Perform com</li> <li>Fabricate ne</li> <li>Perform test</li> </ul>	roject area l ature surve hnical prob olutions bas ailed methor prehensive w models runs and a	based on t y related to lem ed on the dology e design ba nalyze the	the rese o select basic p ased on results	arch into ed area rinciples the eng	erest or unde and nev ineering	rgo fielc w advar Inputs.	trip to	industrie ts in de	es sign, mai	nufacturing	and th	herm	nal scier	nces						
Fabricate         COURSE OUTCOMES: On completion of the course, the students will be able to       BT Mapped (Highest Level)         C01       select domain centric industrial or social problems       Understanding (K2)         C02       prepare detailed work flow chart       Understanding (K2)         C03       develop a conceptual and detailed design using modern engineering tools       Creating (K6)         C04       fabricate new project models       Creating (K6)         C05       perform test run and explore the findings in technical forum       FO1       PO1       PO1 <th colspa<="" td=""><td colspan="14">Exhibit the models in technical forums and disseminate the creation across technical community  Total:120</td></th>	<td colspan="14">Exhibit the models in technical forums and disseminate the creation across technical community  Total:120</td>	Exhibit the models in technical forums and disseminate the creation across technical community  Total:120																			
COURSE OUTCOMES: On completion of the course, the students will be able to         BT Mapped (Highest Level)           CO1         select domain centric industrial or social problems         Understanding (K2)           CO2         prepare detailed work flow chart         Understanding (K2)           CO3         develop a conceptual and detailed design using modern engineering tools         Creating (K6)           CO4         fabricate new project models         Creating (K6)           CO5         perform test run and explore the findings in technical forum         PO1 PO2         PO3         PO6         PO7         PO8         PO1         PO1         PO2         PO3         PO6         PO7         PO8         PO1         PO1         PO1         PO1         PO1         PO1         PO1         PS01         PS02           Cos/Pos         PO1         PO1         PO1         PO1         PO1         PO1         PS01         PS02           Cos/Pos <th c<="" td=""><td>Fabricate</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></th>	<td>Fabricate</td> <td></td>	Fabricate																			
CO2       prepare detailed work flow chart       Conderstanding (K2)         CO3       develop a conceptual and detailed design using modern engineering tools       Creating (K6)         CO4       fabricate new project models       Creating (K6)         CO5       perform test run and explore the findings in technical forum       Evaluating (K5)         CO5/POS       PO1       PO12       PSO1       PSO2         CO5/POS       PO1       PO12       PSO1       PSO2         CO5/POS       PO1       PO1       PO11       PO12       PSO1       PSO2         CO5/POS       PO1       PO11       PO12       PSO1       PSO2         CO1       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3	COURSE OUTCO On completion of CO1 select do	OMES: the course main centri	, the stude	ents will al or soc	be able ial probl	to ems							(H Und	BT Map ighest erstand	bped Level) ding (K2)						
CO3         develop a conceptual and detailed design using modern engineering tools         Correcting (K6)           CO4         fabricate new project models         Creating (K6)           CO5         perform test run and explore the findings in technical forum         Evaluating (K5)           Vereating Correction (K6)           Cos/POs         PO1         PO2         PO3         PO4         PO5         PO6         PO7         PO8         PO9         PO10         PO11         PO12         PS01         PS02           CO1         3         1         1          3         3         2         3         2         3         3         3           CO2         3         3         2          3         3         2         3         2         2         3         <	CO2 prepare			art sile d de					teele				Una	erstand	$\frac{1}{1}$						
Cos inductive new project models       Creating (K0)         COS       perform test run and explore the findings in technical forum       Evaluating (K0)         Mapping of COs with POs and PSOs         COs/POs       PO1       PO2       PO3       PO6       PO7       PO8       PO10       PO11       PO12       PSO1         COs/POs       PO1       PO11       PO12       PSO1       PSO2         COs/POs       PO1       PO11       PO12       PSO1       PSO2         CO1       3       3       2       S         CO1       3       1       1       S         CO2       3       3       2       3       3       2       2         CO2       3       3       2       3       3 <th 3"3"3<="" <="" colspan="6" td=""><td>CO3 develop</td><td></td><td>ai and deta</td><td></td><td>sign usir</td><td>ng mode</td><td>ern engi</td><td>neenng</td><td>loois</td><td></td><td></td><td></td><td></td><td>reating</td><td>J(K6)</td></th>	<td>CO3 develop</td> <td></td> <td>ai and deta</td> <td></td> <td>sign usir</td> <td>ng mode</td> <td>ern engi</td> <td>neenng</td> <td>loois</td> <td></td> <td></td> <td></td> <td></td> <td>reating</td> <td>J(K6)</td>						CO3 develop		ai and deta		sign usir	ng mode	ern engi	neenng	loois					reating	J(K6)
In periodicite initial desperiod the initial gene destination for an example of construction of the initial desperiod and initial descent d	CO5 perform	test run and		he findir	nas in te	chnical	forum						F.	/aluatin	a (K5)						
Mapping of COS with POS and PSOS           COS/POS         PO1         PO2         PO3         PO4         PO5         PO6         PO7         PO8         PO9         PO10         PO11         PO12         PSO1         PSO2           CO1         3         1         1          3         3         2         3         2         2         2         3         3           CO2         3         3         2          3         3         2         3         2         2         2         3         3           CO2         3         3         2          3         3         2         3         2         2         2         3         3           CO3         3         3         2         3         3         2         3         2         3         3         3         3         3         3         3         3         3         3         2         3         2         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3					igo in te		orun						<u> </u>	aiuuili	9 (10)						
COs/POs         PO1         PO2         PO3         PO4         PO5         PO6         PO7         PO8         PO9         PO10         PO11         PO12         PS01         PS02           CO1         3         1         1          3         3         2         3         2         2         2         3         3           CO2         3         3         2         3         3         2         3         2         2         2         3         3           CO2         3         3         2         3         3         2         3         2         2         2         3         3           CO3         3         3         2         3         3         3         2         3         2         3					Mappin	g of CO	s with	POs an	d PSOs	5											
CO1       3       1       1        3       3       2       3       2       2       2       2       3       3         CO2       3       3       3       2       3       3       2       3       2       3       3       2       2       2       2       3       3         CO2       3       3       3       2       3       3       2       3       2       2       2       3       3         CO3       3       3       3       2       3       3       2       3       2       3       2       3       3       2       3	COs/POs PO	1 PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	PO11	PO1	2	PSO1	PSO2						
CO2       3       3       3       2       3       3       2       3       2       3       2       2       2       2       3       3         CO3       3       3       3       2       3       3       2       3       2       3       2       3       3         CO3       3       3       2       3       3       3       2       3       2       3       2       3 <td< td=""><td>CO1 3</td><td>1</td><td>1</td><td></td><td></td><td>3</td><td>3</td><td>2</td><td>3</td><td>2</td><td>2</td><td>2</td><td></td><td>3</td><td>3</td></td<>	CO1 3	1	1			3	3	2	3	2	2	2		3	3						
CO3       3       3       2       3       3       2       3       2       3       2       3       2       3       2       3       2       3       2       3       3       3       3       2       3       2       3       2       3       2       3       3       3       3       2       3       2       3	CO2 3	3	3	2		3	3	2	3	2	2	2		3	3						
CO4     3     3     2     2     3     3     2     3     2     3     2     3     2     3<	CO3 3	3	3	2	3	3	3	2	3	2	3	2		3	3						
CO5     3     2     1     3     3     3     3     3     3     3     2     3	CO4 3	CO4         3         3         2         2         3         3         2         3         2         3         2         3         3         2         3         3         2         3         3         3         3         2         3         2         3         3         3         3         2         3         2         3         3         3         3         3         3         2         3         3         3         3         3         3         2         3         2         3																			
	CO5 3	$\begin{array}{c c c c c c c c c c c c c c c c c c c $																			
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy	1 - Slight, 2 - Mc	oderate. 3 –	Substanti	ial. BT-	Bloom's	Taxono	mv	5	5	0	5	0		<u> </u>	0						

						22M	EP62 - I	PROJE	ст wo	RKI							
Progra Branci	imme h	& E	BE & Mea	chanical E	Inginee	ring					Sem.	Category	L	т	Ρ	Credit	
Prereq	luisite	es F	<sup>-</sup> undame Fhermal	ental knov Engineeri	/ledge ( ng	on Desi	gn, Man	ufactu	ring an	d	6	EC	0	0	8	5	
Pream	ble	۲ r t	This cour novel pro hermal so	se deals v totypes or ciences.	with ide upgrac	ntifying lation of	technica existing	al probl g produ	ems an icts und	d formu ler the	ulate rem basic pri	nedial solut inciples of (	ions 1 desigi	hroun, m	ugh fabi nanufact	ication of uring and	
Projec	t Wor	kl															
• Ide	entifyiı	ng proj	ect area b	based on t	he rese	arch inte	erest										
• Pe	erform	literatu	ire survey	y related to	o selecte	ed area	or under	rgo fielc	trip to	industrie	es						
• Ide	entify	a techn	lical prob	lem	h	in sints s				مام ما م			بد ام مر م	<b>.</b>			
	ormula	dotaila	tions bas	I methodology													
Pe	epare	compr	mprehensive design based on the engineering Inputs.														
• Fa	bricat	e new i	new models														
• Pe	Perform test runs and analyze the results																
• Ex	Exhibit the models in technical forums and disseminate the creation across technical community																
																Total:120	
Fabrica	ate																
COUR	SE Ol	JTCON	NES:												BT Map	ped	
On con	npletic	on of th	e course	, the stude	nts will	be able	to							(۲	lighest	Level)	
CO1	sele	ct dom	ain centri	c industria	l or soc	ial probl	ems							Und	derstand	ling (K2)	
CO2	prep	are de	tailed wor	rk flow cha	ırt									Uno	derstand	ling (K2)	
CO3	deve	elop a c	conceptua	al and deta	ailed des	sign usir	ng mode	rn engi	neering	tools					Creating	(K6)	
CO4	fabri	cate ne	ew projec	t models										(	Creating	(K6)	
CO5	perfo	orm tes	t run and	explore the	ne findir	igs in te	chnical f	orum						E	valuatin	g (K5)	
						Mappin	g of CO	s with	POs an	d PSOs	6						
COs/P	Os	P01	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO1	2	PSO1	PSO2	
CO	1	3	1	1			3	3	2	3	2	2	2		3	3	
CO	2	3	3	3	2		3	3	2	3	2	2	2		3	3	
CO	3	3	3	3	2	3	3	3	2	3	2	3	2		3	3	
CO	4	3	3	2	2	3	3	3	2	3	2	3	2		3	3	
CO	5	3	2			1	3	3	3	3	3	3	3		2	3	

	22GET31 - UNIVERSAL HUMAN VALU	ES					
	(Common to All Engineering and Technology E	Branches	)				
Programme& Branch	All BE/BTech Branches	Sem.	Category	L	т	Ρ	Credit
Prerequisites	Nil	3/6	BS	2	0	0	2
Preamble Unit – I Need and Basic Gu Exploration – Conte Aspirations – Contir Human Aspirations Unit – II	To make the student to know what they 'really want to be meaning of happiness and prosperity for a human being. Also harmony at all the levels of human living, and live accordingly <b>Introduction:</b> idelines of Value Education – Content and Process of Value E ent and Process of Self exploration – Natural Acceptance – R nuous Happiness and Prosperity – Exploring Happiness and Pro- Relationships – Physical Facilities – Right Understanding. <b>Harmony in the Self and Body:</b>	' in their o to facil ducation ealization osperity	r life and pro itate the stuc n – Self Explo n and Under – Basic Requ	ofess lents oratic stand uirem	to u to u on – I ding - nent f	unders nders ourpo – Bas or Fu	stand the tanding of 6 se of self- sic Human Ifillment of 6
Human Being and E the Self and Body, S in the Self ('I) – Und	Body – Understanding Myself as Co–existence of Self ('I') and E Self ('I') as the Conscious Entity, the Body as the Material Entity - erstanding Myself – Harmony with Body.	Body, Ne – Exercis	eds of the Se se – Body as	elf ar an li	nd Bo nstrui	ody, A ment-	ctivities in - Harmony
Unit – III	Harmony in the Family and Society:						6
Harmony in the Farr	nily – Justice – Feelings (Values) in Human Relationships – Rela	ationship	from Family	to So	ociety	/ – Ide	entification
of Human Goal – Fiv	ve dimensions of Human Endeavour.	-	-		-		
Unit – IV	Harmony in Nature and Existence:						6
Order of Nature – I Conformance – Intr Existence is Co–exis	nterconnectedness – Understanding the Four order – Innatene oduction to Space – Co–existence of units of Space – Limit stence.	ess – Na ed and	unlimited –	terist Activ	ic – e an	Basic d No-	Activity – –activity –
Unit – V	Implications of the above Holistic Understanding of Harmo	ony on P	rofessional	Ethio	cs:		6
Values in different of Identification of Cor Professional Ethics.	Imensions of Human Living – Definitiveness of Ethical Human ( nprehensive Human Goal – Humanistic Education – Universa	I Humar	-Implications	mpe	/alue tence	base and	d Living – Issues in
							Total:30
TEXT BOOK:							
1. Gaur R.R., Books Pvt.	Sangal R., Bagaria G.P., "A Foundation Course in Human Value: Ltd., New Delhi, 2016.	s and Pro	ofessional Etl	nics"	, 1 <sup>st</sup> €	dition	, Excell
REFERENCES:							
1. Ivan Illich, "I	Energy & Equity", The Trinity Press, USA, 1974.						
2. Schumache	r E.F., "Small is Beautiful: a study of economics as if people mat	tered", B	britain, 1973.				

COUR	COURSE OUTCOMES: BT Mapped On completion of the course, the students will be able to (Highest Level)											
CO1	restate the meaning of happiness and prosperity and do a correct appraisal of the current scenario in the society	Applying (K3)										
CO2	distinguish between the Self and the Body, understand the meaning of Harmony in the Self, the Co–existence of Self and Body	Applying (K3)										
CO3	infer the value of harmonious relationship based on trust, respect and other naturally acceptable feelings in human–human relationships and explore their role in ensuring a harmonious society	Applying (K3)										
CO4	transform themselves to co-exist with nature by realising interconnectedness and four order of nature	Applying (K3)										
CO5	CO5 distinguish between ethical and unethical practices, and extend ethical and moral practices for a Applying (K3) better living											
	Mapping of COs with POs and PSOs											
COs/F	20s   P01   P02   P03   P04   P05   P06   P07   P08   P09   P010   P011   P0	12 PSO1 PSO2										

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1										
CO2	3	2	1	1										
CO3	3	2	1	1										
CO4	3	2	1	1										
CO5	3	2	1	1										
1 – Slight, 2	– Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy													

	ASSESSMENT PATTERN - THEORY													
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %							
CAT1	25	75					100							
CAT2	25	75					100							
ESE	ESE NA 100													
* ±3% may be varied (CAT 1&2 – 60 marks & ESE – 100 marks)														

22GCT71 - ENGINEERING ECONOMICS AND MANAGEMENT (Common to All BE/BTech branches)														
	(Common to All BE/BTech branche	s)												
Programme Branch	All BE/BTech branches	Sem.	Category	L	т	Ρ	Credit							
Prerequisite	s Nil	7	HS	3	0	0	3							
			1			1	1							
Preamble	The aim of the course is to create fundamental knowledge on ma economics, national income, marketing, operations management	nagemei , account	nt by introduc ting principles	ng o etc.	once	pts lil	(e							
Unit – I	Micro Economics						9							
Economics – Equilibrium –	Economics – Basics Concepts and Principles – Demand and Supply – Law of demand and Supply – Determinants – Market Equilibrium – Circular Flow of Economic Activities and Income.													
Unit – II	Unit – II Macro Economics, Business Ownership and Management concepts 9													
National Inco Business – C Skills - Level	National Income and its Measurement Techniques. Inflation - Causes of Inflation – Controlling Inflation – Business Cycle - Forms of Business – Ownership Types. Management concepts: Taylor and Fayol's Principles – Functions of Management - Managerial Skills - Levels of Management - Roles of Manager.													
Unit – III	Skills - Levels of Management - Koles of Manager.       Unit - III     Marketing Management     9													
Marketing - 0 Product Life	ore Concepts of Marketing - Four P's of Marketing - New Product Development of Pricing Strategies and Decisions.	elopment	t – Intellectual	Pro	perty	Righ	ts (IPR),							
Unit – IV	Operations Management						9							
Operations N and Control	anagement - Resources - Types of Production System - Site Selection Inventory - EOQ Determination.	i, Plant L	ayout, Steps i	n Pr	oduc	tion P	lanning							
Unit – V	Financial Management						9							
Accounting F Even Analys	inciples – Financial Statements and its Uses – Depreciation - Straight – Capital Budgeting - Significance – Traditional and Discounted Cash	Line and Flow Me	I Diminishing thods.	Bala	nce l	Netho	d – Break							
							Total:45							
TEXT BOOK														
1. Compiled by Department of Management Studies, Kongu Engineering College, "Economics and Management for Engineers", 1 <sup>st</sup> Edition, McGraw Hill Education, Noida, 2013.														
REFERENCES:														
1. Gee	ka, Piyali Ghosh and Purba Roy Choudhury, "Managerial Economics",	, 3 <sup>rd</sup> Editi	on, McGraw-H	lill, I	New I	Delhi,	2018.							
2. Willia	2. William J. Stevenson, "Operations Management", 14 <sup>th</sup> Edition, McGraw-Hill Education, 2021.													
3. Willia Educ	3. William G. Nickels, James M. McHugh, Susan M. McHugh, "Understanding Business", 12 <sup>th</sup> Edition, McGraw-Hill Education, New York, 2019.													

COUR: On con	SE OUTCOMES: npletion of the course, the students will be able to	BT Mapped (Highest Level)
CO1	identify market equilibrium and interpret national income calculations and inflation issues	Applying (K3)
CO2	choose a suitable business ownership for their enterprise and illustrate managerial functions	Applying (K3)
CO3	infer marketing management decisions	Understanding (K2)
CO4	apply appropriate operation management concept in business situations	Applying (K3)
CO5	interpret financial and accounting statements and evaluate new proposals	Applying (K3)

## Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	2			3		2	2	2	3	2		
CO2		1	2			2	2	2	2	2	3	2		
CO3	1	2	1			2		2	2	2	3	2		
CO4	1	2	1			2		2	2	2	3	2		
CO5	2	2				2		2	2	2	3	2		

ASSESSMENT PATTERN - THEORY														
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %							
CAT1	20	40	40				100							
CAT2	20	40	40				100							
CAT3	20	40	40				100							
ESE	ESE 20 40 40 100													
* ±3% may be varied (0	* ±3% may be varied (CAT 1, 2 & 3 – 50 marks & ESE – 100 marks)													

	22MEP71 - PROJECT WORK II PHASE I															
Progra Branch	mme	& I	BE & Med	hanical E	Inginee	ring					Sem.	Category	L	т	Р	Credit
Prerequ	uisite	es l	Fundame Thermal I	ntal knov Engineeri	vledge ( ng	on Desi	gn, Mar	ufactu	ring an	d	7	EC	0	0	10	5
Preamb	ole	- i	This cours ndustrial design and	se deals survey, fra alysis and	with ide aming o prepare	ntifying bjective e test sp	domain to provi ecimens	centric de remo s / proto	or inte edial so types.	erdiscipl lution, p	inary res prepare o	search prot detailed wo	olems rk line	throu , per	ugh lite form p	erature or reliminary
<ul> <li>Project</li> <li>Ide</li> <li>Fra</li> <li>Pre</li> <li>Per</li> <li>Per</li> </ul>	<ul> <li>Project Work I</li> <li>Identify domain centric or interdisciplinary research problems through literature or industrial survey</li> <li>Frame objective in-line with identified problem</li> <li>Prepare detailed work line</li> <li>Perform preliminary design analysis</li> <li>Prepare test specimens / prototypes</li> </ul>															
Prepare test specimens / prototypes     Total:150																
COURS On com	COURSE OUTCOMES: BT Mapped On completion of the course, the students will be able to (Highest Level)															
CO1	form surv	ulate d ey	lomain ce	ntric or inf	erdiscip	linary re	search	problem	ns throu	gh litera	ature or i	ndustrial		Unde	erstand	ling (K2)
CO2	fram	e obje	ctive in-lin	e with ide	ntified p	roblem								Unde	erstand	ling (K2)
CO3	prep	are de	tailed wor	k line										Unde	erstand	ling (K2)
CO4	perfo	orm pre	eliminary	design an	alysis									A	nalysis	s (K4)
CO5	fabri	cate te	st specim	iens / prot	otypes									С	reating	j (K6)
						Mappin	g of CO	s with	POs an	d PSOs	6					
COs/PC	Ds	PO1	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	PO11	P01	2	PSO1	PSO2
CO1		3	1				3	3	2	3	2	3	2			3
CO2	02 3 3 3 3 3 2 3 2 1 3 3															
CO3	;	3	3		2		3	3	2	3	2	1	3			3
CO4	ļ	3	3		2	2	3	3	2	3	2				2	3
CO5	5	3	2		2	2	3	3	3	3	3	2	3		2	3
1 – Slig	ht, 2	– Mode	erate, 3 –	Substanti	al, BT- I	Bloom's	Taxono	my								

					2	2MEP72	- PRO	JECT W	ORK II	PHAS	EI					
Progra Branci	imme h	& E	BE & Med	chanical I	Enginee	ring					Sem.	Category	L	т	Р	Credit
Prereq	luisite	es F	<sup>-</sup> undame Thermal I	ental knov Engineeri	vledge ( ing	on Desi	gn, Mar	nufactu	ring an	d	7	EC	0	0	12	6
Pream	ble	T ii c	This cour ndustrial design an	se deals survey, fra alysis and	with ide aming o I prepare	ntifying bjective e test sp	domain to provi	centric ide rem s / proto	c or inte edial so otypes.	erdiscip olution,	inary res prepare	search prot detailed wo	olems rk line	thro e, per	ugh lit form p	erature or preliminary
Projec	t Wor	'k I	 			•						• •				
	entify	domain	i centric c	or interdisc	siplinary	researc	h proble	ems thro	ough lite	erature o	or industi	rial survey				
• Pr	epare	detaile	d work lir	ne	lieu pior	Jem										
• Pe	Prepare detailed work line     Perform preliminary design analysis     Prepare test specimens / prototypes     Total:150 COURSE OUTCOMES:     BT Mapped     (Uisheast Level)															
• Pr	epare	test sp	ecimens	/ prototyp	es											T-1-1-450
																l otal:150
COUR	COURSE OUTCOMES: BT Mapped															
On con	COURSE OUTCOMES: BT Mapped On completion of the course, the students will be able to (Highest Level)															
CO1	form surv	on of the course, the students will be able to (Highest Level) nulate domain centric or interdisciplinary research problems through literature or industrial vey (K2)														
CO2	fram	ne objec	ctive in-lir	ne with ide	entified p	roblem								Und	erstan	ding (K2)
CO3	prep	oare det	tailed wor	rk line										Und	erstan	ding (K2)
CO4	perf	orm pre	liminary	design an	alysis									A	nalysi	s (K4)
CO5	fabr	icate te	st specim	nens / prot	otypes									С	reating	g (K6)
						Mappin	g of CO	s with	POs an	d PSO:	6					
COs/P	Os	PO1	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	PO11	P01	2	PSO1	PSO2
CO	1	3	1				3	3	2	3	2	3	2			3
CO	2	3	3				3	3	2	3	2	1	3			3
CO	3	3	3		2		3	3	2	3	2	1	3			3
CO	4	3	3		2	2	3	3	2	3	2				2	3
CO	5	3	2		2	2	3	3	3	3	3	2	3		2	3
1 – Slię	ght, 2	– Mode	erate, 3 –	Substanti	al, BT- I	Bloom's	Taxono	my	-	-	-	1	,	I		-

					22	2MEP81	- PRO	JECT W	ORK II	PHASE	EII										
Progra Branci	imme h	&	BE & Mee	chanical I	Enginee	ering					Sem.	Category	L	т	Ρ	Credit					
Prereq	luisite	es .	Fundame Thermal	ental knov Engineer	vledge ing	on Desi	gn, Mar	nufactu	ring an	d	8	EC	0	0	8	4					
Pream	ble	1	The cours their perfo disclosure	se deals v ormance i e documer	vith perf in comp nt for pu	orming t arison t blicatior	technica o conve n in repu	l charac entional ted jour	cterizati system nal / pa	on of pi , prepa tent.	repared t re repor	test specime t and resea	ens / j rch m	proto	otypes, script	analyzing invention					
Projec • •	t Wor Per Ana Pre	<b>k I</b> form te alyze te pare re	echnical c echnical p eport and	haracteriz erformano research	ation of ce of dev manusc	prepare veloped ript / inv	ed test s specime rention d	pecimer ens in c lisclosur	ns / prot omparis re docui	otypes on with nent fo	convent r publica	ional syster tion in reput	n ed jou	ırnal	/ pate	nt. Total:120					
																10(a).120					
COUR: On con	COURSE OUTCOMES:       BT Mapped         On completion of the course, the students will be able to       (Highest Level)         CO1       perform technical characterization of prepared test specimens / prototypes       Applying (K3)																				
CO1	CO1     perform technical characterization of prepared test specimens / prototypes     Applying (K3)       CO2     analyze technical properties of developed specimens     Analyzing (K4)																				
CO2	anar	yze teo	chnical pr	openies o		pea spe	mens	ith conv	ontiona	lovoton			Image: constraint of the second state of the seco								
CO3	com	pare tr	ie periori		levelope	ea speci	mens w	ith conv	entiona	systen	1			A	naiyzir	$\log(K4)$					
CO4	prep prep pate	are pro are res	search ma	anuscript /	/ inventio	on discle	osure do	cument	for pub	lication	in reput	ed journal /		A	nalyzir	ig (K4) ig (K4)					
						Mappin	a of CC	)s with	POs an	d PSO	s										
COs/P	0s	P01	PO2	PO3	PO4	PO5	PO6	PO7	PO8	P09	PO10	PO11	PO1	2	PSO1	PSO2					
CO <sup>2</sup>	1	3	3	3	3	3	3	3	2	3	2	2	3		3	3					
	י ר	2	2	2	2	2	2	2	2	2	2	2	2		2	2					
00	2	3	3	3	3	3	3	3	2	3	2	2	3		3	3					
	5	3	3	3	3	3	3	1	2	3	2	2	3		3	3					
CO4	4	3	1	1		2		1	2	3	2	1	2		3	3					
CO	5	2				1			2	3	2	1	2		3	3					
1 – Slig	ght, 2	– Mod	erate, 3 –	Substant	ial, BT- I	Bloom's	Taxono	my													

		22MEE01 - FLUID POWER SYSTEM											
Progra Branch	mme & 1	BE & Mechanical Engineering	Sem.	Category	L	т	Ρ	Credit					
Prereq	uisites	Fluid Mechanics and Hydraulic Machines	5	PE	3	0	0	3					
Preamb	ble	This course provides knowledge and skill to generate, control ar and pneumatic systems. It offers designing of fluid power circuit fo of industrial circuits sealing devices, service & maintenance.	nd trans or variou	mission of pc is industrial a	ower pplic	using ation	g both and	n hydraulic knowledge					
Unit –		Fundamentals of Hydraulic System						9					
Basics Applica Pump F	of Fluid P tion – Loss Performanc	ower System – Advantages and Applications of Fluid Power Syste ses in Pipes – Valves and Fittings – Fluid Power Symbols – Hydrau ce – Characteristics and Selection – Sizing of Pumps.	ems – F ulic Pum	luid Propertie ps - Gear – \	es – /ane	Pasc and	al's L Pistoi	aw and its n Pumps –					
Unit –		Control Components of Hydraulic System						9					
Directic Pressu Control	Direction Control Valves - Three Way Valve – Four Way Valve – Check Valve and Shuttle Valve – Actuation Mechanisms in DCV         Pressure Control Valves - Pressure Relief – Pressure Reducing – Counter Balance – Sequencing and Unloading Valves – Flow         Control Valves and its Types – Proportional Valves – Servo Valves - Mechanical Type and Electrohydraulic Servo Valves.         Unit – III       Pneumatic System and Actuators       9												
Unit –	Unit – III Pneumatic System and Actuators 9												
Pneumatic System and Actuators 9 Pneumatic System: Properties of Air – Perfect Gas Laws – Compressors - Piston – Screw and Vane Compressor – Fluid Conditioning Elements - Filter Regulator and Lubricator Unit – Pneumatic Silencers – After Coolers – Air Dryers – Air Control Valves. Actuators: Linear And Rotary Actuators – Types – Cushioning Mechanism in Cylinders – Sizing of Actuators.													
Unit –	IV	Fluid Power Circuit Design						9					
Basic F Cascad Accum	Pneumatic le Circuit ulator –Typ	Circuits – Pneumatic Vacuum Systems – Electrical Components ar Design Method (Two / Three Cylinder Circuits) – Introduction pes and Application Circuits – Pressure Intensifier Circuits – PLC Application Circuit	nd Electr to Flui pplicatio	rical Controls d Logic Dev ns in Fluid Po	for F rices wer	luid I and Circu	Powei Appl iit.	r Circuits – lications –					
Unit – '	V	Industrial Circuits and Maintenance						9					
Industri Counte Synchre Mainter	al Circuits r Balance onizing Cir nance: Mai	: Speed Control Circuits – Regenerative Cylinder Circuits – Pum Valve Circuit – Hydraulic Cylinder Sequencing Circuit – Automa cuits – Fail Safe Circuits – Sealing Devices - Types and Materials – ntenance and Trouble Shooting of Fluid Power Systems.	np Unloa atic Cyli - Safety	iding Circuit - Inder Recipro Aspects – Ins	- Do catir stalla	uble ng Ci tion.	Pum rcuit	p Circuit – – Cylinder					
								Total:45					
TEXT E	BOOK:												
1.	Esposito	Anthony, "Fluid Power with Applications", 7th Edition, Pearson High	her Educ	cation, New Y	ork,	2015							
REFER	ENCES:												
1.	Jegadees	a T, "Hydraulics and Pneumatics", I.K International Publishing Hou	ise Pvt.	Ltd., New Del	hi, 2	019.							
2.	Majumda	r S. R, "Oil Hydraulic Systems – Principles and Maintenance", $2^{nd}$ E	Edition, 7	Fata McGraw-	Hill,	New	Delhi	, 2012.					

3. Majumdar S. R, "Pneumatic Systems – Principles and Maintenance", 2<sup>nd</sup> Edition, Tata McGraw-Hill, New Delhi, 2015.

COUR	SE OI		NES:	المراجع والمراجع			4-						(1	BT Mapp	ed
On con	npietio	on of th	e course	, the stude	ents wil	be able	10						(F	lignest L	ever)
COURSE OUTCOMES: On completion of the course, the students will be able to         BT Mapped (Highest Level)           CO1         identify fluid power components and their symbols as used in industry and also select suitable pump for hydraulic power pack         Applying (K3)           CO2         choose appropriate control valves for fluid power applications         Applying (K3)           CO3         select pneumatic components and fluid power actuators for low-cost automation         Applying (K3)           CO4         design, construct, installation, maintenance and troubleshooting of fluid power circuits for engineering applications         Mapping of COs with POs and PSOs         PO1         PO11         PO12         PS01         PS0           CO3         3         1         2         6         7         PO8         PO9         PO10         PO11         PO12         PS01         PS0           COs/POs         PO1         PO2         PO3         PO4         PO5         PO6         PO7         PO8         PO9         PO10         PO11         PO12         PS01         PS0           COs/POS         PO1         PO2         PO3         PO4         PO5         PO6         PO7         PO8         PO9         PO10         PO11         PO12         PS01         PS0											<3)				
CO2	choo	ose app	oropriate	control va	lves for	fluid pov	ver appl	ications	5				A	pplying (I	<b>〈</b> 3)
CO3	sele	ct pneu	imatic co	mponents	and flu	id power	actuato	ors for lo	w-cos	t automa	ition		A	pplying (I	<3)
CO4	desi	gn and	construc	t a fluid po	ower ci	rcuit for r	eal time	applica	itions				A	pplying (I	<3)
CO5	desi engi	gn, con ineering	istruct, in g applicat	stallation, tions	mainte	nance ar	nd troub	leshoot	ing of f	luid pow	er circuit	ts for	Α	pplying (I	<3)
						Mappin	g of CO	s with	POs a	nd PSO	S				
COs/F	POs	P01	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO	1	3	1	2											3
CO	2	3	1												3
CO	3	3	1	3											3
CO	4	3	1	3											3
CO	5	3	2	2											3
1 – Slig	ght, 2	– Mode	erate, 3 –	Substant	ial, BT-	Bloom's	Taxono	my		4			1		
						ASSES	SMENT	PATTE	ERN - 1	THEORY	,				
Tes C	t / Blo atego	oom's ory*	Re	memberi (K1) %	ng	Understa (K2)	anding %	Apply (K3)	ying ) %	Analyz (K4)	ing %	Evaluating (K5) %	) Cre (K	eating (6) %	Total %
	CAT	1		10		40		50	)						100
	CAT	2		10		40		50	)						100
	CAT	3		10		40		50	)						100
	ESE	Ξ		10		40		50	)						100
* ±3%	may b	e varie	d (CAT 1	, 2 & 3 – :	50 mar	ks & ESE	– 100 r	narks)			1		1	1	

	22MEE02 - PIPING DESIGN												
Programme Branch	BE & Mechanical Engineering	Sem.	Category	L	т	Ρ	Credit						
Prerequisite	Strength of Materials, Engineering Materials	5	PE	3	0	0	3						
Preamble	This course is designed to impart the knowledge of piping design wit	th the he	lp of standar	ds ar	nd co	des.	1						
Unit - I	Introduction to Piping						9						
Evolution of API Standard	Piping – Piping and Pipeline Codes – ASME B31 Codes – Boiler and Pre s and Recommended Practices – Classification of Pipes: Process, Line, \$	essure Ve Structura	essel Codes II – Manufact	– AS uring	ME I Met	B16 S hods.	tandards –						
Unit - II	Piping Materials						9						
Ferrous pipe Procurement	Ferrous pipe – Non-ferrous pipe – Fabrication of Steel pipe – Fabrication of Pipe Fittings and Components – Mechanical Properties – Procurement.         Unit - III       Pressure Design for Piping       9												
Unit - III	Pressure Design for Piping						9						
Thin wall approximation – Pipeline Design Equation – Pressure Design of Plant Piping – Yield and Burst Pressure – Design Pressure         – Buckling Pressure – Rating – High Pressure Design.         Unit - IV       Basic Piping Components and Piping Equipment													
Unit - IV Basic Piping Components and Piping Equipment 9													
Basic Piping Components: Elbows – Weld Tee – Couplings – Reducers – Cap – Flanged fittings – Flanges – Types – P-T Ratings and Facings – Major Valves – Types – Operations – Applicability – Gaskets – Bolts and Nuts. Horizontal Vessels – Accumulators – Fractionating Columns – Pumps – Heat Exchangers – Re-boiler – Heaters – Boilers – Tanks – Cooling Towers.													
Unit - V	Piping Layouts and Pipe Ways						9						
Piping Layou Frames – An Pipe Ways :	ts: Spacing of Pipe Supports – Design Standards – Selection of Pipe S chorage to Concrete – Layout Rules for Good Practice. Fypes of Pipe Ways – Trenched Piping – Underground Piping – Subsea F	upports · Pipelines	<ul> <li>Design of a</li> <li>Welding of</li> </ul>	Supp <sup>:</sup> Pipe	ort – e.	- Desi	gn of Steel						
							Total:45						
TEXT BOOK													
1. Sahı	. G. K., "Handbook of Piping Design", 2 <sup>nd</sup> Edition, New Age International	Publishe	rs, New Delh	i, 20 <sup>-</sup>	18.								
REFERENCE	S:												
1. Geor Editio	ge A. Antaki, "Piping and Pipeline Engineering: Design, Construction, Mai n, Taylor & Francis, USA, 2020	intenance	e, Integrity, a	nd R	epai	r", Spe	ecial Indian						
2. Rudo	mino B., "Steam Power Plant Piping Design", MIR Publishers, Moscow, 1	986.											

COUR On co	SE OUTC	OMES: If the cou	rse, the s	tudents w	/ill be abl	e to							BT Ma (Highest	pped Level)			
CO1	identify a	and selec	t standar	d codes fo	or piping	oractice							Understan	ding (K2)			
CO2	describe	the prop	erties of	piping ma	terials								Applyin	g (K3)			
CO3	use an a	ppropriat	e pipe de	sign for d	esired wo	orking pre	essure						Applyin	g (K3)			
CO4	illustrate	the funct	tions of pi	pe fittings	and pipi	ng equipi	ment us	ed in in	dustries				Understan	ding (K2)			
CO5	prepare	pipe layo	uts and e	xplain the	types of	pipe way	/S						Applyin	g (K3)			
	Mapping of COs with POs and PSOs																
COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	P011	P01	O12 PSO1 PSO2				
CO1	1	3												2			
CO2	1	3	2											2			
CO3	1	3	2											2			
CO4	1	3												2			
CO5	1	3	2											2			
1 – Sli	ght, 2 – M	loderate,	3 – Subs	tantial, B	T- Bloom	's Taxono	omy		·					-			
					ASSE	SSMEN		ERN –	THEOR	Y							
Test /	est / Bloom's Remembering Understanding Applying Analyzing Evaluating Category* (K1) % (K2) % (K3) % (K4) % (K5) %								Creating	Total							

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %					
CAT1	10	90					100					
CAT2	5	60	35				100					
CAT3	5	60	35				100					
ESE	5	75	20				100					
* ±3% may be varied (CAT 1, 2 & 3 – 50 marks & ESE – 100 marks)												

## 22MEE03 - UNCONVENTIONAL MACHINING PROCESSES

Programme & Branch	BE & Mechanical Engineering	Sem.	Category	L	т	Р	Credit							
Prerequisites	Machining and Measurements	5	PE	3	0	0	3							
			<u> </u>											
Preamble	This course covers the fundamentals of various unconventional n	nachining	g processes a	s we	ell as	the ir	fluence of							
	process parameters on machining performance in diverse applica	tions.												
Unit – I	Introduction and Mechanical Energy Based Processes						9							
Unconventional M Machining (AJM) Principles – Equip	Machining Processes – Needs – Classifications – Process Select – Water Jet Machining (WJM) – Abrasive Water Jet Machining (A pment Used – Process Parameters – MRR – Applications.	tion — Li WJM) -	mitations – A Ultrasonic Ma	dva chir	ntage iing (	es. Ab USM)	orasive Jet - Working							
Unit – II	Electrical Energy Based Processes						9							
Electric Discharge Machining (EDM) - Working Principle - Equipment - Process Parameters - Surface Finish and Material Removal Rate (MRR) - Electrode / Tool – Power and Control Circuits -Tool Wear – Dielectric – Flushing – Wire Cut EDM – Applications.														
Unit – III	t – III Chemical and Electrochemical Energy Based Processes 9													
Chemical Machining (CHM) - Etchants – Maskant - Techniques of Applying Maskant– Process Parameters – Surface Finish and MRR – Applications - Principles of Electrochemical Machining (ECM) – Equipment - Surface Roughness and MRR - Electrical Circuit - Process Parameters – Applications.														
Unit – IV Thermal Energy Based Processes 9														
Laser Beam Mac Types – Process	chining (LBM) - Plasma Arc Machining (PAM) and Electron Beam Parameters - Beam Control Techniques - MRR – Applications.	n Machir	ning (EBM). F	Princ	iples	– Eq	luipment –							
Unit – V	Hybrid Processes and Advanced Finishing Processes						9							
Electro Chemical Principle – Appli Finishing (MAF) – – Applications.	Grinding (ECG) – Electro Chemical De-burring (ECD) – Shaped cations – Limitations. Advanced Finishing Processes: Abrasive - Chemical Mechanical Polishing (CMP) – Working Principles – Me	Tube Ele Flow M chanism	ectrolytic Mach achining (AFI of Material R	ninin M) - emc	g (S⁻ - Ma val –	TEM) gnetic Surfa	– Working c Abrasive ace Quality Total:45							
TEXT BOOKS:														
1. Vijay.K. J	Jain., "Advanced Machining Processes". 1 <sup>st</sup> Edition ,Allied Publishe	ers Pvt. I	_td., New Dell	hi, 2	021	for Un	nits I, II, III,							
2. Pandey F	P.C. and Shan H.S., "Modern Machining Processes". 1 <sup>st</sup> Edition, Ta	ta McGra	aw-Hill, New D	Delh	i, 201	7 for	Unit V.							
<b>REFERENCES</b> :														
1. Paul De Ltd., 8 <sup>th</sup> E	Garmo, J.T.Black, and Ronald. A.Kohser., "Material and Processe dition, New Delhi 2008.	es in Ma	nufacturing" F	ren	tice H	lall of	India Pvt.							
2. Kapil Gu Springer	Kapil Gupta, N.K.Jain and R.F.Laubscher., "Hybrid Machining Process: Perspectives on Machining and Finishing", Springer International Publishing, 2016.													
<ol><li>Mc Geou</li></ol>	gh., "Advanced Methods of Machining", Springer, London, 2016.													

COUR	SEO	UTCON	IES:											BT Map	ped
On cor	npletic	on of th	e cours	e, the stude	ents wi	l be able	to						(	Highest L	.evel)
CO1	choo	ose app	propriate	emechanic	al ener	gy based	unconv	entiona	I mach	nining pro	cess.			Applying	(K3)
CO2	iden	OUTCOMES:     BT Mapped (Highest Level)       ation of the course, the students will be able to noose appropriate mechanical energy based unconventional machining process.     Applying (K3)       antify a suitable electrical energy based unconventional machining process application.     Applying (K3)       aplain the concept of machining the hard material using chemical energy and electrochemical ergy.     Applying (K3)       Jatrate various thermal energy-based process for engineering applications.     Applying (K3)       Jatrate the hybrid processes and advanced finishing processes used for various applications     Applying (K3)       Jatrate the hybrid processes and advanced finishing processes used for various applications     Applying (K3)       Mapping of COs with POs and PSOs     Mapping of COs with POs and PSOs       PO1     PO2     PO3     PO4     PO5     PO6     PO7     PO8     PO9     PO10     PO11     PO12     PSO1     PSO2       3     3     3     3     3     3     3     3     3       3     3     3     3     3     3     3     3     3       3     3     3     3     3     3     3     3     3       3     3     3     3     3     3     3     3     3       3     3     3     3     3     3													
CO3	COURSE OUTCOMES:         BT Mapped (Highest Level)           CO1         choose appropriate mechanical energy based unconventional machining process.         Applying (K3)           CO2         identify a suitable electrical energy based unconventional machining process application.         Applying (K3)           CO3         explain the concept of machining the hard material using chemical energy and electrochemical energy.         Applying (K3)           CO4         illustrate various thermal energy-based process for engineering applications.         Applying (K3)           CO5         illustrate the hybrid processes and advanced finishing processes used for various applications         Applying (K3)           CO5         Illustrate the hybrid processes and advanced finishing processes used for various applications         Applying (K3)           CO5         PO1         PO2         PO3         PO4         PO5         PO6         PO7         PO8         PO9         PO10         PO11         PO12         PSO1         PSO2           CO3         3         3         3         3         3         3         3         3         3           CO4         10         PO3         PO5         PO6         PO7         PO8         PO9         PO10         PO11         PO12         PSO1         PSO2														
CO4	illust	trate va	rious th	ermal ener	gy-bas	ed proces	ss for er	ngineeri	ng app	lications				Applying	(K3)
CO5	illust	trate the	e hybrid	processes	and a	dvanced f	finishing	proces	ses us	ed for va	rious ap	plications		Applying	(K3)
	1			•											<b>、</b> /
	Mapping of COs with POs and PSOs														
COs/POs         PO1         PO2         PO3         PO4         PO5         PO6         PO7         PO8         PO9         PO10         PO11         PO12         PS01         PS02															
CO	1	3				3								3	3
CO	2	3				3								3	3
CO	3	3				3								3	3
CO	4	3				3								3	3
CO	5	3				3								3	3
1 – Slio	nht. 2	– Mode	erate. 3	- Substanti	al. BT·	Bloom's	Taxono	mv		1	1		1		1
	<b>j</b> , <u> </u>		, .		,										
						ASSES	SMENT	PATTE	RN –	THEOR	(				
Tes	t / Blo	oom's	R	ememberi	ng	Understa	anding	Apply	ving	Analyz	ing	Evaluating	I Cro	eating	Total
C	atego	ory*		(K1) %		(K2)	%	(K3)	%	(K4) 🤋	<b>%</b>	(K5) % ັ	(M	(6) %	%
	CAT	1		35		65							•		100
	CAT	2		35		65									100
	CAT	3		35		65									100
	ESE	-		45		55									100
* ±3%	may b	e varie	d (CAT	1,2,3 – 50	marks	& ESE –	100 ma	rks)			1		1		

		22MEE04 - DESIGN FOR MANUFACTURE AND	) ASSEN	<b>IBLY</b>									
Progra Branch	mme &	BE & Mechanical Engineering	Sem.	Category	L	т	Ρ	Credi t					
Prereq	uisites	Manufacturing Technology, Engineering Materials and Metallurgy, Machining and Measurements	5	PE	3	0	0	3					
Preamb	ble	This course provides the essential concepts behind manufacturing design guidelines for machining, casting and injection molding to a	and ass chieve c	embly orient de ost effective de	esign. I esign	t also	provi	des					
Unit – I		Tolerance Analysis						9					
Geome Conver Tolerar	etric Toler sion of nce –Proc	ances – Tolerance Analysis – Worst Case Method – Assembly Design Datum into Manufacturing Datum – Tolerance Stacks ess Capability.	Limits - – True	<ul> <li>Design and</li> <li>Position Theorem</li> </ul>	Manu ory – 2	factur Zero	ing D True	atum – Position					
Unit – I	I	Materials Selection and Design for Assembly						9					
Principal Materials – Selection of Materials and Processes –Design – Possible Solutions – Evaluation Method. General DesignPrinciples for Manufacturability – General Design Guidelines for Manual Assembly – Assembly Efficiency – Effects of PartSymmetry – Part Thickness and Weight on Handling Time – Types of Manual Assembly Methods – Design for High SpeedAutomatic Assembly and Robot Assembly.Unit – IIIDesign for Machining9													
Unit – III         Design for Machining         9													
Design Features to Facilities Machining – Single Point and Multipoint Cutting Tools – Choice and Shape of Work Material – Accuracy and Surface Finish – Design Recommendations for Turning and Milling Operations: Process Description – Suitable Materials. Guidelines for Machining of Rotational and Non-Rotational Components – Reduction of Machined Area – Design for Clamp ability – Design for Accessibility.													
Unit – I	V	Design for Injection Molding and Powder Metal Processing						9					
Injectio of Optii Design Guideli	n Molding mum Num for Pow nes for Po	Materials – The Molding Cycle – Molding Systems and Molds – Cy ber of Cavities – Design Guidelines for Injection Molding. der Metal Processing: Introduction to Powder Metal Processing - bowder Metal Parts.	cle Time – Materi	e and Mold Cos ials and Manu	st Estin ufacturi	nation	o – Es ost –	timation Design					
Unit – Y	V	Design for Sand and Die Casting						9					
Sand C Design DieCas	Casting Al . Die Cas .ting – Des	loys – Sand Cores – Design Rules for Sand Castings – Identific ting Alloys – The Die Casting Cycle – Determination of Number sign Principles for Die Casting.	ation of r of Cav	Uneconomica rities and App	l Desig ropriate	gn – I e Mao	Modif <u></u> chine	ying the Size in					
							٦	Total:45					
TEXT E	BOOK:												
1.	Boothroy 2011.	d G, Dewhurst P & Knight W. A., "Product Design for Manufacture	e and As	ssembly", 3 <sup>rd</sup> E	Edition,	CRC	Pres	s, USA,					
REFER	ENCES:												
1.	Peck Ha	larry, "Designing for Manufacture", 1 <sup>st</sup> Edition, Pitman Publications, London, 1983.											
2.	Bralla J	G., "Design for Manufacturability Handbook", 2 <sup>nd</sup> Edition, McGraw H	ill Educa	tion, New York	k, 1999								

COUR: On con	SE OI	UTCON on of th	IES: e course	, the stud	ents wil	l be able	to						(	BT Map Highest L	ped _evel)		
CO1	ana mar	lyze the	e dimens ring orier	tions of co	mponei n	nts and id	dentify th	ne suita	ble ge	ometrica	l tolerand	ces for		Analyzing	ı (K4)		
CO2	sele ass	ect suita embly i	able mate	erials for c	ompone	ents and	demons	strate th	e desi	gn consi	derations	for		Applying	(K3)		
CO3	prov	vide sui	table de	sign recor	nmenda	ations for	various	machir	ning op	erations				Applying	(K3)		
CO4	ana reco	lyze the	e design dations f	requireme or powde	ent for ir metal	njection r processir	nolded o	compon	ents a	nd demo	onstrate t	he design		Analyzing	ј (K4)		
						Маррі	ng of C	Os with	n POs	and PSC	Ds						
COs/P	Os	PO1	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2		
CO	1	3	1	3											3		
CO2	2	3	1	3											3		
CO	3	3	1	3										3			
CO4	1	3	1	3											3		
COS	5	3	1	3											3		
1 – Slig	ht, 2	– Mode	erate, 3 -	Substant	ial, BT-	Bloom's	Taxono	my									
						ASSE	SSMEN	Τ ΡΑΤΤ	ERN -	THEOR	RY						
Tes C	t / Blo atego	oom's ory*	Re	emember (K1) %	ng l	Understa (K2)	anding %	Apply (K3)	ying ) %	Analyz (K4)	ing E %	Evaluating (K5) %	Cre (K	ating 6) %	Total %		
	CAT	1		20		40	)	20	)	20					100		
	CAT	2		20		40		40	)						100		
	CAT	3		20		40		30	)	10					100		
	ESE			20		40		20	)	20					100		
* ±3% ı	nay b	e varie	d (CAT 1	,2&3–	50 marl	ks & ESE	E – 100 r	narks)					1				
CO5	ider	ntify une	economi	cal design	to mod	ify desig	n for sar	nd and o	die cas	tings				Applying	(K3)		

	22MEE05 - AUTOMOBILE ENGINEER	RING											
Programme & Branch	BE & Mechanical Engineering	Sem.	Category	L	т	Ρ	Credit						
Prerequisites	Nil	5	PE	3	0	0	3						
Preamble	This course deals with the structure and construction of au functional components. In addition, an insight is provided abo standards.	tomobiles out electri	s and also, tl c vehicles, po	ne wo	orking n norr	prin ns ar	ciples of nd safety						
Unit – I Ve	hicle Structure and Engine						9						
Vehicle Structure Components of Engine Managem	: Types of Automobiles – Vehicle Construction – Chassis – Typ Engine – Functions and Materials – Turbo Chargers – Supercha nent System.	oes – Fra Irgers –	ame and Body Turbo Lag –	r Type Introc	es. Er luctio	ngine: n to E	Types – Electronic						
Unit – II Fu	el Supply Systems and Electrical Systems						9						
Fuel Supply Sys and Multi Point I Fuel Supply Sys Introduction to H Electrical System	tem: Carburetion and Simple Carburetor – Electronically Controll Fuel Injection Systems (MPFI) – Gasoline Direct Injection (GDI) tem – Types – Electronically Controlled Diesel Fuel Injection Sy ydrogen fuel based Engines. hs: General Layout of Electrical System – Different Sub Circuits – L	ed Gasol – Fuel stem – C ighting S	ine Fuel Injec Stratified Injec Common Rail	tion S tion ( Direct	ysten FSI). t Injed	n – M Diese ction	lonopoint el Engine (CRDI) –						
Electrical Systems: General Layout of Electrical System – Different Sub Circuits – Lighting System.         Unit – III       Transmission Systems         9													
Transmission Systems:       Pransmission Systems         Transmission Systems:       Clutch – Types and Construction – Gear Boxes – Types - Manual and Automatic – Selector Mechanism – Over Drives – Transfer Box - Fluid Flywheel - Torque Converter – Propeller Shaft – Slip Joint – Universal Joints – Differential Unit - Rear Axle – Hotchkiss Drive – Torque Tube Drive.													
Unit – IV St	eering, Brakes and Suspension Systems						9						
Steering: Wheel Steering Gear Be Working – Antilo Suspension Syst	s and Tyres – Wheel Alignment Parameters – Types of Front ox and Types – Power Steering. <b>Brakes:</b> Types – Hydraulic and ock Braking System – Single Channel – Dual Channel – Electronic ems: Types – Independent Suspension Systems.	Axle – Pneumat Brake fo	Steering Geo ic Braking Sys rce Distribution	metry stems n (EB	and – Co D).	Mech nstrue	nanism – ction and						
Unit – V El	ectric Vehicles, Emission Control and Safety						9						
Electric Vehicles Lead Acid Batter and Drives. Emission Control Safety: Safety Me	: Hybrid Vehicles – Electric Vehicles – Solar Powered Vehicles y – Lithium-ion Battery, Battery Thermal Management System (BT : Global Standards – Indian Pollution Norms for Petrol and Diesel easures in Automobiles – Airbag – Passenger Safety – Vehicle Saf	– Fuel ( ™S) – Is Vehicles fety.	Cells – Const ssues and Cha – Data analyti	tructic alleng cs on	on and es – Exha	d Ope Starti lust E	eration of ng Motor mission.						
							Total:45						
TEXT BOOK:													
1. Kirpal Singl	n, "Automobile Engineering", 14 <sup>th</sup> Edition, Volume I & II, Standard F	Publishers	s Distributor, N	lew D	elhi, 2	2021.							
REFERENCES:													
1. Crouse Wi	liam H. and Anglin Donald L., "Automotive Mechanism", 10th Editic	on, Tata N	/IcGraw-Hill, N	ew De	elhi, 2	017.							
2. Rajput R.K	., "A Text book of Automobile Engineering", 2 <sup>nd</sup> Edition, Laxmi Pul	blication,	New Delhi, 20	17.									
3. P.S.Gill, " A	A Text Book of Automobile Engineering", 2 <sup>nd</sup> Edition, S.K.Kataria &	Sons, Ne	ew Delhi, 2012										

COURS On com	SE OUTCOMES: apletion of the course, the students will be able to	BT Mapped (Highest Level)
CO1	recognize the various automobile components and explain the functions of engine parts and engine management system.	Understanding (K2)
CO2	describe the fuel supply systems and electrical systems in automobiles.	Applying (K3)
CO3	explain the working of transmission systems and its inner elements.	Applying (K3)
CO4	illustrate the working of suspension, steering and braking systems.	Applying (K3)
CO5	comprehend the pollution norms and safety measures and also illustrate the working of electric vehicles.	Applying (K3)

	Mapping of COs with POs and PSOs													
COs/POs	P01	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2		3											3
CO2	2		3											3
CO3	2		3											3
CO4	2		3											3
CO5	1		3		1		2						1	3
1 - Slight 2 - Moderate 3 - Substantial RT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY									
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %		
CAT1	20	50	30	-	-	-	100		
CAT2	20	50	30	-	-	-	100		
CAT3	20	50	30	-	-	-	100		
ESE	20	50	30	-	-	-	100		
* ±3% may be varied (CAT 1, 2 & 3 – 50 marks & ESE – 100 marks)									

22MEE06 - FUELS AND COMBUSTION TECHNOLOGY											
Programme & BranchBE & Mechanical EngineeringSem.CategoryLTPC											
Prerequisites	Engineering Thermodynamics	5	PE	3	0	0	3				
		1	1								
Preamble	This course provides an overview of fuel properties and the thermodynamics, sources of pollution and their controlling measu	ir compo res.	osition. It als	so d	escrit	oes con	nbustion				
Unit – I	Fuel Characteristics						9				
Fuels - Types and Characteristics of Fuels - Determination of Properties of Fuels - Calorific Value - Gross and Net Calorific Values - Calorimetry - Dulong's Formula for Calorific Value Estimation - Flue Gas Analysis - Orsat Apparatus – Gas Chromatograph.											
Unit – II	Unit – II Solid Fuels and Liquid Fuels 9										
Solid Fuels: Wood and Wood charcoal-Origin of Coal- Composition of Coal - Analysis Fuels- Proximate and Ultimate Analysis - Moisture Determination and Properties of Different Grades of Coal-Preparation and Storage of Coal-Coal washing – Briquetting- Coke Preparation Techniques – Gasification and Liquefaction of Solid Fuels. Liquid Fuels: Origin of Petroleum Fuels-Production - Composition-Petroleum Refining- Various Grades of Petro-Products-Properties and Testing - Gasification of Liquid Fuels											
Unit – III Gaseous Fuels 9											
Classification - Composition and Properties – Fractional Distillation – Gas Calorimeter- Rich and Lean Natural gases and LPG - Producer gas - Water gas – Hydrogen – Acetylene											
Unit – IV	Stoichiometry and Kinetics						9				
Stoichiometry: Methods. Kine Combustion -I	Mass Basis and Volume Basis - Excess Air Calculation - Fuel and Flu tics: Combustion Processes -Stationary Flame - Flameless Combustio gnition and Ignition Energy - Spontaneous Combustion - Flame Propa	ue Gas C on - Subi gation -A	Compositions merged Comb Adiabatic Flan	- Ca ousti ne T	lculat on- M empe	ions - R lechanis erature.	apid sm of				
Unit – V	Air Pollution						9				
Types- Combu Generated Pol	stion Generated Air Pollution - Effects of Air Pollution - Fossil Fuel Ge ution and Power Plants Generated Pollution and its Control.	enerated	Pollution and	its (	Contro	ol - Auto	omobiles				
							Total:45				
TEXT BOOK:											
1. Om Prakash Gupta., "Elements of Fuels & Combustion Technology", 4 <sup>th</sup> Edition, Khanna Book Publishing Company (P) Ltd., New Delhi, 2018.											
REFERENCES:											
1. Mishra	D.P., "Fundamentals of Combustion", 1st Edition, PHI Learning Pvt L	td, India,	, 2010.								
2. Samir	Sarkar., "Fuels & Combustion", 3 <sup>rd</sup> Edition, CRC Press, India, 2010.										

COURSE	ουτςο	MFS:											F	ST Mapped	d
On comp	etion of t	he co	urse,	the stude	ents w	ll be able	to						(Hi	ghest Lev	el)
CO1 0	etermine	the f	uel p	roperties	using	standard	approac	hes					Ap	plying (K3	5)
CO2 e	xplain th	e com	nposi	tion and p	orepara	ation meth	nods of s	solid & I	quid fu	iels			Ap	plying (K3	3)
CO3 e	xplain th	e com	nposi	tion and p	roper	ties of ga	seous fu	iels					Ap	oplying (K3	5)
CO4 0	escribe t	he sto	oichio	ometry an	d kine	tics of cor	nbustior	of fuel	S				Ap	plying (K3	5)
CO5 r	ecognize	the ty	ypes	of air poll	ution a	and explai	n their c	ontrollir	ng meth	nods			Unde	rstanding	(K2)
						Mappin	g of CO	s with	POs ar	nd PSO:	5				
COs/PO	PO1	P	02	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3			3											3
CO2	3			2											3
CO3	3			2											3
CO4	3			2											3
CO5	1							3	3						3
1 – Slight	2 – Moc	lerate	, 3 –	Substanti	al, BT	- Bloom's	Taxono	my							
ASSESSMENT PATTERN - THEORY															
/ Test Cate	Bloom's egory*		Re	memberi (K1) %	ng	Understa (K2)	anding %	Apply (K3)	/ing %	Analyzi (K4) 9	ing l %	Evaluating (K5) %	uating Creating To 5) % (K6) % %		
С	AT1			20		40		40	)						100
С	AT2			20		40		40	)				10(		

\* ±3% may be varied (CAT 1, 2 & 3 – 50 marks & ESE – 100 marks)

CAT3

ESE

22MEE07 - INDUSTRIAL ENGINEERING									
Programme & Branch	B.E. & Mechanical Engineering	Sem.	Category	L	т	Ρ	Credit		
Prerequisites	Manufacturing Technology, Machining and Measurements	5	PE	3	0	0	3		
			I	1		I			
Preamble	The course brings with fundamental aspects of various Industrial planning, forecasting techniques and value engineering that organization.	al Engin involve	eering tools es enlightenii	ike ng t	work he e	study, fficienc	resource y of an		
Unit – I	Work System Study						9		
Method Study – Basic Procedure – Selection – Recording of Process – Critical Analysis – Development – Implementation – Micro Motion and Macro motion study – Principles of Motion Economy – Work Measurement – Techniques of Work Measurement – Time Study – Computation of Standard Time-Work Sampling – Synthetic Data – Predetermined Motion Time Standards – Job Evaluation – Merit Rating- Ergonomics and Safety.									
Unit – II	Process Control for Production Planning and Control						9		
Need for PPC-Objectives – Functions-Information Required for PPC – Production-Organization – Manufacturing Methods – Types of Production System – Characteristics of Flow – Job - Batch – Productivity-Factors Affecting Productivity – Plant Layout – Classification – Layout Design Procedures – Computerized Relative Allocation of Facilities Technique (CRAFT) – Automated Layout Design Program (ALDEP) – Computerized Relationship Planning (CORELAP)- Productivity Measures –Problems – Production control – Loading – Sequencing – Scheduling - Dispatching.									
Unit – III	Forecasting and Facility Planning						9		
Need for Forecasting – Demand Patterns-Forecasting Models – Judgmental Techniques – Time Series Analysis – Moving Average – Exponential Smoothing-Regression and Correlation Method – Forecast Error – Costs and Accuracy of Forecasts. Facility Location – Influencing Factors – Plant Location – Single Location Problems.									
Unit – IV	Material Requirement Planning and Capacity Planning						9		
Material Require Manufacturing R Capacity Plannir Planning (ERP) manufacturing.	Material Requirement Planning and Capacity Planning Material Requirement Planning and Capacity Planning Material Requirement Planning (MRP): Objectives – Terminologies – Systems – Outputs – Management Information to MRP – Manufacturing Resource Planning – Capacity Requirement Planning – Measures of Capacity – Capacity – Need. Capacity Planning: Influencing – Aggregate Planning-Guidelines Master Production Schedule- Introduction to Enterprise Resource Planning (ERP) – Strategy – Need – Benefit-Modules – Introduction to Lean Manufacturing – Comparison with conventional manufacturing								
Unit – V	Production Cost Estimation						9		
Importance of C Procedure – E Estimation of few	osting and Estimation – Methods of Costing – Elements of Cost Estination Labour Cost, Material Cost – Allocation of Overhead v Types of Jobs From Forming and Machining Operations.	mation – Charges	Types of Est - Calculation	imat on c	es – of De	Estimat preciatio	ing on Cost.		
							Total:45		
TEXT BOOKS:									
1. Martand T Telsang ., "Industrial Engineering and Production Management", 3 <sup>rd</sup> Edition, S. Chand and Company, New Delhi, 2019 for Units I,II,III,IV.									
2. Sinha B.P, "Mechanical Estimating and Costing", Tata-McGraw Hill Publishing Co, 1995 for Unit V.									
REFERENCES:									
1. Buffa Elwood S., and Sarin Rakesh K, "Modern Production/Operations Management", 8 <sup>th</sup> Edition, Wiley, New York, 2007.									
2. Chase, Delhi, 2	2. Chase, Richard B., "Operations Management for Competitive Advantage", 11 <sup>th</sup> Edition Tata McGraw-Hill, New Delhi, 2006.								

COUR: On con	SE OUTCOMES: npletion of the course, the students will be able to	BT Mapped (Highest Level)
CO1	apply the different industrial engineering principles & techniques for enhancement of industry performance	Applying (K3)
CO2	apply the concept of production, planning and control techniques for industrial cases	Applying (K3)
CO3	Make use of forecasting models to identify the demand	Applying (K3)
CO4	analyse the various resource in an organization	Analyzing (K4)
CO5	examine the different types of cost estimation in industry	Analyzing (K4)

	Mapping	of	COs	with	POs	and	<b>PSOs</b>
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COs/POs	P01	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2		1									3	3
CO2	3	2		1									3	3
CO3	3	2		1									3	3
CO4	3	2		1							1		3	3
CO5	3	2		1							1		3	3

ASSESSMENT PATTERN - THEORY										
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %			
CAT1	25	30	35				100			
CAT2	20	40	40				100			
CAT3	20	30	25	25			100			
ESE 20 30 35 15 100										
* ±3% may be varied (CAT 1, 2 & 3 – 50 marks & ESE – 100 marks)										

22MEE08 - PRODUCTION PLANNING AND CONTROL										
Progra Branc	amme & h	BE & Mechanical Engineering	Sem.	Category	L	т	Ρ	Credit		
Prerec	uisites	NIL	5	PE	3	0	0	3		
				L						
Pream	ble	This course offers insight on various functions and decision making of production activities adopted in industries.	ng proce	ess involved i	n plai	nning a	and co	ontrolling		
Unit –	l Intro	oduction						9		
Definition – Objectives and Functions of Production Planning and Control – Elements of Production Control – Types of Production – Organization of Production Planning and Control Department – Internal Organization of Department - Break Even Analysis - Economics of a New Design – Aesthetic Aspect.										
Unit – II Forecasting, Product Planning and Process Planning 9										
Forecasting: Demand Forecasting, Forecasting Techniques. Product Planning: Extending the Original Product Information-Value										
Analysis-Problems in Lack of Product Planning. Process Planning: Pre Requisite Information Needed for Process Planning - Steps										
in Process Planning - Quantity Determination in Batch Production-Machine Capacity - Balancing.										
Unit – III Routing and Scheduling 9										
Routing – Definition – Routing Procedure – Route Sheets – Bill of Material – Factors Affecting Routing Procedure, Scheduling										
Chase	Planning -	Expediting and Controlling Aspects	a Scheo	iuling wethoo	is	Aggreg	jate F	ranning,		
Dispot	ching Activ	patoning itias - Dispatabing Procedure - Follow Up - Reason for Existence		tions Manut	octu	inglo	ad	Э		
Time-	Techniques	s for Aligning Completion Times and Due Dates – Applications of C	computer	r in Productio	n Pla	nnina a	au and C	ontrol		
Unit –	V Inve	entory Control and Trends in PPC	omputor			in ing c		9		
Invento – Dete model- Just in	ory Control: rministic m - Safety St Time (JIT)	Inventory Management – Functions of inventories – Purpose of H odels: Always Better Control (ABC) analysis – Inventory Productio ock Inventory Control Systems. Trends in PPC: Enterprises Resourt and KANBAN system.	lolding s on Quan urce Plar	tock - Effect tity – Econor nning (ERP)	of De nic O · Line	mand o rder Q e of Ba	on Inv uantit lance	rentories y (EOQ) (LOB) –		
	- (- )	· · · · · · · · · · · · · · · · · · ·						Total:45		
TEXT	BOOK:									
1. Jain K.C. & Agarwal L.N., "Production Planning Control & Industrial Management", 8 <sup>th</sup> Edition, Khanna Publishers, New Delhi, Reprint 2019.										
REFERENCES:										
1. Upendra Kachru., "Production and Operations Management – Text and Cases", 1 <sup>st</sup> Edition, Excel Books, New Delhi, 2009.										
2.	2. Norman Gaither G. & Frazier., "Operations Management", 9th Edition, Thomson Learning, 2002.									

COUR On cor	SE OUTCOMES: npletion of the course, the students will be able to	BT Mapped (Highest Level)				
CO1	describe the role of production planning and control activities in manufacturing and service industries.	Understanding (K2)				
CO2	demonstrate the forecasting techniques and the sequences of process planning operations	Applying (K3)				
CO3	interpret the flow of product in machineries through scheduling	Applying (K3)				
CO4	integrate the product lead time and its related parameters using dispatching technique	Applying (K3)				
CO5	employ various inventory management techniques and apply in real manufacturing scenario	Applying (K3)				
Mapping of COs with POs and PSOs						

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3										1			2
CO2	3	2	1										3	2
CO3	3	2	1											3
CO4	3	2	1											3
CO5	3	2	1											3

ASSESSMENT PATTERN – THEORY												
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %					
CAT1	20	60	20				100					
CAT2	20	50	30				100					
CAT3	20	50	30				100					
ESE	20	60	20				100					
* ±3% may be varied (CAT 1, 2 & 3 – 50 marks & ESE – 100 marks)												

22MEE09 - DESIGN OF TRANSMISSION SYSTEMS												
(Use of PSG Design Data book / Machine Design data book by V.B.Bhandari is permitted for the End Semester Examination)												
Programme & Branch	BE & Mechanical Engineering Sem. Category L T P											
Prerequisites	Strength of Materials, Design of Machine Elements	6 PE 3				0	3					
Preamble This course imparts the knowledge on design of various transmission devices like belt, chain, rope, gear and gear box which aid in effective working of mechanical systems. Apart from these, this course give detailed view about design of power screws, lead screw and coupling as per standards.												
Unit – I	Design of Belt, Rope and Chain Drives						9					
Design of Belt, Rope and chain: Classification of Belt Drives – Selection of Flat Belts, V Belts and Pulleys – Selection of Wire Ropes and Pulleys - Selection of Transmission Chains and Sprockets.												
Unit – II	Unit – II         Design of Spur Gears and Helical Gears         9											
Design of Spur Gears: Gear Terminology – Speed Ratios and Number of Teeth – Force Analysis – Tooth Stresses – Dynamic Effects – Fatigue Strength – Factor of Safety – Gear Materials – Module and Face Width – Power Rating Calculations Based on Strength and Wear Considerations. Design of Helical Gears: Parallel Axis Helical Gears – Pressure Angle in the Normal and Transverse Plane – Equivalent Number of Teeth–Forces and Stresses – Estimating the Size of the Helical Gears												
Unit – III	Design of Bevel Gears and Worm Gears						9					
Design of Bevel Gears: Straight Bevel Gear-Terminology-Tooth Forces and Stresses-Equivalent Number of Teeth- Estimating the Dimensions of Pair of Straight Bevel Gears. Design of Worm Gears: Merits and Demerits-Terminology- Thermal Capacity-Materials-Forces and Stresses-Efficiency-Estimating the Size of the Worm Gear Pair.												
Unit – IV Design of Gear Boxes 9												
Geometric Pro Constant Mesl	ogression–Standard Step Ratio–Ray Diagram–Kinematic Layo h Gear Box–Design of Multi Speed Gear Box.	outs-De	sign of Slid	ing	Mes	h Gea	r Box—					
Unit – V	Design of Brakes and Clutches						9					
Types of Brake Plate Clutches -	-Simple and Compound - Internal and External Shoe Brakes – Dis- Multi-Disk clutches – Cone Clutches – Description of Centrifugal C	c Brakes lutches.	s (Description	Onl	y) - [	Design o	of Single					
							Total:45					
TEXT BOOK:												
1. Prabhu	IT.J., "Design of Transmission Elements", 5 <sup>th</sup> Edition, New age Intern	national F	Publisher, Ch	enna	i, 20′	19.						
REFERENCES:												
1. Bhanda	ari V.B., "Design of Machine Elements", 4 <sup>th</sup> Edition, Tata McGraw-Hil	l, New D	elhi, 2016.									
2. Shigley NewYo	<ul> <li>J.E.&amp; Mischke C.R., "Mechanical Engineering Design",11<sup>th</sup> E rk,2019.</li> </ul>	dition, N	McGraw Hill	Inte	rnatio	onal Ec	ducation,					
3. Norton	R.L., "Design of Machinery", 6th Edition, McGraw Hill, New Delhi,201	19.										
STANDARDS:												
<ol> <li>IS4460:Parts</li> <li>IS7443:2002</li> <li>IS15151:200</li> <li>IS 2122: Part Part1 Flat Be</li> <li>IS2122:Part2 Part 2V-Belt</li> </ol>	<ol> <li>STANDARDS:</li> <li>I. IS4460:Parts1to3:1995-Gears–Spur and Helical Gears–Calculation of Load Capacity</li> <li>IS7443:2002,Methods of Load Rating of Worm Gears</li> <li>IS15151:2002,Belt Drives–Pulleys and V-Ribbed belts for Industrial applications – PH, PJ, PK, PI and PM Profiles: Dimensions</li> <li>IS 2122: Part 1: 1973, Code of practice for selection, storage, installation and maintenance of belting for power transmission: Part1 Flat Belt Drives.</li> <li>IS2122:Part2:1991,Code of practice for selection, storage, installation and maintenance of belting for power transmission: Part 2V-Belt Drives.</li> </ol>											

COURSE OUTCOMES: On completion of the course, the students will be able to													BT Mapped (Highest Level)				
CO1 choose proper assumptions, perform analysis and select appropriate belt drives and chain drives												es	Applying (K3)				
CO2	2 select suitable dimensions for spur and helical gear drives for given application													Applying (K3)			
CO3	O3 design the bevel gear and worm gear for the suitable loading conditions													Applying (K3)			
CO4	draw and analyse the speed calculation of different stages in a multi speed gear box													Applying (K3)			
CO5	5 design the clutch and brakes for various applications												Applying (K3)				
Mapping of COs with POs and PSOs																	
COs/F	POs PO1		PO2	PO3	PO	4 PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2		
CO	1	2	1	3											3		
CO	2	2	1	3											3		
CO	3	2	1	3											3		
CO	4	2	1	3											3		
CO	5	2	1	3											3		
1 – Slię	ght, 2	– Mode	erate, 3	- Substant	ial, B	T- Bloom's	s Taxono	my		- I		ľ	- <b>L</b>				
						ASSE	SSMENT	PATTE	ERN - '	THEORY	,						
Test / Bloom's Remembering Category* (K1) %					ing	Understanding (K2) %		Applying (K3) %		Analyzing (K4) %		Evaluating (K5) %		reating (K6) %	Total %		
	CAT	CAT1 15		15		70							100				
	CAT2			15		15		70							100		
	CAT3		15		15		70							100			
	ESE	ESE 15			15		70							100			
* ±3%	may b	e varie	d (CAT	1,2&3-	50 ma	arks & ES	E – 100 r	marks)	I		1		1		1		
	22MEE10 - VIBRATION AND NOISE COM	ITROL															
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Programme & Branch	BE & Mechanical Engineering	Sem.	Category	L	т	Ρ	Credit										
Prerequisites	Matrices and Ordinary Differential Equations, Multivariable Calculus and Complex Analysis, Dynamics of Machinery, Strength of Materials	6	PE	3	0	0	3										
Preamble	This course imparts the knowledge on natural frequency of vibratic sensors, basics source of noise, measurement of sound and its co	on systen ntrol.	n, vibration me	easuri	ng ins	strume	ents and										
Unit – I	Basics of Vibration and One degree of Freedom System						9										
Introduction, C Vibration – Re Systems – Tors	lassification of Vibration: Free and Forced Vibration – Undamped as sponse of Damped and Undamped Systems Under Harmonic For sional Vibration – Determination of Natural Frequencies.	and Dam orce – A	ped Vibration nalysis of Sin	– Line Igle D	ear ar egree	nd No e of F	n-Linear Freedom										
Unit – II	Two Degree of Freedom System and Vibration Control						9										
Vibration of Tv Spring Coupled	vo Degree of Freedom System - Semi Definite System - Forced \ and Mass Coupled system Vibration Absorber – Vibration Isolation	/ibration – Rando	of Two Degre m Vibration.	e of F	reed	om S	ystem –										
Unit – III	Vibration Measurement						9										
Vibration Meas Studies – Balar	uring Instruments – Types of Exciters - Types of Sensors – Vibration noing – Single and Double Plane Balancing – Modal Analysis techniq	Test – F ues.	ree and Force	d Vibı	ation	Tests	s – Case										
Unit – IV	Basics of Noise						9										
Introduction – A Levels – Noise Frequency Ana	Amplitude – Frequency – Wavelength and Sound Pressure Level - Dose Level – Legislation – Measurement and Analysis of Noise Ilysis – Tracking Analysis – Sound Quality Analysis.	– Additior e – Meas	n – Subtractio surement Envi	n and ironme	Aver ent –	aging Equi	Decibel pment –										
Unit – V	Source of Noise and Control						9										
Methods for Co Enclosures – A through Barrier	ontrol of Engine Noise – Combustion Noise – Mechanical Noise – Automotive Noise Control Principles – Sound in Enclosures – So s.	Predictive und Ener	e Analysis – F gy Absorptior	Palliati n – So	ve Tr ound	eatme Trans	ents and smission										
							Total:45										
TEXT BOOKS:																	
1. Singh	V.P., "Mechanical Vibrations". 6 <sup>th</sup> Edition, Dhanpat Rai & Co. Ltd., N	ew Delhi,	2016 for Unit	s I,II,II	I.												
2. Pujara	Kewal., "Vibrations and Noise for Engineers", 4th Edition, Dhanpat F	Rai & Son	s, New Delhi,	2018	for U	nits I\	/, V.										
REFERENCES	:																
1. Rao S	ingiresu S., "Mechanical Vibrations", 6 <sup>th</sup> Edition, Pearson Education,	New Del	hi, 2018.														
2. Rao J Interna	.S., and Gupta K., "Introductory Course on Theory and Practice o ational Publishers, New Delhi, 1999.	f Mechar	nical Vibration	s", 6 <sup>th</sup>	Editi	on, N	lew Age										
3. Rama	murthi, V., "Mechanical Vibration Practice and Noise Control", Naros	a Book D	istributors Pvt	. Ltd.,	New	Delhi	, 2012.										

COUR: On con	SE OUTCOMES: npletion of the course, the students will be able to	BT Mapped (Highest Level)
CO1	solve the frequency response of single degree of freedom system	Analyzing (K4)
CO2	solve and design vibration absorber for the two degrees of freedom system	Analyzing (K4)
CO3	apply the vibration measuring instruments and analyze machine signature for identifying the vibration signal	Applying (K3)
CO4	apply the noise related parameters for identify the noise level	Applying (K3)
CO5	identify and analyze the sources of noise and control	Applying (K3)

					Mappin	g of CO	s with	POs an	d PSOs	5				
COs/POs	P01	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1											3
CO2	3	3	1											3
CO3	3	1	2											3
CO4	3	3												3
CO5	CO5 3 3 3													
1 – Slight, 2	– Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy													

		ASSESSMENT	PATTERN -	THEORY									
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %						
CAT1	10	10	40	40			100						
CAT2	10	10	40	40			100						
CAT3	15	15	70				100						
ESE	ESE 10 10 40 40 100												
* ±3% may be varied (C	* ±3% may be varied (CAT 1, 2 & 3 – 50 marks & ESE – 100 marks)												

		22MEE11 - IN		MANUFACTU	JRING	SYSTEM	IS						
Programme & Branch	BE & Mechanica	I Engineering				Sem.	Category	L	т	Ρ	Credit		
Prerequisites	Manufacturing Mechanical Syst	Technology, ems	Artificial	Intelligence	in	6	PE	3	0	0	3		
Preamble	This course delve technologies that applications.	es into the funda are integral to	mental princi smart manut	iples through a facturing includ	comp ling th	rehensive eir under	e understandi lying principl	ng of v es, fun	arious ctions	s con , and	cepts and I practical		
Unit – I	Intelligent Manuf	facturing – Intro	duction and	l Implementati	on						9		
Introduction - Pe Customers – Te the Execution Pl	eople and Process echnology Conside hase. Implementing	Culture Enable rations – Strateg Smart Manufac	rs - Technolo gy Developm turing: Orgar	ogy Enablers. S ent – Other Co nization Specific	Strateg onside Strate	gy: Under rations. E egy – Inte	standing the Execution: Re elligent Manuf	Busine comme acturin	ess / ( endati g Exa	Opera ons t mple	ations and o Support s.		
Unit – II     Industry 4.0     9													
Introduction - RA Administration S Order - Controlle	AMI 4.0: Motivation Shell: Motivation – ed Production – Se	u – Layers – Life AAS Requireme amless Dynamic	Cycle and V ents – AAS Engineering	′alue Stream – Design. Applica Plants – Road	Hierai ations: dmap	rchy Leve : Value-B - Researc	els – Example ased Service ch Scope.	e Usage es – Ac	e of R daptat	AMI A	4.0. Asset actories –		
Unit - III         Cyber Infrastructure         9													
Cyber Infrastructure - Intelligent Manufacturing from a Business Perspective, Complexity of Interconnectedness, Reducing the Heavy Lift of Data Modeling and Contextualization, The Data-Centric View of Smart / Intelligent Manufacturing, Building Blocks of Smart Manufacturing. Operational Data Models: Smart Manufacturing Profiles – Machine Example. Overarching R&D Considerations: Discretized Modeling - Smart Manufacturing Innovation Platform – Technical Foundations.													
Discretized Modeling - Smart Manufacturing Innovation Platform – Technical Foundations.           Unit – IV         Industrial Internet of Things (IIoT)         9													
Overview of IoT Systems – Indu Quality Control -	: IoT Architecture Istrial Sensing – Ir - Case Studies.	<ul> <li>Protocols – C</li> <li>dustrial Process</li> </ul>	loud Comput s, Machine L	ting – Sensor ( .earning and D	Cloud lata S	– Big da cience in	ta. IIoT: Intro Industries, I	ductior nvento	n - Inc ry Ma	dustria nage	al Internet ment and		
Unit – V	Digital Twin Driv	en Smart Manu	facturing								9		
Background - Co Digital Twin Sho Twin Shop Floor	procept of Digital Tv p Floor: Evolution I - Characteristics -	vin - Value of Dig Path of Shop Flo - Key Technologi	gital Twin - D or - Related es – Challen	Digital Twin in P Works - Conce ges.	Product pt of E	t Lifecycle Digital Tw	e - Digital Tw in Shop Floo	in in In r - Impl	dustri emen	al Ap tatior	plications. of Digital		
											Total:45		
TEXT BOOKS:													
1. Masoud So United Stat	oroush, Michael Ba tes, 2020 for Units	aldea and Thom I, II, III.	as F. Edgar.	, "Smart Manu	facturi	ng Conce	epts and Met	hods",	1 <sup>st</sup> Eo	dition	, Elsevier,		
2. Anandarup Edition, CF	Mukherjee, Chan C Press, New Yorl	dana Roy and \$ <, 2021 for Unit I	Sudip Misra. V.	, "Introduction	to Ind	lustrial In	ternet of Thi	ngs an	d Ind	ustry	4. 0", 1 <sup>st</sup>		
3. Fei Tao, M 2019 for U	3. Fei Tao, Meng Zhang and A.Y.C. Nee., "Digital Twin Driven Smart Manufacturing", 1 <sup>st</sup> Edition, Academic Press, United Kingdom, 2019 for Unit V.												
REFERENCE:													
1. Masoud S Elsevier P	oroush, McKetta N ublication, Netherla	lichael Baldea, ands, 2020.	Thomas Edg	ar, "Smart Mar	nufactu	uring App	lications and	Case	Studie	es", 1	<sup>st</sup> Edition,		

COURSI On comp	E OU	TCOME	ES: course,	the stud	lents will	be able t	:0							BT Map (Highest	oped Level)
CO1	dev	elop th	e smart	manufa	cturing st	rategies	and their	executio	n					Applyi	ng (K3)
CO2	illus	strate the	e roadm	nap for Ir	ndustry 4	.0 and bu	uild the pr	ofiles for	smart m	nanufactu	uring			Applyi	ing (K3)
CO3	dev	elop teo	chnical b	basis for	a cyber-	infrastruc	ture of a	n Industry	/					Applyi	ing (K3)
CO4	inte	rpret the	e variou	s conce	ots of Ilo	T, design	consider	ations of	the Indu	ustrial Int	ernet, an	d its impa	act	Understand	ling (K2)
CO5	ider	ntify and	l implen	nent the	applicati	ons of dig	gital twin i	in shop fl	oor					Applyi	ing (K3)
						Маррі	ing of CC	Ds with F	Os and	PSOs					
COs/PC	COs/POs         PO1         PO2         PO3         PO4         PO5         PO6         PO7         PO8         PO9         PO10         PO11         PO12         PS01         PS02														
CO1		3 2 1 3													
CO2		3	1	1		2								1	2
CO3		3	1	1										3	3
CO4		3	1			2								2	3
CO5		3	2	1		2								3	3
1 – Sligh	ıt, 2 –	Modera	ate, 3 –	Substan	tial, BT-	Bloom's <sup>·</sup>	Taxonom	у		1	1	1	1		
-								-							
						ASSE	SSMENT	PATTE	RN – TH	IEORY					
/ Test Cat	/ Bloc tegor	om's 'y*	Rem (	emberir K1) %	ng U	nderstai (K2) %	nding %	Applyi (K3)	ing %	Analyzi (K4) %	ng ‰	Evaluati (K5) %	ng	Creating (K6) %	Total %
C	CAT1			20		50		30							100
C	CAT2			20		50		30							100
C	CAT3 20 60 20 100														
	ESE			20		55		25							100
* ±3% m	ay be	varied	(CAT 1,	, 2 & 3 –	50 mark	s & ESE	– 100 ma	arks)							

	22MEE12 - MANUFACTURING INFORMATIO	N SYSTE	M				
Programme Branch	& BE & Mechanical Engineering	Sem.	Category	L	т	Ρ	Credit
Prerequisite	S Manufacturing Technology	6	PE	3	0	0	3
			1			11	
Preamble	The course provides the importance of databases and its applic information on the database concepts, database designing and matching and	ation in anufactu	manufacturir ring consider	ng syst ations.	ems l	oy off	ering the
Unit – I	Introduction						9
Introduction Resource Pl	<ul> <li>Goals for Manufacturing - Evolution of Order Policies from Material anning (MRP II) to Enterprise Resource Planning (ERP) - Role of Prod</li> </ul>	Require	ment Plannin rganization -	ig (MR Opera	P) to tion C	Manu ontro	ufacturing I.
Unit – II	Database						9
Data Model Managemer	ing for Database - Records and Files - Abstraction and Data Integrated to System (DBMS) - Components of DBMS - Advantages and Disadvared to System (DBMS) - Records and Disadvared to System (DBMS) -	ation - T ntages of	hree Level A DBMS.	Archite	cture	for D	ata Base
Unit – III	Designing Database						9
Relationship Model – Cor	Among Entities - Entity Relationship (ER) Diagram - Data Models – acepts – Principles – Keys - Relational Operations - Functional Dependent	Relationa lency – N	al – Network Iormalization	– Hier - Que	archio ry lang	cal - F guage	Relational es.
Unit – IV	Manufacturing Consideration						9
The product - Order Scho	and its Structure - Inventory and Process Flow - Shop Floor Control - eduling Module – Input / Output Analysis Module (IOM) - Stock Status I	Data Str Database	ucture and P e - Complete	rocedu IOM D	ıre - ∖ ataba	/ariou se.	is Models
Unit – V	Information System for Manufacturing						9
Parts Orien Production Emission Co	ted Production Information System – Concepts and Structure - C Control Systems – Computerized Production Management System ar Introl Norms and Regulation for Manufacturing Sector – Case Studies.	Compute nd Manu	rized Produc facturing Info	ction S prmatio	ched n Sys	uling stems	- Online - Indian
							Total:45
TEXT BOOK	S:						
1. Lu	ca G. Sartori., "Manufacturing Information Systems", London Prentice Ha	II, 2003 f	or Units I,IV,V	<i>'</i> .			
2. Da	te C.J., "An Introduction to Database Systems". 8 <sup>th</sup> Edition, Pearson Edu	cation, 20	)21 for Units I	1,111.			
REFERENCI	ES:						
1. Or	licky G. "Material Requirements Planning". 3 <sup>rd</sup> Edition, McGraw-Hill, New	York, 20	11.				
2. Ke Ma	rr Roger M., "Knowledge Based Manufacturing Management: Applic anagement of Manufacturing Companies", Addison Wesley, Boston, MA,	ations o 1991.	f Artificial In	telligen	ce to	the	Effective

COURSE On comp	E OU	TCOME n of the	E <b>S:</b> course,	the stud	lents will	be able t	:0						(	BT Map Highest	ped _evel)
CO1	exp	plain the	evoluti	on of ord	ler practi	ces							Un	derstandi	ng (K2)
CO2	dei	monstra	te the c	oncept o	f data ba	ise mana	gement s	systems						Applying (	K3)
CO3	illu	strate th	ne conce	ept involv	ved in de	signing o	f data ba	se						Applying (	K3)
CO4	des	scribe th	ne shop	floor cor	trol and	inventory	manage	ment in a	an orgar	nization				Applying (	K3)
CO5	des	scribe th	ne conce	ept and p	aramete	ers involve	ed in com	puterize	d produ	ction plan	ning and	control		Applying (	K3)
Manning of COa with BOa and BSOa															
Mapping of COs with POs and PSOs           COs/POs         PO1         PO1         PO1         PO1         PSO1         PSO2															
	/POs         PO1         PO2         PO3         PO4         PO5         PO6         PO7         PO8         PO9         PO10         PO11         PO12         PS01         PS02           O1         3         1         1         1         3         1         1         3         1         1         3         1         1         3         1         1         3         1         1         3         1         3         1         1         3														
CO1		3	1			1							1	1	3
CO2		3	2			1							1	1	3
CO3		3	2			1							1	1	3
CO4		3	2			1							1	1	3
CO5		3	2			1							1	1	3
1 – Sligh	t, 2 -	- Modera	ate, 3 –	Substan	tial, BT-	Bloom's <sup>·</sup>	Taxonom	v			1	1	1	11	
			,					5							
						ASSE	SSMENT	PATTE	RN - TH	IEORY					
/ Test Cat	Blo Blo	om's ry*	Rem (	emberir K1) %	ng U	Indersta (K2) 9	nding %	Apply (K3)	ing %	Analyzi (K4) %	ng ‰	Evaluatii (K5) %	ng (	Creating (K6) %	Total %
C	CAT1			15		45		40							100
C	CAT2			10		40		50							100
C	CAT3 20 35 45 100														
	ESE			10		50		40							100
* ±3% m	ay be	e varied	(CAT 1	2&3-	50 mark	s & ESE	– 100 ma	arks)							

		22MEE13 - ALTERNATIVE ENERGY SYSTEMS AND A	PPLICA	TIONS				
Progran Branch	nme &	B.E. & Mechanical Engineering	Sem.	Category	L	т	Ρ	Credit
Prerequ	isites	Engineering Thermodynamics, Fluid Mechanics and Hydraulic Machines	6	PE	3	0	0	3
Preambl	е	This course discusses various technologies behind renewable pov challenges in integrating the renewable energy power plants with g	ver gene rid.	eration from v	vario	us sc	ources	and the
Unit – I		Need of Renewable Power Generation and Grid Integration						9
Energy I Cuses – of Renev Limitatio Micro Gi	Resource - Lifetime wable En ons – Inte rid - Adva	s and Classification – Energy Reserves and Consumption at Internat of Fossil Fuels – Issues and Challenges in Conventional Power Ger ergy (RE) – Sources – Worldwide RE Availability – RE in India – RE grating RE into the Grid – Issues and Challenges – Variability – In ntages.	tional an neration Convers itermitter	d National Le – Energy Inte sion Technolo ncy – Dispate	evel - ensit ogies chab	– Ene y and s – Ae ility –	ergy S I GDF dvant - Sma	Scarcity – P – Need ages and art Grid –
Unit – II		Solar Energy and Wind Energy						9
Solar Er Crop Dr Wind Er – Horizo Effects.	nergy: So ying – Sp nergy: Wir ontal Axis	lar Collectors – Types – Solar Water Heating Applications – Active ace Cooling – Solar Pond – Solar Chimney – Solar Cookers – Solar nd Availability – Site Selection – Wind Mills – Characteristics of Wind Wind Turbine Generators – Vertical Axis Wind Turbine Generator	System Stills. Mill Rot ors – Ty	– Passive S tors – Wind T pes – Applic	yster Turbin atior	m – 3 nes – ns –	Solar - Clas Envir	Dryers – sification onmental
Unit – II	l	Biomass Energy						9
Sources Gasifiers Digestio Ethanol from Liq	and Ava s – Updra n – Biog productic uid Waste	iilability – Biomass Conversion Technologies – Direct Combustion - aft – Downdraft –Fluidized Bed Gasifier – Pyrolysis – Biochemical as Plants – Floating Drum Type – Fixed Dome Type – Fermentation – Biomass Cogeneration – Case Study in Rice Mill – Energy Reco e – Applications.	<ul> <li>Therm</li> <li>Convers</li> <li>ion – Fa</li> <li>overy fro</li> </ul>	ochemical – ion – Aerobio ictors Affectio m Urban Wa	Gas c dig ng B ste -	ificat estio iogas - Pov	ion – n – A s Proo ver Go	Biomass maerobic duction – eneration
Unit – IV	/	Hydrogen Energy and Fuel Cells						9
Hydroge photolys Applicati Fuel Cel Carbona Limitatio	n Energy is – Stora ions – Po II: Princip ate Fuel o ons.	<ul> <li>r: Sources – Properties – Generation Technologies – Electrolysi- age Techniques – Compressed Gas Storage – Liquid Storage – So- wer Generation – Automobiles – Safety Issues.</li> <li>le – Types – Alkaline Fuel Cells – Polymer Electrolyte Membrane Fue Cells – Solid Oxide Fuel Cell – Direct Methanol Fuel Cells – Hea</li> </ul>	s – The blid State el Cells - t genera	ermolysis – <sup>-</sup> e Storage – <sup>-</sup> - Phosphoric ttion – Applic	Therr Trans Acic catior	moch sport I Fue ns –	emica Tech I Cell Adva	al – Bio- iniques – – Molten ntages –
Unit – V	-	Hydro Energy, Ocean Energy and Thermoelectric Power Gener	ation					9
Hydro E Ocean E Plants – Applicati Thermoe Thermio	nergy: Mi Energy: O Single ba ions. electric a nic Conve	ni and Micro-hydel Power Plants – Site Selection – Challenges – Ecc cean Thermal Energy Conversion – Open Cycle– Closed Cycle – Hy asin – Two Basin – Wave Energy Conversion Machines – Types – Bu nd Thermionic: Principle – Thermoelectric Materials – Thermo erter – Vacuum Thermionic – Vapour Thermionic – Applications.	onomics brid Cyc Joy - Dol electric	– Application de – Advanta phin - Oscilla Converter	ns. ges - nting Modu	– Apj Duck ile –	olicati -Cha App	ons Tidal allenges - lications.
								Total:45
TEXT B	OOK:							
1.	Shobh N	lath Singh., "Non-Conventional Energy Resources" 1 <sup>st</sup> Edition, Pears	on Educ	ation India, N	lew l	Delhi	,2015	
REFERE	ENCES:							
1.	Rai G.D	, "Non-Conventional Energy Sources", 6 <sup>th</sup> Edition, Khanna Publisher	s, New I	Delhi, 2017.				
2.	Kothari I Learning	D.P., Singal K.C., Rakesh Ranjan, "Renewable Energy Sources and Pvt. Ltd., New Delhi, 2011.	Emergin	g Technologi	es",	2 <sup>nd</sup> E	dition	, PHI

3. Jefferson W. Tester, Elisabeth M. Drake, Michael J. Driscoll, Michael W. Golay, William A. Peters., "Sustainable Energy: Choosing Among Options", 2<sup>nd</sup> Edition, MIT Press, USA, 2012.

COURS On con	SE OU <sup>n</sup>	TCOME on of the	S: e coui	rse, the	stude	nts w	ill be ab	le to						(	BT Map Highest L	ped .evel)
CO1	iden rene	itify the wable p	neces ower	sity of r generati	enewa on.	able b	ased po	wer ger	neration	and d	iscuss tl	ne grid ii	ntegration	of Un	derstandi	ng (K2)
CO2	deso its c	cribe the	e cons es.	truction,	workir	ng an	d applica	ations of	f solar a	and win	id energ	y system	is along w	ith	Applying (	(K3)
CO3	deso appl	cribe th lications	e bio	mass-ba	ased p	powei	r produc	ction te	chnique	es alor	ng with	its cha	llenges a	nd	Applying (	(K3)
CO4	deso	cribe the	work	ing of hy	droger	n ene	rgy, fuel	cells, w	ith its ap	oplicati	ons and	challeng	es.		Applying (	(K3)
CO5 describe the working of hydro energy, Ocean energy and thermoelectric conversion systems Applying (K3)																
Mapping of COs with POs and PSOs																
COs/POs         PO1         PO2         PO3         PO4         PO5         PO6         PO7         PO8         PO9         PO10         PO11         PO12         PS01         PS02																
CO	1	3						2	3							3
CO	2	3			1			1	3							3
CO	3	3			1			1	3							3
CO	4	3						1	3							3
CO	5	3						1	3							3
1 – Slig	ht, 2 –	Modera	ate, 3 -	- Substa	ntial, E	BT- B	loom's T	axonom	у			I	1		1	
						Δ	SSESS		ATTER	N - TH	IEORY					
Te	st / Bl Catego	oom's ory*		Remen (K1	bering ) %	g l	Jndersta (K2)	anding %	Apply (K3)	ving %	Analyzi (K4) %	ng E %	Evaluating (K5) %	) C	reating K6) %	Total %
	CAT	1		2	0		50		30	)						100
	CAT	2		2	0		40		40	)						100
	CAT3 20 <sup>40</sup> 40 100															
	ESE	Ξ		2	0		40		40	)						100
* ±3% n	nay be	varied	(CAT	1,2&3	– 50 m	narks	& ESE –	- 100 ma	arks)			<u> </u>				

		22MEE14 - INSTRUMENTATION IN THERMAL E	ENGINE	ERING										
Programm Branch	ne &	BE & Mechanical Engineering	Sem.	Category	L	т	Ρ	Credit						
Prerequis	sites	Nil	6	PE	3	0	0	3						
Preamble		This course introduces the characteristics of measuring instru- uncertainty analysis. Modern measurement techniques for gas course.	ments, te propertie	echniques an es are specifi	d impo cally c	ortanco overe	e of e d thro	rror and ugh this						
Unit – I		Measurement Characteristics						9						
Instrumen Systemati Instrumen	nt Class ic and nts - Rel	sification-Characteristics of Instruments - Static and Dynamic Random Errors - Statistical Analysis – Uncertainty - Experi iability of Instruments.	Respor imental I	nses - Expe Planning and	rimenta I Sele	al Err ction	or Ar of Me	alysis - easuring						
Unit – II		Microprocessors and Computers in Measurement						9						
Data Log Instrumen	iging ar hts in Us	nd Acquisition - Use of Sensors for Error Reduction - Eleme e.	ents of I	Microcompute	er Inte	rfacin	g - Ir	ntelligent						
Unit – III	nit – III Measurement of Physical Quantities 9													
Measurem	nent of T	Thermo - Physical Properties -Temperature – Pressure - Flow vari	iables - L	Jse of Sensor	s for P	hysica	al Vari	ables.						
Unit – IV	Unit – IV     Advanced Measurement Techniques     9													
Shadowgr Measuren	raph – S nent.	Schlieren Interferometer - Laser Doppler Anemometer - Hot Wire	Anemom	eter - Heat F	lux Se	nsors	- Tele	metry in						
Unit – V		Measurement Analyzers						9						
Chemical Spectrome	– Ther etry - M	mal-Magnetic - Optical Gas Analyzers - Measurement of Smoleasurement of pH.	ke-Dust a	and Moisture	- Gas	6 Chro	omato	graphy -						
							-	Total:45						
TEXT BO	OK:													
1. Ho	olman J	.P., "Experimental Methods for Engineers", 8th Edition, McGraw-H	lill, New `	York, 2012.										
REFEREN	NCES:													
1. Na 20	1. Nakra, B.C., Choudhry K.K., "Instrumentation, Measurements and Analysis", 4 <sup>th</sup> Edition, Tata McGraw Hill, New Delhi, 2016.													
2. Bo	olton W	, "Industrial Control & Instrumentation", 2 <sup>nd</sup> Edition, Universities Pr	ress, Pvt.	Ltd, Hyderat	oad, 20	04.								
3. Ra 20	angan ( 017.	C.S., Sarma G.R., Mani V.S.V., "Instrumentation Devices and System of the second statement of the seco	tems", 2 <sup>n</sup>	<sup>d</sup> Edition, Mc	Graw-	Hill, N	ew De	elhi,						

COUR On cor	COURSE OUTCOMES: BT Mapped On completion of the course, the students will be able to (Highest Level)														
CO1	class	sify the	instrur	nents and	perfo	rm error a	nalysis						Ар	plying (K3)	
CO2	illust	rate the	e integ	ation of m	nicrop	rocessors	and con	nputers	with pł	nysical ir	nstrumen	ts	Ap	plying (K3)	
CO3	desc	ribe the	e meas	urement i	netho	ds of therr	no-phys	ical pro	perties				Ар	plying (K3)	
CO4	illust	rate the	e princi	ples of mo	odern	measuren	nent tec	hniques					Ар	plying (K3)	
CO5	expla	ain the p	princip	les of exh	aust g	jas measu	rement	analysis	6				Under	standing (K	2)
Manning of COa with BOa and BSOa															
Mapping of COs with POs and PSOs															
PO	COs/ POs         PO1         PO2         PO3         PO4         PO5         PO6         PO7         PO8         PO9         PO10         PO11         PO12         PS01         PS02														
CO	x01     3     2     3     2														
CO	2	3				2							1	3	3
CO	3	3				3								3	3
CO	4	2				3								3	3
CO	5	2				3								3	3
1 – Slię	ght, 2 -	- Moder	ate, 3	<ul> <li>Substar</li> </ul>	ntial, E	3T- Bloom	s Taxor	iomy							
					- 1	ASS	ESSME	NT PAT	TERN	- THEO	RY				
Tes	st / Blo Catego	om's ry*	R	emember (K1) %	ing	Understa (K2)	anding %	Apply (K3)	ying %	Analyz (K4) 9	ing %	Evaluating (K5) %	Crea (K6	ing )%	Total %
	CAT1			35		40		2	5					-	100
	CAT2	2		25		30		4	5						100
CAT3 20 35 45 100															
	ESE			30		30		4	0						100
* ±3%	may be	e varied	(CAT	1, 2 & 3 -	- 50 m	arks & ES	SE – 100	marks)							

	22MEE15 - DIGITALIZATION IN SUPPLY CHAIN N	MANAGE	MENT											
Programme& Branch	BE & Mechanical Engineering	Sem.	Category	L	т	Ρ	Credit							
Prerequisites	Manufacturing Technology	6	PE	3	0	0	3							
	1 1			1										
Preamble	This course delivers the concept of supply chain management information systems for making effective decision.	its netw	vork design, f	orec	astin	g, sou	urcing and							
Unit – I	Introduction Supply Chain Management						9							
Introduction – Ty Fit – Drivers of Vs. Decentralize	pes of Supply Chains with and Examples – Evolution of SCM Cor Supply Chain Performance – Key Decision Areas – External Driv d System.	ncepts – ers of Cł	Supply Chain nange. Supply	Per / Co	forma ntrac	ance - ts – C	<ul> <li>Strategic</li> <li>Centralized</li> </ul>							
Unit – IISupply Chain Network Design9Need for Distribution Network Design – Factors Affecting – Design Options for Distribution Network. Network Design Decisions –														
Need for Distribu Framework – Fa Modes of Transp Food Mile Conce	Need for Distribution Network Design – Factors Affecting – Design Options for Distribution Network. Network Design Decisions –         Framework – Factors Influencing – Models of Facility Location and Capacity Allocation – Role of Transportation in Supply Chain –         Modes of Transportation Modal Selection – Classification of Carriers – Carrier Selection – Transportation Execution and Control.         Food Mile Concept – Design Options – Software Cases.         Unit – III       Demand and Supply in Supply Chain													
Unit – III	Demand and Supply in Supply Chain         9           orecasting in Supply Chain – Methods – Approach – Errors – Aggregate Planning in Supply Chain – Problem – Strategies and													
Implementation Shipment – Trac Milk Run Model Unit – IV Purchasing Vs F Managing Sourc	Implementation – Predictable Variability in Supply Chain – Managing Supply and Demand – Distribution Strategies – Direct         Shipment – Traditional Warehousing – Cross Docking – Inventory Pooling – Transhipment – Choosing Appropriate Strategy –         Milk Run Model – Software Cases.         Unit – IV       Sourcing and Inventory Decisions in Supply Chain         9         Purchasing Vs Procurement Vs Strategic Sourcing – Item Procurement Importance Matrix – Strategic Sourcing Methodology –         Managing Sourcing and Procurement Process – Supplier Selection and Evaluation – Bullwhip Effect and its Management –													
Uncertainty in Su	ipply Chain – Safety Inventory – Determination Of Appropriate Leve	el – Impa	ct on Uncerta	inty	– Ca	ises.	inventory.							
Unit – V	Supply Chain and Information Systems						9							
Information in S Relationship Mar Chain.	Supply Chain – Role of Information Technology – it Framework nagement. Role of E-Business in Supply Chain – E-Sourcing and	k in Sup E-Procu	oply Chain – irement. Tech	Sup nolc	oplier gy D	and rivers	Customer in Supply							
							Total:45							
TEXT BOOK:														
1. Sunil Cl Educatio	nopra, Peter Meindl and Kalra, "Supply Chain Management, S n, 7 <sup>th</sup> Edition, 2019.	Strategy,	Planning, a	and	Ope	ration	", Pearson							
REFERENCES:														
1. V.V.Sop	1. V.V.Sople., "Supply Chain Management, Text and Cases", 1 <sup>st</sup> Edition, Pearson Education, South Asia, 2011.													
2. John Ma	ngan., "Global Logistics and Supply Chain Management", 4 <sup>th</sup> Editio	n, John \	Viley & Sons,	Nev	v Del	hi, 20	21.							
		-												

COUR: On con	COURSE OUTCOMES:     BT Mapped       On completion of the course, the students will be able to     (Highest Level)														
CO1	rec	all the r	ole of su	ipply chair	n mana	gement ir	n an orga	anization.					Und	erstandin	g (K2)
CO2	ide	ntify the	various	aspects of	of suppl	y chain m	nanagem	nent and t	he facto	rs affecti	ng them			Applying	(K3)
CO3	imp sup	lement	the relation the relation operation of the second s	tionship a tions.	mong v	arious fac	ctors invo	olved in p	lanning,	organisi	ng and c	ontrolling		Applying	(K3)
CO4	exa	mine th	e sourci	ing and in	ventory	decision	s involve	d in supp	ly chain	operatio	ns with c	ases	A	nalyzing	(K4),
CO5	use per	and in spective	vestigate e and de	e of inform ecisions	ation te	echnology	/ in supp	ly chain n	nanagen	nent bas	ed on cu	stomer	A	nalyzing	(K4),
Mapping of COs with POs and PSOs															
COs/P	COs/POs         PO1         PO2         PO3         PO4         PO5         PO6         PO7         PO8         PO9         PO10         PO11         PO12         PS01         PS02														
CO1	CO1         3         2         2         3         3														
CO2	CO1     3     2     2     3       CO2     3     2     2     3														
CO3	3	3	2	2											3
CO4	ŀ	3	2		2										3
CO5	5	3	2			2									3
1 – Slię	ght, 2	2 – Mod	erate, 3	– Substar	ntial, BT	- Bloom's	s Taxono	omy						1	I
						ASSES	SSMENT		RN - THE	ORY					
Test Ca	: / Blo atego	oom's ory*	Re	ememberi (K1) %	ng	Understa (K2)	anding %	Apply (K3)	/ing %	Analyz (K4)	ing E %	valuating (K5) %	g Cı (	reating K6) %	Total %
	CAT	1		20		50	)	30	)						100
	CAT	2		25		30	)	45	5						100
	CAT	3		20		20	)	25	5	35					100
	ESE	=		20		25	j	35	5	20					100
* ±3%	may	be varie	ed (CAT	1, 2 & 3 -	- 50 ma	rks & ESI	E – 100 I	marks)	1		1		,		

		22MEE16 - LEAN SIX SIGMA												
Progra Branch	mme & N	BE & Mechanical Engineering	Sem.	Category	L	т	Р	Credit						
Prereq	uisites	Nil	6	PE	3	0	0	3						
			r.											
Preamb	ble	This course deals the implementation concept of lean, six sig tools in industries.	jma, pro	ject selection	, pro	cess	tools an	d design						
Unit – I		Introduction to Lean and Six Sigma						9						
Definition Creatin of six si	on-Purpos g a lean e igma, Orig	e, Features of lean, Top seven wastes and Need for lean mana nterprise, Elements of lean, Lean principles, Lean metric and Hid in, Concept and Critical success factors for six sigma.	agement Iden time	. The philoso e traps. Introd	phy ( uctio	of lea on to	an manag quality - I	ement – Definition						
Unit – I	Integration of Lean and Six Sigma           olution, synergy, definition, principles, scope and features of Lean Six Sigma (LSS). Laws of LSS - Elements of LSS													
Evolutio model a Organia	<i>i</i> volution, synergy, definition, principles, scope and features of Lean Six Sigma (LSS). Laws of LSS - Elements of LSS - odel and benefits of LSS. Initiation - Top management commitment – Infrastructure and deployment planning, Process focus, rganizational structures. Measures – Rewards and Recognition, Infrastructure tools and Structure of transforming.													
Unit –	- III Project Selection and Team Building													
Resour projects mappin	Resource and project selection, Selection of black belts, Training of black belts and Champions and Identification of poter projects .Top down (Balanced score card) and bottom up approach – Methods of selecting projects - Benefit/effort graph, Proc mapping, Value stream mapping, Predicting and Improving team performance, Nine team roles and Team leadership.													
Unit –	Unit – IV Design Measure Analyse Improve Control (DMAIC) Process and Tools													
The DM mappin and Mu Elimina	/IAIC proce g, Lead tir ulti voting. ting variati	ess - Toll gate reviews. The DMAIC tools - Project definition for ne/cycle time, Cause and effect matrix. Generating and organizir Data collection and accuracy tools- Check sheet, Gage Repe ion- run charts. Analyse tools - scatter plots, ANOVA, Regression	rm and S ng tools- eatability n analysis	SIPOC diagra Brainstormin and Reprod s and Time tra	m. N g, No ucibi ap ar	leasu omina lity-U nalysi	ure Tools al group to Inderstand is.	-Process echnique ding and						
Unit – '	V	Institutionalizing and Design for Six Sigma						9						
Instituti Reduci solving	onalizing leng product (TRIZ), Ro	ean six sigma – Improving design velocity, creating cycle time ba t line complexity. Design for lean six sigma -Quality Function Dep bust Design-Case study presentations.	se line, \ loyment	/aluing projec (QFD), Theo	cts, G ry of	Bating Inver	g the proje ntive Prot	ects, blem						
								Total:45						
TEXT E	TEXT BOOKS:													
1. Salman Taghizadegan, "Essentials of Lean Six Sigma", 4 <sup>th</sup> Edition Elsevier, 2010 for Units I,II and III														
2.	Michael L	George, "Lean Six Sigma", 5 <sup>th</sup> Edition, McGraw-Hill., Europe, 2	002 for l	Jnits IV and V	/									
REFERENCES:														
1.	Erick Jon	es, "Quality Management for Organizations Using Lean Six Sigm	na Techn	iques", 1 <sup>st</sup> Ed	lition	, CRO	C Press, 2	2014.						
2.	Matthew Press, 20	John Franchetti, "Lean Six Sigma for Engineers and Managers 21.	s: With A	Applied Case	Stu	dies",	, 1 <sup>st</sup> Editi	on, CRC						

COUR: On con	COURSE OUTCOMES:       BT Mapped         On completion of the course, the students will be able to       (Highest Level)         CO1       reshape the concept of lean six signa and its significance in industry.       Understanding (K2)														
CO1	resh	hape the	e conce	pt of lean	six sign	na and its	significa	ance in i	indust	ry.			Unde	erstanding	(K2)
CO2	inter	rpret the	e variou	is laws of I	ean six	sigma							Unde	rstanding	(K2)
CO3	cons	struct th	e perc	eptions of t	eam bu	uilding							Ap	plying(K3	)
CO4	cate	egorize t	the lear	n six sigma	tools a	ind its imp	oortance	in indu	stry				Ana	alyzing (K4	4)
CO5	CO5 examine productivity improvement tool through the six sigma concepts and principles Analyzing (K4)														4)
Mapping of COs with POs and PSOs															
COs/P	COs/POs         PO1         PO2         PO3         PO4         PO5         PO6         PO7         PO8         PO9         PO10         PO11         PO12         PS01         PS02														
CO	CO1         3         2         1         1         1         1         3														3
CO2	CO1         3         2         1         1         3													3	
COS	3	3	2			1				1				3	3
CO4	4	3	2			1				1				3	3
COS	5	3	2			1				1				3	3
1 – Slig	ght, 2	– Mode	erate, 3	- Substan	tial, BT	- Bloom's	Taxono	my	1		1		-1	1	
						ASSES	SMENT	PATTE	ERN -	THEOR	,				
Tes C	t / Blo atego	oom's ory*	F	Remember (K1) %	ing	Understa (K2)	anding %	Apply (K3)	ying ) %	Analyz (K4) (	ing %	Evaluatin (K5) %	g Cr (ł	eating (6) %	Total %
	CAT	1		30		70	)								100
	CAT	2		25		35	;	40	)						100
	CAT	3		15		20	)	25	5	40					100
	ESE	Ξ		20		20	)	35	5	25					100
* ±3% I	mav b	e varie	d (CAT	1.2&3-	50 mai	ks & ESE	E – 100 r	narks)			1		1		

		22GEE01 - FUNDAMENTALS OF RESEA	ARCH												
	(Common to All BE/BTech branches)         Programme & Branch       All BE/BTech branches       Sem.       Category       L       T       P       Credit         Programuisitos       Nil       7       CE       2       0       0       2														
Program Branch	ime &	All BE/BTech branches	Sem.	Category	L	т	Ρ	Credit							
Prerequi	sites	Nil	7	GE	3	0	0	3							
Preamble	9	This course familiarizes the fundamental concepts/techniques also disseminate the process involved in collection, consolidat a presentable form using latest tools.	adopted tion of pu	d in research, blished litera	prol ture a	olem and r	formu ewritir	lation and ng them in							
Unit – I		Introduction to Research						9							
Introducti Characte	ion to Res ristics of a	search: Types and Process of Research - Outcomes of F Good Research Problem - Errors in Selecting a Research Proble	Research em - Imp	- Sources ortance of Ke	of F eywor	Resea rds.	arch I	Problem -							
Unit – II		Literature Review						9							
Literature	iterature Review: Literature Collection - Methods - Analysis - Citation Study - Gap Analysis - Problem Formulation Techniques.           Jnit – III         Research Methodology         9														
Unit – III	nit – III Research Methodology 9 esearch Methodology: Appropriate Choice of Algorithms/Methodologies/Methods – Data Collection – Primary Data Analysis –														
Research Experime Limitatior	Research Methodology: Appropriate Choice of Algorithms/Methodologies/Methods – Data Collection – Primary Data Analysis – Experimental Methods and Result Analysis - Investigation of Solutions for Research Problem - Interpretation - Research imitations.														
Unit – IV		Journals and Papers						9							
Journals Types of	and Papers	s: Journals in Science/Engineering - Indexing and Impact factor Papers - Original Article/Review Paper/Short Communication/Ca	r of Journ ase Study	nals. Plagiari /.	sm a	and R	esear	ch Ethics.							
Unit – V		Reports and Presentations						9							
How to W Sub-Head PPTs. Re	Vrite a Repo dings - Foc esearch Too	ort - Language and Style - Format of Project Report - Title Page otnotes - Tables and Figures - Appendix - Bibliography etc - Di ols.	e - Abstra ifferent R	act - Table of Reference For	Con mate	tents s. Pre	- Hea esenta	dings and ition using							
								Total:45							
TEXT BC	DOK:														
1. V	1. Walliman, Nicholas. "Research Methods: The basics". 2 <sup>nd</sup> edition, Routledge, 2017., for Units I, II, III, IV & V														
REFERE	REFERENCES:														
1. N	/lishra, S.B	. and Alok, S. "Handbook of research methodology" Educreation	n Publish	ing, 2017											
2. K	2. Kumar, Ranjit. "Research Methodology: A step-by-step guide for beginners". SAGE Publications Limited, 2019.														
3. N	Nayak, J.K. Distributors,	and Singh, P. "Fundamentals of Research Methodology Probler, 2021.	ms and F	Prospects". S	SDN	Publ	ishers	&							

COUR: On cor	SE OUTCOMES: npletion of the course, the students will be able to	BT Mapped (Highest Level)
CO1	list the various stages in research and categorize the quality of journals	Applying (K3)
CO2	formulate a research problem from published literature/journal papers	Evaluating (K5)
CO3	write, present a journal paper/ project report in proper format	Creating (K6)
CO4	select suitable journal and submit a research paper	Applying (K3)
CO5	compile a research report and the presentation	Applying (K3)

Mapping of COs with POs and PSOs														
COs/POs	P01	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	2	1	1	3	3	1	1	3	3	3
CO2	3	3	3	3	2	1	1	3	3	3	3	3	3	3
CO3	3	3	3	3	3	1	1	3	3	3	1	3	3	3
CO4	3	2	1	1	2	1	1	3	2	1	1	3	3	3
CO5	3	3	2	2	3	1	1	3	3	3	1	3	3	3
1 – Slight 2	– Mode	arate 3_	Substanti	al BT-I	Bloom's	Taxono	mv							

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY														
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %							
CAT1		40	50	10			100							
CAT2		30	50	10	10		100							
CAT3		20	30	30	10	10	100							
ESE 40 40 10 10 ·														
* · O(/ may / hay / article//			d ( a )											

 $^{\ast}$  ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

	22MEE17 - MECHANICS OF COMPOSITE M	ATERIAL	S				
Programme & Branch	BE & Mechanical Engineering	Sem.	Category	L	т	Р	Credit
Prerequisit	Engineering Mechanics, Engineering Materials and Metallurgy, Strength of Materials	7	PE	3	0	0	3
Preamble	This course involves the basic concept, manufacturing, characteri various static and dynamic applications.	ization an	d designing of	f cc	omposite	e mate	erials for
Unit – I	Basics of Fibers, Matrices and Composites						9
Basics of F Polyester ar Surface Tre	bers: Definition – Need – General Characteristics and Applications. d Natural Fibers. Matrices: Polymer - Ceramic and Metal Matrices - atments - Fillers and Additives - 3D Printer Filament Wires.	Fibers: ( Characte	Glass – Carbo pristics of Fibe	on - ers	- Ceram and Ma	nic – / atrices	Aramid - s - Fiber
Unit – II	Composite Manufacturing						9
Hand Layu ReservoirM – Stir Casti	<ul> <li>Spray up - Bag Molding - Compression Molding – Pultrusion – F olding - Tube Rolling – Quality Inspection Methods- Processing of Meta g – Squeeze Casting and Powder Metallurgy Technique – 3D Printer W</li> </ul>	ilament W al Matrix C /ires – Cor	/inding – Resi Composites (M mposites Manu	n F MC ufac	Film Infu 5) – Diffu cturing T	ision usion echni	<ul> <li>Elastic</li> <li>Bonding</li> <li>ques.</li> </ul>
Unit – III	Composite Performance and Analysis						9
Static Mec Properties Tolerance -	nanical Properties – Dynamics Mechanical Analysis – Thermo – Environmental Effects – Long Term Properties - Service Life F Creep Behaviors.	gravimetr Predicatio	ic Analysis n - Fracture	- F Be	atigue havior	and and I	Impact Damage
Unit – IV	Composite Mechanics						9
Fiber Conter Strength of Poisson's R – Laminates	t - Density and Void Content - Rule of Mixture - Volume and Mass Fract Naterials Approach and Semi-Empirical Model - Longitudinal Young's I tio-in-Plane Shear Modulus - Ultimate Strengths of a Unidirectional Lan – Lamination Theory.	ions - Eva Modulus - nina - Cha	Iuation of Four Transverse N tracteristics of	r Ela You Fib	astic Mo ngʻs Mo er-Reinf	duli E odulu: forcec	Based on s –Major I Lamina
Unit – V	Design of Composites						9
Failure Pred Joint Desigr Design of a Laminated C	ctions - Theories of Failure - Laminate Design Consideration - Design - Bolted and Bonded Joints - Design Examples - Design of a Tension Beam - Design of a Torsional Member - Application of Finite Elem omposites - Design of Layering Thickness - Infill Pattern - Infill Density o	Criteria - I Member ent Metho of 3D Printo	Design Allowa - Design of a od (FEM) for er Wires Comp	ble Co De bos	- Desig mpressi sign an ites.	n Gui ion M d An	delines - ember – alysis of
							Total:45
TEXT BOO	:						
1. Mal Frai	ck P.K., "Fiber Reinforced Composites: Materials, Manufacturing an cis, New York, 2009.	id Design	", 3 <sup>rd</sup> Edition,	CF	RC Pres	ss Ta	ylor and
REFERENC	ES:						
1. Aut	r K. Kaw, "Mechanics of Composite Materials", 2 <sup>nd</sup> Edition, CRC Press,	New York	, 2018.				
2. Bha 4 <sup>th</sup> I	gwan D. Agarwal, Lawrence J. Broutman & Chandrashekhar K., "Ar dition,John Wiley & Sons, New York, 2021.	nalysis an	d Performanc	e c	of Fiber	Com	posites",
]							

COUR On cor	COURSE OUTCOMES:       BT Mapped         On completion of the course, the students will be able to       (Highest Level)         CO1       demonstrate the fundamentals of fibers, matrices, additives, 2D printer wires and compositor														
CO1	demo	onstrate	the funda	amentals	of fiber	s, matrice	es, addit	ives, 3D	) printe	er wires a	and com	posites		Applying	ı (K3)
CO2	descr	ibe the	various n	nanufactu	ring pr	ocesses i	nvolved	in the f	abrica	tion of co	mposite	material		Applying	J (K3)
CO3	evalu	ate the	performa	nce of co	nposit	e materia	ls							Applying	ı (K3)
CO4	calcu	late the	physio-m	nechanica	l prope	erties of co	omposit	e mater	ials					Applying	ı (K3)
CO5	desig	n appro	priate fib	er reinford	ed cor	nposites	for suita	ble app	licatio	าร				Applying	ı (K3)
Mapping of COs with POs and PSOs															
COs/	COs/POs         PO1         PO2         PO3         PO4         PO5         PO6         PO7         PO8         PO9         PO10         PO11         PO12         PS01         PS02														
CC	301         3         3														
CC	)2	3	3												3
CC	)3	1	3	2											3
CC	)4		3	2	2										3
CC	)5		3	3	1										3
1 – Sli	ght, 2 –	- Moder	ate, 3 – S	Substantia	I, BT-	Bloom's T	Taxonon	ny						L	
						ASSES	SMENT	PATTE	RN - '	THEORY	,				
Te	st / Blo Catego	om's ory*	Re	memberi (K1) %	ng	Understa (K2)	anding %	Apply (K3)	ving %	Analyz (K4) 9	ing l %	Evaluating (K5) %		Creating (K6) %	Total %
	CAT	1		25		25		50	)						100
	CAT	2		20		30		50	)						100
	CAT	3		20		30		50	)						100
	ESE			20		30		50	)						100
* ±3%	may be	e varied	(CAT 1,	2 & 3 – 50	) mark	s & ESE -	– 100 m	arks)					<u> </u>		

		22MEE18 - DESIGN OF JIGS, FIXTURES AND PR	RESS TO	OLS										
Progra Branch	mme &	BE & Mechanical Engineering	Sem.	Category	L	т	Ρ	Credit						
Prereq	uisites	Manufacturing Technology, Strength of Materials, Design of Machine Elements	7	PE	3	0	0	3						
Preamb	ble	This course provides the fundamental aspects of various type jigs, fixtures, press, strip layouts and dies for industrial application	es of wo s.	ork holding d	evic	es ai	nd de	esigning of						
Unit – I		Introduction to Jigs and Fixture						9						
Tool D Types Analys	esign Obj of Fixtures is.	ectives - Production Devices –Inspection Devices- Materials u	sed in . Iysis of	Jigs and Fixt Clamping Fo	tures rce-	s — <sup>-</sup> Tole	Type: rance	s of Jigs - and Error						
Unit – I	I	Jigs						9						
Drill Bu DrillJig	ishes - Dif s-Rack and	ferent Types of Jigs-Plate Latch- Channel- Box- Post- Angle Plate d Pinion Operated- Air Operated Jig Components- Design of Jigs.	e- Angul	ar Post- Turn	over	- Po	t Jigs	Automatic						
Unit – I	it – III Fixtures 9													
Genera andWe	I Principles	s - Boring- Lathe- Milling and Broaching Fixtures- Grinding- Plannii es- Modular Fixtures-Design of Fixtures	ng and S	Shaping Fixtu	res /	Asser	nbly-	Inspection						
Unit – I	V	Press Working Terminologies and Elements of Press						9						
Press \ Elemer GuideF	ss Working Terminology: Presses and Press Accessories-Computation of Capacities and Tonnage Requirements. ments of Press: Progressive- Combination and Compound- Die Block-Die Shoe- Bolster Plate-Punch Plate – Punch Holder- dePins – Bushes- strippers – Knockouts-Stops –Pilots-Selection of Standard Die sets-Strip Layout Calculations.													
Unit – '	V	Design of Dies						9						
Design Drawin	of Progr g DieDes	essive and Compound Dies — Blanking and Piercing Opera ign-Design of Drawing Dies. Design Considerations: Forging- Ext	tions- E trusion- (	ending Dies Casting-Plasti	De ic Di	sign es.	–For	ming and						
								Total:45						
TEXT E	BOOKS:													
1.	Edward G	6. Hoffman, "Jigs & Fixture Design", 5 <sup>th</sup> Edition, Thomson-Delmar L	earning,	Singapore, 2	004	for U	nits I,	II.						
2.	Elanchezhian.C., Sunder Selwyn.T., Vijaya Ramnath. B., "Design of Jigs, Fixtures and Press Tools", 1 <sup>st</sup> Edition, Eswar Press, Chennai, 2004 for Units III, IV, V.													
REFER	FERENCES:													
1.	Donaldso 2010.	on C, George H. Lecain, Joyjeet Ghose, Goold V.C, "Tool Desig	gn", 4 <sup>th</sup> I	Edition, Tata	McG	Graw-	Hill, I	New Delhi,						
2.	Joshi P.H	H., "Jigs & Fixtures", 3 <sup>rd</sup> Edition, Tata McGraw-Hill Publishing Comp	oany Ltd.	, New Delhi, 2	2012									
3	Kempste	r, "Jigs & Fixtures Design", 5 <sup>th</sup> Edition, Cengage India, Uttar Prade	sh, India	, 2008.										

COURS On con	SE OI	UTCON on of th	IES: e cours	se, the st	udents	will be	e able	to							BT Mapp (Highest L	oed .evel)
CO1	dem	nonstra	te the f	undamer	tals of	vario	us wor	k holdin	g devic	es and	l analyze	the rela	ted forces		Applying (	K3)
CO2	ider	ntify and	d desig	n the sui	able jig	s for	variou	s compo	onents.						Analyzing	(K4)
CO3	ider	ntify and	d desig	n the sui	able fix	tures	for va	rious co	mponei	nts.					Analyzing	(K4)
CO4	dem	nonstra	te the	function	of vario	ous p	oarts o	of dies	and de	sign tl	ne strip	layout fo	or various		Analyzing	(K4)
CO5	des	ign and	l select	the vario	us type	s of o	dies.								Analyzing	(K4)
I																
						Μ	lappin	g of CC	s with	POs a	nd PSO	S				
COs/P	COs/POs         PO1         PO2         PO3         PO4         PO5         PO6         PO7         PO8         PO9         PO10         PO11         PO12         PS01         PS02															
CO	vPos         PO1         PO2         PO3         PO4         PO5         PO6         PO7         PO8         PO9         PO10         PO11         PO12         PS01         PS02           O1         2         3         1         -         -         -         -         -         3															
CO2	D1     2     3     1     3       D2     1     2     3     3															
COS	3	1	2	3												3
CO4	4	1	2	3												3
COS	5	1	2	3												3
1 – Slig	ght, 2	– Mode	erate, 3	– Substa	intial, B	T- Bl	loom's	Taxono	my				1	1		1
	-															
						Α	SSES	SMENT	PATTE	RN –	THEOR	ſ				
Tes C	t / Blo atego	oom's ory*	F	Rememb (K1) <sup>(</sup>	ering %	Un	dersta (K2)	anding %	Apply (K3)	ying %	Analyz (K4) <sup>c</sup>	ing %	Evaluating (K5) %	g (	Creating (K6) %	Total %
	CAT	1		10			10		60	)	20					100
	CAT	2		10			10		40	)	40					100
	CAT	3		10			10		40	)	40					100
	ESE	1		10			10		40	)	40					100
* ±3% ı	may b	e varie	d (CAT	1,2&3	– 50 m	arks	& ESE	– 100 r	narks)					1		

		22MEE19 - CNC TECHNOLOG	GY					
Progr Branc	amme & ch	BE & Mechanical Engineering	Sem.	Category	L	т	Р	Credit
Prere	quisites	Machining and Measurements	7	PE	3	0	0	3
Prea	mble	The course focus on Computer Numerical Control (CNC) manufacturing industry, programming and tooling methods for economic operation.	machines or CNC r	s and tools with nachines and a	h aut Iso pi	oma rovid	tion p es th	processes in e aspects o
Unit	-1	Basic Concepts of Metal Cutting and CNC Machines						9
Intro Surfa Syste Cont	duction – M ace Finish - em – Interfa rol (DNC) M	Mechanics of Chip Formation - Mechanics of Oblique Cutt – Machinability – Classification of CNC Machines - Const acing – Monitoring – Diagnostics – Machine Data – Comper lachine – Adaptive Control CNC Systems.	ing – Cu ruction D sations f	utting Forces an etails – Structu for Machine Acc	nd Po re - C curacy	ower Config / – I	· _ ¬ gurati Direct	Fool Life – on of CNC Numerical
Unit	- 11	Drives and Controls						9
Drive Spin Com	e Mechanisn dle Bearing pensation -	n – Gearbox - Spindle Drives - Axes Drives – Magnetic Levitat – Arrangement and Installation – Slide Ways - Re-Circul Linear Motion Guide Ways.	ion and L ating Ba	inear Motors – Il Screws – Ba	Timin acklas	g Be h M	elts ar leasui	d Pulleys – rement and
Unit	· III P	Part Programming in CNC Machines						9
Part (Turr Mach	Program To ning and Mi nines in ISO	erminology - G and M Codes – Types of Interpolation - CNG illing) - Various Programming Techniques – Automatically F and FANUC - CAM Packages for CNC Machines.	C Part Pr Programm	rogramming – M ned Tool (APT)	/lanua Prog	al Pa rami	art Pr ming	ogramming for Various
Unit	- IV T	ooling For CNC Machines						9
Inter Chai Hold Mana	changeable nge Tooling ers – Tool agement - P	Tooling System – Preset and Qualified Tools – Coolant F System – Automatic Head Changers – Tooling Requirer Assemblies – Tool Magazines – Automatic Tool Changer (A rinciples of Location - Clamping and Work Holding Devices.	eed Too nents fo TC) Mec	ling System – I r Turning and hanisms – Auto	Modu Mach matic	lar F ining Pal	ixturi g Cer let Ch	ng – Quick nters –Tool nanger Tool
Unit	- V	Economics of CNC Machines and Retrofitting						9
Fact CNC Requ	ors Influenc Machines uirements –	cing Selection of CNC Machines – Cost of Operation of C in Industries – Maintenance Features of CNC Machines Retrofitting - Necessary for Retrofitting - Advantages.	NC Mac – Preve	hines – Practic ntive Maintenai	al As nce -	pect Oth	ts of her M	Introducing aintenance
								Total:45
техт	BOOKS:							
1.	Kalpakjian. Delhi, 2020	S. and Schmid. S. R., "Manufacturing Engineering and Techno for Unit I.	ology", 8 <sup>t</sup>	<sup>h</sup> Edition, Pearso	on Ed	ucat	ion In	dia, Nev
2.	Radhakrishi II, III, IV, V.	nan P, "Computer Numerical Control Machines", 1 <sup>st</sup> Edition, No	ew Centr	al Book Agency	, Kolk	ata,	2018	for Units I,
REFE	RENCES:							
1.	HMT Limite	d,"Mechatronics",1 <sup>st</sup> Edition, TataMcGraw-Hill,NewDelhi,2008.						
2.	Thyer G.E,	"Computer Numeric Control of Machine Tools", 2 <sup>nd</sup> Edition, Butt	terworth-l	Heinemann,Burli	ngtor	199	)1.	
3.	Adithan M a	and Pabla B.S., "CNC Machines", 3 <sup>rd</sup> Edition, New Age Internati	onal Pvt.	Ltd.,NewDelhi,20	018.			

COURS On com	SE OUTCO	MES:	e, the stu	dents wi	ill be able	e to							BT Ma (Highes	apped t Level)
CO1	estimate t system	he param	eters of I	metal cu	tting and	compre	hend the	e basic	compon	ents invo	lved in a (	CNC	Applying	(K3)
CO2	choose th	e appropi	riate drive	es and c	ontrols fo	or CNC I	machines	6					Understan	ding (K2)
CO3	develop p	art progra	amming f	or variou	s machir	ning pro	cess						Applying	(K3)
CO4 select various tooling systems and fixtures for CNC machines Understanding (K2)														
CO5 compute operation and maintenance cost of CNC machines Applying (K3)														
Mappir	ng of COs	with POs	and PS	Os										
POs	PO1	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	PO11	PO12	2 PSO1	PSO2
CO1	3		1											3
CO2	3		1											3
CO3	3		1		2									3
CO4	3		1		2									3
CO5	3		1											3
1 – Slig	ht, 2 – Mo	derate, 3	– Substa	ntial, BT	- Bloom'	s Taxor	iomy							
					ASSE	SSMEN	T PATTE	ERN - 1	THEORY	,				
Test / Cate	Bloom's egory*	Remei (K	mbering 1) %	Und	derstand (K2) %	ling	Applyir (K3) %	ng b	Analyzi (K4) %	ng l %	Evaluating (K5) %	g C	reating (K6) %	Total %
C	AT1		15		45		40							100
C	AT2		15		45		40							100
C	AT3		15		45		40							100
E	ESE 15 45 40 100													
* ±3% r	may be var	ied (CAT	1,2&3	– 50 ma	rks & ES	E – 100	marks)							

		22MEE20 - PRECISION ENGINEERI	NG									
Programm Branch	ne &	BE & Mechanical Engineering	Sem.	Category	L	т	Ρ	Credit				
Prerequisi	ites	Manufacturing Technology, Machining and Measurements	7	PE	3	0	0	3				
Preamble		This course deals with precision manufacturing, micro machine precision machine tools. It also provides insights on machine surface	ning an ace chara	d fundamen acteristics an	tal d d err	esigr or de	requ tection	irements of n methods.				
Unit – I		Precision Manufacturing						9				
Introduction	n - Ne ecision	ed for Precision Manufacturing - Taniguchi Diagram - Four Classes – High-Precision - Ultra-Precision Processes and Nanotechnology	of Achie	vable Machi	ning	Accu	acy –					
Unit – II		Precision Machining and Unconventional Micromachining Te	chnique	S				9				
Ultra-Preci Ultrasonic Laser Bear	Micror Micror Micror	Diamond Turning - Conventional Micro Machining Techniques: Diamond Turning. Unconventional Micromachining Techniques: nachining - Micro Electrical Discharge Machining - Photochemica omachining - Electron Beam Micromachining - Focused Ion Beam	Abrasive Abrasive Al Machin Microma	a Jet and M ning - Electro chining.	/ater oche	Jet mical	Micro Micro Micro	machining - machining - machining -				
Unit – III		Machine Design For Precision Manufacturing						9				
Philosophy of Precision Machine Design - Ultra-Precision Machine Elements: Guide Ways - Drive Systems - Friction Drive - Linear Motor Drive - Spindle Drive. Bearings: Principle - Construction and Application of Rolling - Hydrodynamic and Hydrostatic Bearings Aerostatic Bearings - Magnetic Bearings.												
Unit – IV		Mechanical and Thermal Errors						9				
Sources of Structural Budgets.	f Error Compl	<ul> <li>Principles of Measurement - Errors due to Machine Elements – Beliance – Vibration - Thermal Effects - Environmental Control of</li> </ul>	earings - Precisic	- Spindles - F on Machinery	≺iner ∕. Er	natic ror N	Desig Iappin	n - g and Error				
Unit – V		Dimensional Metrology for Micro Machining						9				
Machine Vi Optical Met Need - Mea Microscope	ision - trology asuren es - Sc	Laser Tracking Systems - Laser Scanners – White Light– White L - Fringe Projection Method - Measurement of Typical Nano Featur nent – Chromatic Confocal Microscopy – Interferometer - Non-Optic anning Probe Microscopes - Parameters for Characterizing 3D Sur	_ight Inte es. Surfa cal Scani face Top	erference 3D ace Metrolog ning Microsco ography.	Micr y: 3E opy -	oscop ) Surf - Sca	bes - F ace To nning	Focus-based opography – Electron				
								Total:45				
TEXT BOO	OKS:											
1. Jai	in V.K.	, "Micro-manufacturing Processes", 1 <sup>st</sup> Edition, CRC Press, Taylor	and Frar	ncis Group, 2	012	for Ur	nits I, V	V.				
2. Da	avid Do	rnfeld, Dae-Eun Lee, "Precision Manufacturing", 1 <sup>st</sup> Edition, Spring	er Bosto	n,2008 for Ui	nits II	, III, I	V.					
REFEREN	CES:											
1. Ve	enkate	sh V.C., Izman,Sndir., "Precision Engineering", 2 <sup>nd</sup> Edition, Tata Mo	cGraw-H	ill, New Delh	i, 20′	15.						
2. Ja	ain V.K	., "Introduction to Micromachining", 2 <sup>nd</sup> Edition, Narosa Publishers,	New De	lhi, 2022.								

COUR On cor	SE O	UTCON	IES:	, the stude	ents wi	l be able	to							BT Map	ped evel)
CO1	illus	strate th	e conce	pts of pred	cision n	nanufactu	iring						Un	derstandir	ng (K2)
CO2	den	nonstrat	te the wo	orking prin	ciple o	f different	precisio	on mach	nining p	rocesse	S			Applying	(K3)
CO3	cho	ose the	basic d	esign requ	iiremer	its for the	constru	ction of	precis	ion macl	nine tool	S		Applying (	(K3)
CO4 identify various errors affecting the accuracy of precision manufacturing												Applying (K3)			
CO5 apply a suitable measurement technique to measure and characterize the features of precision Applying (K3) applying (K3)												(K3)			
						Маррі	ng of C	Os with	POs a	and PSC	)s				
COs/F	os	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO	1	3	1											2	2
CO	2	3	1	3										2	3
CO	3	3	1	3										2	3
CO	4	3	1	3				1						2	3
CO	5	3	1	3										2	3
1 – Slię	ght, 2	– Mode	rate, 3 -	- Substant	ial, BT	Bloom's	Taxono	my							
						ASSE	SSMEN <sup>®</sup>	T PATT	ERN –	THEOR	Y				
Tes C	Test / Bloom's Category*Remembering (K1) %Understanding (K2) %Applying (K3) %Analyzing (K4) %Evaluating (K5) %Creating (K6) %Total														
	CAT	1		25		50		25	5						100
	CAT	2		25		25		50	)						100

 $^{\ast}$  ±3% may be varied (CAT 1, 2 & 3 – 50 marks & ESE – 100 marks)

CAT3

ESE

	22MEE21 - COMPUTATIONAL FLUID DYN	NAMICS					
Programme & Branch	BE & Mechanical Engineering	Sem.	Category	L	т	Р	Credit
Prerequisites	Fluid Mechanics and Hydraulic Machines, Heat and Mass Transfer	7	PE	3	0	0	3
	·						
Preamble	This course deals with the application of numerical methods in so generation techniques and turbulence models are covered extensively	olving fluid y through t	d flow and he his course.	at tran	sfer p	roble	ms. Grid
Unit – I	Governing Equations and Boundary Conditions						9
Governing Equ General Transp CFD –Elliptic -	ations: Basics of Computational Fluid Dynamics – Governing Equations port Equation. Boundary Conditions: Physical Boundary Conditions – E Parabolic -Hyperbolic Equations.	s – Continu Discretizati	uity - Momentu on – Mathema	m and atical B	Energ ehavid	y Equ or of F	uations – PDEs on
Unit – II	Finite Difference Method						9
Finite Difference Matrix-Applicati Errors.	e Method – Taylors Series – Forward - Central - Backward Differences on of the TDMA to Two-Dimensional Problems– ADI Method –Solution	s – Explic Methodol	it Method – Im ogy for Parabo	plicit M blic and	lethod Ellipt	l – Tri ic Equ	diagonal Jations –
Unit – III	Finite Volume Method						9
Finite Volume F Schemes - Uns problems – Cer	Formulation for Steady-State – One and Two - Dimensional Diffusion F steady Heat Conduction on Elliptic and Parabolic Equations - Steady Itral - Upwind Differencing Schemes- Hybrid - Power-Law - QUICK Sche	Problems State On emes –Pro	<ul> <li>Parabolic Equie-Dimensional perties of Disc</li> </ul>	uations Convertization	– Ex ection on Sch	plicit - and nemes	<ul> <li>Implicit</li> <li>Diffusion</li> <li>S.</li> </ul>
Unit – IV	Grids						9
Types of Grid - Correction – SI	<ul> <li>Grid Generation – Grid Transformation – Calculation of Flow Field M</li> <li>MPLE Algorithm – SIMPLER Algorithm - SIMPLEC Algorithm – PISO Algorithm</li> </ul>	/ariable – gorithm.	Staggered Gr	id – Pr	essure	e and	Velocity
Unit – V	Turbulence Models						9
Turbulence – E Boundary Laye Stress Model-In	ffect of Turbulence on Time Averaged Navier Stokes Equation – Cha r – Pipe Flow – Turbulence Models – Mixing Length Model – K-ε Mod ternal flow analysis using ANSYS-FLUENT.	aracteristic els – Rey	s of Simple T nolds Stress E	urbuler quatior	nt Flov n Mod	v – F el – <i>F</i>	lat Plate Algebraic
							Total:45
TEXT BOOKS:							
1. Ander Units I	son John D., "Computational Fluid Dynamics: Basic with Applications", , II.	Indian Edi	tion, Tata McG	Braw-Hi	ill, Ind	ia, 20	17 for
2. Verste Pearse	eg H. K. & Malalasekera W., "An Introduction to Computational Fluid Dy on Education Ltd., UK, 2007 for Units III, IV,V.	/namics: T	he Finite Volu	me Met	hod",	2 <sup>nd</sup> E	dition,
REFERENCE:							
1. Jiyuai	n Tu, Guan Yeoh, Chaoqun Liu, "Computational Fluid Dynamics: A Prac	tical Appro	oach", 3 <sup>rd</sup> Editi	on, Els	evier,	USA,	2019

COURS On com	SE OUTO	COMES: of the cou	irse, the s	tudents	s will be able	e to						E (Hi	BT Mappe ghest Le	ed vel)
CO1	derive	the gove	erning equ	ations	and use the	boundar	y conditio	ns for flu	uid dynar	nic probl	ems.	Aŗ	oplying (K	3)
CO2	apply	finite diffe	erence me	ethods	to solve the	one dime	ensional a	nd two c	limensio	nal probl	ems	Aj	oplying (K	3)
CO3	3       formulate the finite volume equations for convection diffusion problems.       Applying (K3)													
CO4 perform the grid generation and grid transformation operations and calculate the flow field variables. Applying (K3)														
CO5 recognize the characteristics of turbulence models and apply the models to physical problems. Applying (K3)														
												1		
				1	Ma	pping of	COs with	n POs a	nd PSOs	5				
COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	P011	PO12	PSO1	PSO2
CO1	3											3		3
CO2	3											3		3
CO3	3				3							1	3	
CO4	3				3							1	3	
CO5	3				3							1	3	
1 – Slig	ht, 2 – M	loderate,	3 – Subs	tantial,	BT- Bloom'	s Taxonoi	my						1	
					AS	SESSME	ENT PATT	ERN - 1	THEORY	,				
Test / Cate	Bloom's egory*	a Re	memberi (K1) %	ing	Understa (K2)	inding %	Applyi (K3)	ng %	Analyzi (K4) %	ng %	Evaluating (K5) %	Crea (K6	iting ) %	Total %
С	AT1		20		40		40							100
С	AT2		20		40		40							100
С	AT3		20		40		40							100
E	ESE 20 40 40 100													
* ±3% n	nay be v	aried (CA	T 1, 2 & 3	3 – 50 ı	marks & ES	E – 100 n	narks)	·						

	22MEE22 - GAS DYNAMICS AND JET PROF	PULSION	N				
	(Use of Gas Tables are permitted in the End Semest	er Exam	ination)				
Programme & Branch	BE & Mechanical Engineering	Sem.	Category	L	т	Ρ	Credit
Prerequisites	Engineering Thermodynamics, Thermal Engineering	7	PE	3	0	0	3
Preamble	This course deals with concepts of compressible fluid flow in va behind aircraft and space propulsion systems along with their per course.	riable ar formanc	nd constant a e calculations	rea are	ducts cove	. The red th	principles prough this
Unit – I	Fundamentals of Compressible Flow and Isentropic Flow thr	ough Va	ariable Area I	Duct	S		9
Fundamentals - Critical State Number on Co Ratio as a Fund	of Compressible Flow: Adiabatic Energy and Momentum Equations for - Mach Number - Reference Velocities - Various Regions of Flow mpressibility. Isentropic Flow through Variable Area Ducts: T-s and tion of Mach Number - Mass Flow Rate Through Nozzles and Diffus	or Comp - Mach d h-s Dia ers.	ressible Fluid Cone - Macl agrams for No	Flov n An ozzle	vs - S igle - e and	Stagn Effe Diffu	ation State ct of Mach iser - Area
Unit – II	Flow Through Constant Area Ducts						9
Flow in Consta Mach Number Variation of Flo	nt Area Ducts with Friction - Fanno Curves and Fanno Flow Equati with Duct Length - Flow in Constant Area Ducts with Heat Transfer w Properties - Maximum Heat Transfer	on - Var - Raylei	iation of Flow igh Line and I	Pro Rayl	perti eigh	es - \ Flow	/ariation of Equation -
Unit – III	Flow Across Shock						9
Generation of Variation of Flo Strength of Sho	Shock in Shock Tubes - Desirable and Undesirable Effects of Sho w Parameters Across the Normal Shock - Prandtl Meyer Equation ck Wave - Introduction to Oblique Shock.	ock -Gov 1 - Impo	verning Equa ssibility of Sh	tions ock	in S	lorma ubsor	al Shock – nic Flows -
Unit – IV	Aircraft Propulsion						9
Types of Jet Er -Combustion C and Overall Eff	gines - Energy Flow through Jet Engines - Study of Turbojet Engine namber - Turbine and Exhaust Systems - Performance of Turbo Jet B ciencies - Ram Jet. Scram Jet and Pulse Jet Engines	Compor Engines	nents – Diffuse – Thrust - Thr	er – ust l	Comp Powe	oress r - Pr	or opulsive
Unit – V	Rocket Propulsion						9
Types of Rocke Velocity - Spec Systems - Stag	t Engines - Solid Propellant Rocket - Liquid Propellant Rocket and H ific Impulse - Rocket Engine Performance - Solid and Liquid Pro es of a Rocket during Course of Travel.	ybrid Ro pellants	cket - Thrust I - Compariso	Equa n of	ation Diffe	- Effe erent	ctive Jet Propulsion
							Total:45
TEXT BOOK:							
1. Yahya Interna	S.M., "Fundamentals of Compressible Flow with Aircraft and ional Publishers, New Delhi, 2018.	Rocket	Propulsion",	6 <sup>th</sup>	Ed	ition,	New Age
REFERENCES							
1. Ratha	rishnan E. , "Gas Dynamics", 7 <sup>th</sup> Edition, Prentice Hall of India, Delh	ni, 2020.					
2. Ahmee	F. El-Sayed. , "Fundamentals of Aircraft and Rocket Propulsion", 1 <sup>s</sup>	t Edition	, Springer, Sp	ain,	2016	6	

COURS On con	SE O	UTCON on of the	IES: e cours	e, the stud	ents w	ill be able	to						(	BT Mapp Highest L	oed evel)
CO1	ana	lyze the	e compr	essible flov	w throu	ıgh variab	le area	ducts						Analyzing	(K4)
CO2	exa	mine th	e flow t	hrough cor	nstant	area duct	with hea	at transf	er and	friction				Analyzing	(K4)
CO3	eva	luate th	e flow a	ssociated	with n	ormal sho	ck							Analyzing	(K4)
CO4	exp	lain the	workin	g of aircra	ft engi	nes								Applying (	K3)
CO5	exp	lain the	types of	of rocket er	ngines	and their	working	principl	es					Applying (	K3)
													ù		
						Mappin	g of CO	s with	POs a	nd PSO:	5				
COs/P	Os	P01	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO	1	2		3									1		3
CO2	2	2		3									1		3
COS	3	2		3									1		3
CO4	4	3		2											2
COS	5	3		2											2
1 – Slig	ght, 2	– Mode	erate, 3	<ul> <li>Substant</li> </ul>	ial, BT	- Bloom's	Taxono	my							
					. T	ASSES	SMENT	PATTE	RN –	THEOR	( 				
Tes C	t / Blo atego	oom's ory*	R	ememberi (K1) %	ng	Understa (K2)	anding %	Apply (K3)	ying %	Analyz (K4) 9	ing     %	Evaluating (K5) %		reating (K6) %	Total %
	CAT	1		10		20		35	5	35				· ·	100
	CAT	2		10		20		40	)	30					100
	CAT3 20 30 50 100														
	ESE 10 20 40 30 100														
* ±3% ı	may b	e varie	d (CAT	1, 2 & 3 -	50 ma	rks & ESE	– 100 r	narks)							

	22MEE23 - PROJECT MANAGEMEI	NT					
Programme & Branch	BE & Mechanical Engineering	Sem.	Category	L	т	Ρ	Credit
Prerequisites	Manufacturing Technology	7	PE	3	0	0	3
		I	I				
Preamble	This course provides market analysis, financial analysis and syste provides different industrial management techniques for various a	ems appr pplicatio	oach in indus ns.	strial	case	study p	rojects. It
Unit – I	Introduction						9
An Overview – <sup>-</sup> Selection – Proje	Types – Characteristics of Projects – Project Life Cycle – Identificat ect Appraisal.	tion of Ir	vestment Op	portu	unities	s – Scre	ening and
Unit – II	Market and Demand Analysis						9
Market Survey - Location Project	<ul> <li>Demand Forecasting Methods – Technical Analysis – Manufactu Charts and Layouts.</li> </ul>	uring Pro	ocess – Mate	erials	– Pr	oduct N	lix – Plant
Unit – III	Financial Management						9
Budgeting Techi Return.	niques – Net Present Value – Profitability Index – Internal Rate of	Return	– Payback F	Period	d – A	ccounti	ng Rate of
Unit – IV	Mathematical Techniques for Project Management						9
Mathematical Te Project Manager	echniques for Project evaluation – Linear Programming – Goal Programming – Goal Programment – CPM – PERT – Multiple Projects and Constraints – Scheduli	ramming ng.	– Network T	echn	ique f	or	
Unit – V	Project Implementation						9
Organization Sys	stems for Project Implementation – Work Breakdown – Coordination	and Co	ntrol – Projec	t Ma	nager	nent So	oftware.
							Total:45
TEXT BOOK:							
1. Prasann 2019.	a Chandra, "Projects – Planning, Analysis, Financing, Implementat	ion and	Review", 9 <sup>th</sup>	Editio	on, Mo	cGraw I	Hill, Noida,
REFERENCES:							
1. Choudh	ury S, "Project Management". 32 <sup>nd</sup> Reprint, Tata McGraw Hill Educ	ation Pr	vate Limited,	India	a, 200	9.	
2. Mike Fi	eld & Laurie Keller, "Project Management", 3 <sup>rd</sup> Edition, Thompson B	usiness	Press, Wash	ingto	n, 20 <sup>-</sup>	12.	

COUR On cor	SE OUTCOMES: npletion of the course, the students will be able to	BT Mapped (Highest Level)
CO1	describe the project life cycle and appraise the projects	Understanding (K2)
CO2	perform market and demand analysis	Understanding (K2)
CO3	perform financial analysis of projects	Applying (K3)
CO4	evaluate the projects using mathematical techniques	Analyzing (K4)
CO5	categorize the different phases of project implementation	Analyzing (K4)

Mapping of COs with POs and PSOs														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2									3			3
CO2	2	1									3			3
CO3	1	2									3			3
CO4	1	2									3			3
CO5	1	1			1						3		1	3
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY													
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %						
CAT1	50	50					100						
CAT2	25	25	50				100						
CAT3	20	20	30	30			100						
ESE	20	25	35	20			100						
* ±3% may be varied (0	CAT 1, 2 & 3 – 50 m	arks & ESE – 100 r	narks)										

22GEE02 - TOTAL QUALITY MANAGEMENT														
Programm Branch	ne &	BE & Mechanical Engineering	Sem.	Category	L	т	Р	Credit						
Prerequis	ites	Nil	7	PE	3	0	0	3						
Preamble	Preamble This course deals with quality concepts and Total Quality Management (TQM) principles focusing on process quality for customer perspective. It also deals with the basic and modern quality management tools including ISO standards													
Unit – I		Quality Concepts and Principles						9						
Definition of Quality - Dimensions of Quality - Quality Planning - Quality Assurance and Control - Quality Costs with Case Studies - Elements / Principles of TQM - Historical Review – Leadership – Qualities / Habits - Quality Council - Quality Statements, Strategic Planning – Importance - Case Studies - Deming Philosophy - Barriers to TQM Implementation – Cases with TQM Success and Failures.														
	0-1-	TQM-Principles and Strategies		0			4°	9						
Customer Satisfaction - Customer Perception of Quality - Customer Complaints - Customer Retention, Employee Involvement – Motivation - Empowerment - Teams - Recognition and Reward - Performance Appraisal, Continuous Process Improvement - Juran's Trilogy - PDSA Cycle - 5S - Kaizen, Supplier Partnership - Partnering - Sourcing - Supplier Selection - Supplier Rating - Relationship Development, Performance Measures – Purpose – Methods - Cases.														
Unit – III	Unit - III     Control Charts for Process Control     9													
Basic Seven Tools of Quality and its Role in Quality Control, Statistical Fundamentals - Measures of Central Tendency and Dispersion, Population and Sample - Normal Curve - Control Charts for Variables and Attributes - Process Capability - Case Study - Introduction to Six Sigma.														
Unit – IV		TQM-Modern Tools						9						
New Seve (HOQ) Co (DOE), To Number (F	en Toc onstruc otal Pro RPN) –	Is of Quality, Benchmarking - Need - Types and Process, Qua tion - Case Studies, Introduction to Taguchi's Robust Design - Q oductive Maintenance (TPM) - Uptime Enhancement, Failure Mod Process - Case Studies.	lity Fun uality Lo de and l	ction Deploy oss Function Effect Analys	mei - D is (	nt - H esigr FME/	louse i of E> A) - R	of Quality operiments isk Priority						
Unit – V	,	Quality Systems						9						
Need for System - 20000 - IS	ISO 9 Docum SO 220	000 and Other Quality Systems - ISO 9000: 2015 Quality Systems - ISO 9000: 2015 Quality Systemation - Quality Auditing, Introduction to ISO 14000 - IATF 169 00 - ISO21001. Process of Implementing ISO - Barriers in ISO Implementing ISO - Barriers in ISO Implementing ISO	stem – E 949 - TL ementat	Elements - I _ 9000-IEC 1 ion.	nple 702	emen 25 - I	tation SO 18	of Quality 3000 - ISO						
								Total:45						
TEXT BOO	OK:													
1. В т	esterfie Total Q	eld Dale H., Besterfield Carol, Besterfield Glen H., Besterfield Mary uality Management", 5 <sup>th</sup> Edition, Pearson Education, Noida, 2018.	/, Urdhw	areshe Hema	ant,	Urdh	wares	heRashmi.						
REFEREN	ICES:													
1. S	ubbura	ij Ramasamy, "Total Quality Management", McGraw Hill Education,	New De	elhi, 2017.										
2. Ja	ames F	R. Evans and William M. Lindsay, "The Management and Control of	Quality"	, 8 <sup>th</sup> Edition, 0	Cen	gage	Learn	ing, 2012.						
3. D	avid G	oetsch & Stanley Davis, "Quality Management for Organizational Pearson, 2017.	Excelle	nce: Introduc	tion	to T	otal Q	uality", 8 <sup>th</sup>						

COUR: On con	COURSE OUTCOMES: On completion of the course, the students will be able to												(Н	BT Mapped (Highest Level)			
CO1	demor	strate th	ne evolu	tion of T	QM prin	ciples								Understanding (K2)			
CO2	2 illustrate the principles and strategies of TQM											Und	Understanding (K2)				
CO3	CO3 use control charts and identify process capability of a process											ŀ	Applying (K3)				
CO4	apply various quality tools and techniques in both manufacturing and service industry										Applying (K3)						
CO5 choose appropriate quality standards and implement them in the respective industry Applying (K											<3)						
Mapping of COs with POs and PSOs																	
COs/POs         PO1         PO2         PO3         PO4         PO5         PO6         PO7         PO8         PO9         PO10         PO11         PO12         PS01								PSO2									
CC	D1	2	2				1							1		3	
CC	D2	2	2				1							1		3	
CC	D3	2	2				1							1		3	
CC	D4	2	2				1							1		3	
CC	D5	1	1				1							1		3	
1 – Slig	ht, 2 – I	Moderat	te, 3 – S	ubstant	al, BT-	Bloom'	s Taxo	nomy									
			_			ASSE	SSME		ERN	- IH	EORY				-		
lest Ca	t / Bloon ategory	n′s *	Remei (K	mbering 1) %	Un	derstan (K2) %	ding	Applyin (K3) %	g	Anal (K4	lyzing 4) %	Evalu	uating 5) %	Creat (K6)	ing %	l otal %	
	CAT1		2	5		45		30								100	
	CAT2		2	0		40		40								100	
	CAT3		2	5		45		30								100	
	ESE 20 40 40 100										100						
* ±3% ı	may be	varied (0	CAT 1, 2	& 3 – 5	) marks	& ESE	– 100 r	marks)									

22MEE24 - INDUSTRIAL TRIBOLOGY														
Programme & Branch	BE & Mechanical Engineering	Sem.	Category	L	т	Ρ	Credit							
Prerequisites	Fluid Mechanics and Hydraulic Machines, Design of Machine Elements	7	PE	3	0	0	3							
Preamble	I his course deals with the fundamentals of friction, wear, lubrication and design aspects of bearing.													
Unit – I	nit – I Surfaces and Friction 9													
Topography of Engineering Surfaces–Contact Between Solids –Sources of Sliding Friction – Friction Characteristics of Metals – Friction of Non-Metals – Friction of Ceramics and Polymers –Rolling Friction – Source of Rolling Friction – Stick Slip Motion.														
Unit – II	Wear and Lubrication		•				9							
Types of Wear – Simple Theory of Sliding Wear Mechanism – Adhesive and Abrasive Wear – Corrosive Wear – Surface Fatigue Wear – Brittle Fracture – Wear of Ceramics and Polymers. Types and Properties of Lubricants –Testing Methods.														
Unit – III Film Lubrication Theory 9														
Hydrodynamic Lubrication – Fluid Film in Simple Shear–Viscous Flow Between Very Close Parallel Plates-Reynolds Equation for Film Lubrication – Solid Lubrication – Hydrostatic Lubrication.														
Unit – IV Journal Bearings 9														
Bearing Geome	try – Pressure Distribution – Load Capacity – Friction Force – Coeffic	cient of F	Friction – Lub	ricar	t Flo	w rate	-							
Practical and O	perational Aspects of Journal Bearings – Thermal Effects in Bearings	– The S	omerfield Dia	igrar	n.									
Unit – V	Bearing Materials		<b></b>				9							
Fluid Film Beari	ents – Reduction of Friction – Wear Resistant Coatings – Materials fongs – Materials for Marginally Lubricated and Dry Bearings.	or Rolling	g Element Bea	arıng	js — I	lateria	als for							
							Total:45							
TEXT BOOK:														
1. Gwidor	W. Stachowiak & Andrew W. Batchelor, "Engineering Tribology", 4th	Edition,	Butterworth-I	Hein	manr	ı, UK,	2013.							
REFERENCES														
1. William	1. Williams J. A., "Engineering Tribology", 1 <sup>st</sup> Edition, Oxford University Press, New Delhi, 2004.													
2. Camer	<ol> <li>Cameron A., "Basic Lubrication Theory", 3<sup>rd</sup> Edition, Ellis Horwood Ltd. Publishers, UK, 1983.</li> </ol>													

COUR: On con	COURSE OUTCOMES: On completion of the course, the students will be able to													BT Mapped (Highest Level)			
CO1	elat	oorate t	he surfa	ce topogra	phy ar	nd physic	-chemica	al aspec	cts of s	olid surf	aces.		Understanding (K2)				
CO2	D2 demonstrate the different wear mechanisms and lubrication aspects on solid metal surfaces.											l surfaces.	Applying(K3)				
CO3 Illustrate the hydrodynamic and hydrostatic lubrications.											Applying(K3)						
CO4	CO4 analyze the performance of journal bearings and design for different assembly												Applying(K3)				
CO5 select the suitable materials for bearings in different applications.												Understanding (K2)					
Mapping of COs with POs and PSOs																	
COs/P	Os	PO1	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	P01	0 PO11	PO12	PSO1	PSO2		
CO	1	3	1										1		3		
CO2	2	3	2										1		3		
COS	3	3	2										1		3		
CO4	1	3	2										1		3		
COS	5	3	1										1		3		
1 – Slig	jht, 2	– Mode	erate, 3 -	- Substant	ial, BT	- Bloom's	Taxono	my									
						ASSES	SMENT	PATTE	ERN –	THEOR	(						
Tes C	t / Blo atego	oom's ory*	Re	ememberi (K1) %	ng	Understa (K2)	anding %	Apply (K3)	ying ) %	Analyz (K4) (	ing %	Evaluating (K5) %	Creat (K6)	ting %	Total %		
	CAT	1		20		50		30	)						100		
	CAT	2		10		45		45	5						100		
	CAT	3		10		60	)	30	)						100		
	ESE	Ξ		10		45		45	5						100		
* ±3% ı	may b	oe varie	d (CAT <sup>·</sup>	1,2&3-	50 mai	ks & ESE	E – 100 r	marks)									

22MEE25 - ADVANCED MECHANICS OF MATERIALS													
Programme & Branch	BE & Mechanical Engineering	Sem.	Category	L	т	Ρ	Credit						
Prerequisites	Engineering Mechanics, Strength of Materials	7	PE	3	0	0	3						
Preamble	amble This course imparts the knowledge on three-dimensional theory of elasticity, shear centre, unsymm section bending stresses, stress analysis on curved beams, the torsion on non-circular members membrane stresses on shells, rotating disc and the beam on elastic foundation.												
Unit – I	nit – I Theory of Elasticity 9												
Theory of Stresses - Infinitesimal and Finite Strains - Strain-Displacement Relationships - Compatibility - Stress-Strain Relationship Elastic Constants - Stress and Displacement Functions- Plane Stress Problems in Cartesian and Polar Coordinates – Boundary Conditions - Representations of Three - Dimensional Stress of a Tension-Generalized Hooke's Law – St.Vennant's Principle – Plane Strain - Plane Stress – Airy's Stress Function.													
Unit – II	Shear Centre and Unsymmetrical Bending						9						
Location of Shear Center for Various Sections – Shear Flow. Unsymmetrical Bending: Stresses and Deflection in Beams Subjected to Unsymmetrical Loading – Kern of a Section.													
Unit – III	Unit – III Stresses on Curved Beams												
Curved Flexural Members - Analysis of Stresses in Beams with Large Curvature – Stress Distribution in Curved Beams – Stresses													
Unit – IV	Stresses Due to Rotation				•		9						
Stresses Due Allowable Spe	o Rotation – Radial and Tangential Stresses in Solid Disc and Ring	of Unifor	m Thickness	and	Vary	ing T	hickness –						
Unit – V	Beams on Elastic Foundation						9						
Infinite Beam S Triangular Loa	ubjected to Concentrated Load – Boundary Conditions – Infinite Bea I - Semi Infinite Beam Subjected to Loads at the Ends and Concentra	am Subje ited Load	ected to a Dis d near the End	tribu ds –	uted L Shor	_oad 3 t Bea	Segment – ms.						
							Total:45						
TEXT BOOKS													
1. Sadhu	Singh, "Applied Stress Analysis", 19 <sup>th</sup> Edition, Khanna Publishers, N	ew Delh	i, 2016 for Un	its I									
2. Rajput	R. K. , "Strength of Materials", 7 <sup>th</sup> Edition, S. Chand & Co, New Delh	i, 2018 f	or Units II, III,	IV,۱	/								
REFERENCES	:												
1. Timos	enko S.P., "Strength of Materials", $4^{th}$ Edition, CBS Publishers, New	Delhi, 20	)12.										
2. Timos	enko S.P. & Goodier J.N., "Theory of Elasticity", 3rd Edition, McGrav	v Hill Edu	ucation, New `	York	, 201	7							
3. Rattar	S.S., "Strength of Materials", 4 <sup>th</sup> Edition, McGraw Hill Education, Nev	v York, 2	017										

COUR On co	SE OUTCOMES: npletion of the course, the students will be able to	BT Mapped (Highest Level)							
CO1	calculate the stress and strain at a point in a three dimensional mode.	Applying(K3)							
CO2	calculate analytically the shear centre and stresses in unsymmetrical bending.	Applying(K3)							
CO3	determine the stresses and deflections on Curved beams	Applying(K3)							
CO4	solve the stresses due to rotation on various components	Applying(K3)							
CO5	analyze the stresses in beams under elastic foundation	Applying (K3)							
	Mapping of COs with POs and PSOs								

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	3	2											3
CO2	1	3	2											3
CO3	1	3	2											3
CO4	1	3	2											3
CO5	1	3	2											3
1 Clight 2	aroto 2	Substant												

1 - Slight, 2 - Moderate, 3 - Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY														
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %							
CAT1	15	15	70				100							
CAT2	15	15	70				100							
CAT3	15	15	70				100							
ESE	15	15	70				100							
* ±3% may be varied (0	* ±3% may be varied (CAT 1, 2 & 3 – 50 marks & ESE – 100 marks)													
			22ME	E26 - ADDITIVE	E MANUFAC	TURIN	G							
--	------------------------------------	--	--	--	---	-------------------------------	--------------------------------	--	-----------------------	---------------------------	--------------------------------	-------------------------------	--	--
Program Branch	ime &	BE & Mechanic	al Engineering				Sem.	Category	L	Т	Ρ	Credit		
Prerequi	sites	Manufacturing Metallurgy	Technology,	Engineering	Materials	and	7	PE	3	0	0	3		
Preamble	Э	This course prov processes for ma	vides scientific a ass customizatio	and technologica n.	al aspects o	f vario	us additi	ve and form	ative	rapi	d man	ufacturing		
Unit - I		Introduction to	Additive Manuf	facturing (AM)								9		
Evolution Additive Compute	n - Funda Manufac er Aided I	amental Fabricatio cturing (AM) Syste Design for AM - 3[	n Processes - F ems - Need for D Modeling - 3D	Product Design a r AM - Classific Solid Modeling	and Develop cation of AM Softwares ar	ment - I Syste nd their	Concept ems - Be Role in	tual Design - enefits of AM AM - Data Fo	Deta / - / orma	ail De AM P it - S1	esign - Process FL files	History of S Chain – S.		
Unit - II		Liquid and Soli	d-based AM sys	stems								9		
Liquid-based AM systems: Stereo Lithography Apparatus (SLA) - Principle, Photo Polymers - Post Processes - Process Parameters - Machine Details - Advantages. Mask Projection VP Technology - Principle - Process Parameters - Process Details - Machine Details - Advantages and ApplicationsSolid-based AM systems: Fusion Deposition Modeling (FDM) - Principle - Raw materials - Support System - Process Parameters - Machine Details - Advantages and Limitations. Laminated Object Manufacturing (LOM) - Principle - Process Parameters - Process Parameters - Process Parameters - Process Parameters - Process Parameters - Machine Details - Advantages and Limitations. Laminated Object Manufacturing (LOM) - Principle - Process Parameters - Process Parameters - Process Parameters - Process Parameters - Potails - Advantages and Limitations.Unit - IIIPowder-based AM systems9														
Unit - II	I	Powder-based	AM systems									9		
Selective Laser Sintering (SLS) - Principle - Process Parameters - Process Details - Machine Details - Raw Materials - Advantages and Applications. Laser Engineered Net Shaping (LENS) - Principle - Process Details - Advantages and Applications. Binder Jetting (BJ) - Principle - Process Parameters - Process Details - Machine Details - Raw Materials - Advantages and Applications.														
Unit - IV         Directed Energy Deposition (DED) and Direct Write AM Technologies         9           DED_Breassage         Breassage         Deposition         Material         Delivery         Systems         Descent and Description         9														
Unit - IV         Directed Energy Deposition (DED) and Direct Write AM Technologies         9           DED Processes: Principle - Process Description - Material Delivery – Systems – Process Parameters - Benefits and Drawbacks – Applications         9           Direct Write Technologies: Background - Ink-Based Technologies - Laser Transfer - Beam Deposition - Liquid-Phase Direct Deposition - Hybrid Technologies – Applications														
Unit - V	'	Design for AM (	(DFAM) and Ap	plications of Al	М							9		
DFAM: In Methods AM Appli and Mac	ntroducti ication D hine Too	on - AM Unique omains: Aerospac Is.	Capabilities - C ce – Electronics	Core DFAM Cor - Health Care –	ncepts and C Defense – A	Dbjectiv lutomo	ves - Ex tive – Co	ploring Designment Designmen	gn F Fooc	reedo I Proc	oms - cessing	Synthesis g - Tooling		
												Total:45		
TEXT BC	DOKS:													
1. (	Chua.C.k or Units	K., Leong K.F. and I, II, III and V.	I Lim C.S., "Rap	oid Prototyping:	Principles an	d Appl	ications"	, World Scier	ntific	, New	Jersy,	2010		
2. [	an Gibs Direct Die	on, David Rosen, gital Manufacturing	Brent Stucker, g", 2 <sup>nd</sup> Edition, S	"Additive Manu pringer, UK, 201	Ifacturing Te 15 for Unit IV	chnolo	gies: 3D	Printing, Ra	apid	Proto	typing	, and		
REFERE	NCES:													
1.	Pham D.	T. and Dimov S.S	., "Rapid Manufa	acturing", Spring	ger -Verlag, L	ondon	, 2011.							
2.	Amitabha	a Ghosh., "Rapid N	Manufacturing a	brief Introductio	n", Affiliated	East W	est Pres	s, New Delhi	i, 20 <sup>.</sup>	11.				
3. 3	Sabrie S	oloman, "3D Printi	ng and Design",	1 <sup>st</sup> Edition, Kha	inna Publishi	ng Hou	ise, Delh	ni, 2020.						

COURS On com	SE OUT	COM of the	IES: e course	e, the stuc	lents wil	be able to	)						(	BT Mapp Highest L	ed evel)
CO1	define	e the c	concepts	s of additi	ve manı	facturing f	or new p	roduct d	evelop	ment			ι	Jnderstand	d (K2)
CO2	select	t the s	suitable I	liquid and	solid-ba	ised AM sy	stem for	a speci	fic app	lication				Applying	(K3)
CO3	identif	fy the	suitable	e powder-	based A	M system	for a spe	cific app	licatior	١				Applying	(K3)
CO4	select	t the s	suitable	DED/Dire	ct write I	based AM	system fo	or a spe	cific ap	plication	I			Applying	(K3)
CO5	choos	se the	suitable	e DFAM p	rocedur	e for new p	oroduct de	evelopm	ent				ι	Jnderstand	d (K2)
	Nonning of COo with DOo and DSOo														
00e/D/	Mapping of COs with POs and PSOs       COs/POs     PO1     PO1     PO1     PO1       COs/POs     PO1     PO3     PO4     PO6     PO7     PO8     PO10     PO11     PO12     PS01     PS02														
COs/Pos         PO1         PO2         PO3         PO4         PO5         PO6         PO7         PO8         PO9         PO10         PO											P011	P012	P501	P502	
CO1		1	3												3
CO2		1	3	2											3
CO3		1	3	2											3
CO4		1	3	2											3
CO5		1	3	2											3
1 – Slig	ht, 2 – I	Mode	erate, 3 -	- Substan	tial, BT-	Bloom's T	axonomy	1	1	1	I		1	1	
						ASSESS	SMENT F	PATTER	N – TH	IEORY					
Test Ca	/ Bloom tegory*	n's *	Rer	memberii (K1) %	ng	Understa (K2)	nding %	Apply (K3)	/ing %	Analyzi (K4) 9	ing E %	valuating (K5) %	J CI	reating K6) %	Total %
(	CAT1			10		90									100
(	CAT2			5		60		35							100
(	CAT3			5		60		35							100
	ESE			5		60		35							100
* ±3% r	nay be	varied	d (CAT	1,2&3-	50 marl	s & ESE -	- 100 ma	rks)					L. L.		·

		221	IEE27 - WELDII	NG TECHNO	DLOGY								
Programme & Branch	BE & Mechanic	al Engineering	ļ			Sem.	Category	L	т	Р	Credit		
Prerequisites	Manufacturing Metallurgy	Technology,	Engineering	Materials	and	7	PE	3	0	0	3		
Preamble	This course prov weldment.	vides the knowle	edge on various	advanced w	elding	process	es, welded jo	oint c	lesigr	is and	testing of		
Unit - I	Welding Princi	ples, Gas and A	Arc Welding Pro	ocesses							9		
Classifications of Welding Processes – Power Sources – Arc Characteristics – V-I Characteristics – Metal Transfer Modes – Electrodes and Fluxes – Types of Weld Joints – Weld Position – Gas Welding: Oxy-Acetylene Welding – Oxy-Hydrogen Welding – Arc Welding: Shielded Metal Arc Welding – Submerged Arc Welding – Gas Tungsten Arc Welding – Gas Metal Arc Welding – Plasma Arc Welding – Electro Slag Welding – Electro-Gas Welding Process – Advantages – Limitations and their Applications. Unit - II Resistance Welding Processes 9													
Unit - II	nit - II Resistance Welding Processes												
Spot Welding – Seam Welding – Projection Welding – Resistance Butt Welding – Flash Butt Welding – Percussion Welding – High Frequency Resistance Welding Process – High Frequency Induction Welding Process – Advantages – Limitations and their Applications.													
Unit - III Solid State Welding Processes 9													
Forge Welding – Friction Welding – Friction Stir Welding - Explosive Welding – Ultrasonic Welding – Cold Welding – Diffusion Bonding – Roll Welding – Hot Pressure Welding Processes – Advantages – Limitations and its Applications.													
Unit - IV	Special Weldin	g Processes ar	nd Design of We	eld Joints							9		
Thermit Weldin Welding Symbo Stainless Steels	g – Atomic Hydro Is – Welding Dim	ogen Welding - ension – Desig	– Electron Bear jn of Various W	m Welding /elded Joint	– Lase s: Wel	er Beam dability o	Welding – of Aluminium	Unc n, Co	ler W opper	ater \ , Cast	Velding – Iron and		
Unit - V	Testing of Weld	dments, Codes	& Standards an	nd Welding	Autom	ation					9		
Destructive Tes Liquid Penetran Codes and Sta Record – Weldin and Surface Tra	ts: Tensile Test - t Test – Magnetic ndards: Introducti ng Procedure Spa ansport Vehicles.	- Ductility Test Particle Test – ion to Codes a ecification – We	<ul> <li>Toughness T</li> <li>Radiographic T</li> <li>nd Standards -</li> <li>elder Performar</li> </ul>	est – Fatigu est – Ultras - Welding a nce Qualifica	ie Test onic Te ind We ation –	- Non- esting of elder Qu Welding	Destructive Weldments. Ialification – g Automatio	Test Pro n in	: Visu cedu Aero	ial Ins re Qu space	pection – alification , Nuclear		
											Total:45		
TEXT BOOK:													
1. David P	hillips. H., "Welding	g Engineering: A	Introduction",	2 <sup>nd</sup> Edition, J	John W	iley & Sc	ons, Ltd.,Unit	ed S	tates,	2023			
REFERENCES:													
1. Parmer	R.S., "Welding En	gineering and To	echnology", 3 <sup>rd</sup> E	Edition, Khan	na Pub	lishers, l	New Delhi, 2	022.					
2. Nadkarr	ni S.V., "Modern Ar	c Welding Tech	nology", 1 <sup>st</sup> Editi	on, Oxford IE	3H Pub	lishers, I	New Delhi, 20	014.					

COURS On com	E OU	TCON n of th	MES: e course	e, the stud	lents will	be able to							(H	BT Mappe lighest Le	ed evel)
CO1	expla applic	ain the cation	e workin Is	g principl	e of we	ding proce	ess and	select th	ne para	ameters	for the g	liven	Unc	lerstanding	g (K2)
CO2	demo	onstra opriate	te the ba etechniq	asic conco ue for ind	epts of c ustrial re	lifferent res quirement	sistance	welding	proces	ss and s	elect an		Unc	lerstanding	g (K2)
CO3	demo appro	onstra opriate	te the b etechniq	asic conc ue based	epts of on spec	various so ified applic	lid state ations	welding	proce	esses an	d apply		,	Applying (I	<3)
CO4	illustr	rate th	ne need t	for specia	l welding	technique	es and ap	oply thes	se prine	ciple on (	different	materials	ŀ	Applying (ł	(3)
CO5	selec	t weld	l codes,	standards	s and pro	ocedure to	examine	the wel	dment	for indus	strial app	lication	ŀ	Applying (ł	(3)
	Mapping of COs with POs and PSOs														
Mapping of COs with POs and PSOsCOs/POsPO1PO2PO3PO4PO5PO6PO7PO8PO9PO10PO11PO12PS01PS02															
CO1		1	3												3
CO2	CO1         1         3           CO2         1         3         2														3
CO3		1	3	2											3
CO4		1	3	2											3
CO5		1	3	2											3
1 – Sligl	ht, 2 –	Mode	erate, 3 -	<ul> <li>Substan</li> </ul>	tial, BT-	Bloom's T	axonomy	/							
						10050									
Teet	Diear	m'a	De	mombori		ASSES	SMENIH	ATTER	(N - 11-		na F	voluotina		e o din a	Tatal
Cat	egory	/*	Rei	(K1) %	ig	(K2)	nung %	(K3)	%	(K4) %	ing E %	(K5) %		K6) %	10tai %
CAT1 10						90									100
C	CAT2			5		70		25							100
C	CAT3			5		70		25							100
	ESE			5		70		25							100
* ±3% m	nay be	varie	d (CAT	1,2&3-	50 mark	s & ESE -	100 ma	rks)							

		22MEE28 - POWER PLANT ENGINEERI	ING												
Progran & Branc	nme ch	BE & Mechanical Engineering	Sem.	Category	L	т	Ρ	Credit							
Prerequ	uisites	Engineering Thermodynamics, Thermal Engineering	7	PE	3	0	0	3							
	1				1										
Preambl	le	This course imparts knowledge on layout and working of various point economic analysis of the power plants.	ower pla	nts and also t	he te	ermin	ologie	es involved							
Unit – I		Energy Scenario and Thermal Power Plant						9							
Energy Scenario: Indian and Global Energy Scenario – Environmental Issues of Present Day Power Generation.         Thermal Power Plant: Layout of Thermal Power Plant – Selection Criteria – Boilers – Fluidized Bed Boilers – Boiler Trial and Testing – Fuel and Ash Handling Systems – Pulverizer – Stokers – Dust Collectors – Cooling Towers – Feed Water Treatment – Distributed Control System (DCS).         Unit – II       Gas Turbine Power Plant and Diesel Power Plant       9															
Unit - II         Gas Turbine Power Plant and Diesel Power Plant         9           Gas Turbine Power Plant:         Gas Turbine Cycles - Thermodynamic Analysis of Cycles - Repeating Powerstion and															
Gas Turbine Power Plant: Gas Turbine Cycles – Thermodynamic Analysis of Cycles – Reheating – Regeneration and Intercooling - Layout of Gas Turbine Power Plant- Selection Criteria – Binary and Combined Cycle – IGCC. Diesel Power Plant: Layout –Types – Selection Criteria – Selection of Engine.															
Unit – II	Unit – III Nuclear Power Plant and Hydel Power Plant 9														
Nuclear Power Plant: Layout – Selection Criteria – Types of Reactors – Radioactivity – Fission Process – Reaction Rates – Diffusion Theory – Elastic Scattering and Slowing Down – Global Standards in Waste Disposal and Nuclear Safety. Hydel Power Plant: Layout – Site Selection Criteria – Selection of Turbines – Micro Hydel Developments.															
Unit – I	V	Other Types of Power Generation						9							
MHD Po	ower Ge	neration – Solar Thermal and PV System - WECS – Types – Biom	nass - G	eo thermal –	OTE	EC - I	Micro	Fuel Cells							
Unit – V		Power Plant Economics						9							
Cost of	Electric	Energy – Load Duration Curves – Fixed and Operating Costs – Er	nergy Ra	ates – Types	of Ta	ariffs	– Eco	onomics of							
Load Sh Thermal	naring – I Power	Comparison - Selection and Economics of Various Power Plants – I Plant – Waste Heat Recovery Boilers in Cement, Sugar and Steel Pla	Energy / ants.	Auditing – Typ	bes	– En	ergy A	uditing for							
								Total:45							
TEXT B	OOK:														
1.	Rajput F	R.K, "Power Plant Engineering", 5th Edition, Laxmi Publications, New	Delhi, 2	016											
REFER	ENCES:														
1.	Arora S	C. and Domkundwar S., "A Course in Power Plant Engineering", 8th	<sup>1</sup> Edition	, Dhanpat Rai	i, Ne	w De	lhi, 20	016.							
2.	Nag P.	K, "Power Plant Engineering", 4 <sup>th</sup> Edition, Tata McGraw-Hill, New De	lhi, 2017	7.											
3.	Hegde	R.K, "Power Plant Engineering", 1 <sup>st</sup> Edition, Pearson India Education	n Service	es Pvt. Ltd, De	əlhi,	2015									

COUR: On con	SE OI	JTCON on of the	IES: e course	, the stude	ents w	ill be able	to							BT Mapp Highest L	oed evel)
CO1	illus	trate th	e layout	and worki	ng of v	arious su	b circuit	s involv	ed in t	hermal p	ower pla	nt		Applying (	K3)
CO2	exp	lain the	working	of gas an	d dies	el power p	plants w	ith layou	uts					Applying (	K3)
CO3	exp with	lain the their la	basic th ayouts	eory of nu	clear p	processes	and wo	orking of	nucle	ar and h	ydel pow	er plants		Applying (	K3)
CO4	des	cribe th	e conce	ots of utiliz	ing re	newable e	energy s	ources	for po	wer gene	eration			Applying (	K3)
CO5	ider mea	ntify the asures	e termir in powei	nologies re generatio	elated n.	to power	plant e	econom	ics ar	nd discus	ss the er	nergy savii	ng	Analyzing	(K4)
	Mapping of COs with POs and PSOs														
COs/P	COs/POs         PO1         PO2         PO3         PO4         PO5         PO6         PO7         PO8         PO9         PO10         PO11         PO12         PS01         PS02														
CO	1	3					1	1							3
CO2	CO2 3						1	1							3
COS	3	3					1	1							3
CO4	4	3					1	1							3
COS	5	1		2			1	1				3			3
1 – Slig	ght, 2	– Mode	erate, 3 -	Substanti	al, BT	- Bloom's	Taxono	my							
						ASSES	SMENT	PATTE	ERN -	THEOR	(				
Tes C	t / Blo atego	oom's ory*	Re	ememberi (K1) %	ng	Understa (K2)	anding %	Apply (K3)	ying %	Analyz (K4) (	ing 1 %	Evaluating (K5) %		reating (K6) %	Total %
	CAT	1		10		40		50	)						100
	CAT2 10			10		40		50	)						100
	CAT3 10					30		40	)	20					100
	ESE			10		40		40	)	10					100
* ±3% ı	may b	e varie	d (CAT 1	, 2 & 3 – 5	50 ma	'ks & ESE	– 100 r	marks)							

	22MEE29 - DESIGN OF HEAT EXCHANG	ERS													
Programr & Branch	ne BE & Mechanical Engineering	Sem.	Category	L	т	Ρ	Credit								
Prerequis	ites Engineering Thermodynamics, Fluid Mechanics and Hydraulic Machines, Heat and Mass Transfer	7	PE	3	0	0	3								
Preamble	The course provides the fundamental aspects on designing different standards and factors to be considered in the design process of heat	ferent ty at exchar	pes of heat ngers are cov	exc ered	hang exte	ers. Th nsively	ie global								
Unit – I	Fundamentals of Heat Exchangers						9								
Introduction - Types - Application - Overall Heat Transfer Coefficient –Fouling - Effect of Fouling on Heat Transfer - Fouling Factor - Techniques to Control Fouling - Logarithmic Mean Temperature Difference (LMTD) Method - Effectiveness-Number of Transfer Units (NTU) Method of Heat Exchanger Analysis - Selection of Heat Exchangers.															
Unit – II	Unit – II Design of Double Pipe Heat Exchangers														
Introduction FinnedInr	roduction - Thermal and Hydraulic Design of Inner Tube and Annulus - Hairpin Heat Exchanger with Bare and Multi Tube inedInner Tube - Parallel-Series Arrangements of Hairpins - Total Pressure Drop.														
Unit – III	Unit – III Design of Shell and Tube Heat Exchangers														
Introduction - Basic Components - Classification - Basic Design Procedure - Tubular Exchanger Manufacturers Association (TEMA)Code - Heat Transfer and Pressure Drop Analysis on Shell Side and Tube Side - Bell Delaware Method.															
Unit – IV	Design of Compact Heat Exchangers						9								
Introduction DropAnal	on - Heat Transfer Enhancement - Plate Fin Heat Exchangers - Tube Fin H ysis of Finned Tube and Plate Fin Heat Exchangers.	leat Exc	hangers - He	at T	ransf	er and	Pressure								
Unit – V	Design of Condensers and Evaporators						9								
Introduction andEvapo	on - Classification - Thermal Design of Shell and Tube Condensers - Th rators for Refrigeration and Air Conditioning - Standards for Condensers ar	nermal A nd Evapo	Analysis of E prators.	vapo	rator	s - Coi	ndensers								
							Total:45								
TEXT BO	ок:														
1. S	adik Kakac, Hongtan Liu & Anchasa Pramuanjaroenkij., "Heat Exchange dition, CRC Press, USA, 2020.	rs: Seleo	ction, Rating,	and	The	rmal De	esign",4 <sup>th</sup>								
REFEREN	ICES:														
1. K	uppan Thulukkanam, "Heat Exchanger Design Handbook", 2 <sup>nd</sup> Edition, CR	C Press,	USA, 2013.												
2. R 20	amesh K. Shah, Dusan P. Sekulic. , "Fundamentals of Heat Exchanger De 003.	sign", 1 <sup>st</sup>	<sup>t</sup> Edition, Joh	n Wil	ey &	Sons Ir	nc, USA,								

COUR: On cor	SE OU	JTCOM on of the	IES: e course	, the stude	nts wil	l be able t	0							BT Map (Highest L	ped _evel)
CO1	expla	ain the	design p	arameters	of a h	eat excha	nger.							Applying	(K3)
CO2	analy	/ze the	thermal	performar	nce and	d design th	ne doub	le pipe l	neat ex	changer	s.			Analyzing	j (K4)
CO3	analy	/ze and	d design	the shell a	nd tube	e heat exc	hanger	6.						Analyzing	j (K4)
CO4	desię	gn the o	compact	heat exch	angers									Analyzing	J (K4)
CO5	desig	gn conc	lensers a	and evapo	rators	using stan	dard co	des						Analyzing	J (K4)
	Manning of COs with POs and PSOs														
COc/5	Mapping of COs with POs and PSOs           COs/POs         PO1         PO3         PO6         PO7         PO8         PO10         PO11         PO12         PSO1         PSO2														
COs/POs         PO1         PO2         PO3         PO4         PO5         PO6         PO7         PO8         PO9         PO10         PO11												PUIZ	P301	2	
	1	1		2				2							3
0.0	2	1		3				2							3
00	3	1		3				2							3
CO	4	1		3				2							3
CO	5	1		3				Z							3
1 – Slig	ght, 2 -	- Mode	rate, 3 –	Substanti	al, BT-	Bloom's	Taxonor	ny							
						ASSESS	MENT	ΡΔΤΤΕ	RN – T	HEORY					
Tes C	t / Blo atego	om's ry*	Re	memberii (K1) %	ng	Understa (K2)	anding %	Apply (K3)	ying %	Analyzi (K4) 9	ing E %	Evaluating (K5) %	J Cro (M	eating (6) %	Total %
CAT1 15						30		30		25					100
	CAT2	2		5		15		40		40					100
	CAT3	}		5		15		40		40					100
	ESE			10		10		40		40					100
* ±3%	may be	e varie	d (CAT 1	, 2 & 3 – 5	i0 marl	ks & ESE	– 100 m	arks)	1		ı.			н 	

		22MEE30 - QUALITY CONTROL AND RELIABILITY E	NGINEE	RING											
Progran Branch	nme &	B.E. & Mechanical Engineering	Sem.	Category	L	т	Ρ	Credit							
Prerequ	lisites	NIL	7	PE	3	0	0	3							
	l														
Preambl	le	The course deals with basic concepts of quality, various tools customer satisfaction of the product. It also deals with concepts of	and teo reliability	chniques invo and its impr	olvec oven	l in i nent	impro techr	iques.							
Unit – I		Introduction						9							
Definitio Quality	on of Quali Assurance	ty - Basic Concept of Quality - Definition of Statistical Quality Cont -Quality Conttrol Quality Cost-Variation in Process- DMAIC Process.	rol (SQC	C) - Benefits	and	Limit	ation	of SQC-							
Unit – II		Process Control for Variables and Attributes						9							
Theory of Control Chart- Uses of Control Chart – Control Chart for Variables – X chart - R chart and σ chart -Process Capability – Process Capability Studies and Simple Problems- Control Chart for Attributes –Control Chart for Non-Conformities– p Chart - np Chart – C and U charts - State of Control and Process Out of Control Identification in charts - Pattern Study															
Unit – II	Unit - III       Acceptance Sampling         Lot-by-Lot Sampling - Types - Probability of Acceptance in Single - Double - Multiple Sampling Techniques - Producer's Risk														
Unit - III         Acceptance Sampling         9           Lot-by-Lot Sampling – Types – Probability of Acceptance in Single - Double - Multiple Sampling Techniques – Producer's Risk and Consumer's Risk. (Acceptable Quality Limit) AQL - Lot Tolerance Percent Defective (LTPD) - Average Outgoing Quality Limit (AOQL) Concepts-Standard Sampling Plans for AQL and LTPD - Uses of Standard Sampling Plans.         9															
Unit – IV     Reliability Engineering     9															
Life Tes	sting – Obje	ective – Failure Data Analysis- Mean Failure Rate- Mean Time to Fai	ilure- Me	an Time Bet	weer	Fail	ure- l	Hazard							
Models Availabi	– Weibull I ility –Simpl	Model- System Reliability Series - Parallel and Mixed Configuration - e Problems- Acceptance Sampling Based on Reliability Test – Operation of the state of the series	<ul> <li>Simple ating Ch</li> </ul>	Problems. N aracteristic (0	lainta D.C)	ainab Curv	ility a es.	ind							
Unit – V	1	Reliability Improvements						9							
Reliabilit –Optimiz	ty Improve zation in R	ments Techniques- Use of Pareto Analysis – Design for Reliability – eliability – Reliability cost – Trade off.	Unit Red	dundancy an	d Sta	Indby	/ Red	lundancy							
								Total:45							
TEXT B	OOKS:														
1.	Douglas.C I,II,III.	. Montgomery, "Introduction to Statistical Quality Control", 8th Editic	on, John	Wiley, United	d Sta	tes, i	2019	for Units							
2.	Srinath L.S	S, "Reliability Engineering", 4 <sup>th</sup> Edition, Affiliated East West Press, 20	)16 for U	Inits IV,V.											
REFERE	ENCES:														
1.	Robert Ja	mes Oakland, John S Oakland, "Statistical Process Control", 7 <sup>th</sup> Edit	tion, Tay	lor & Francis	, 201	8.									
2.	Patrick O'	Connor and Andre Kleyner, "Practical Reliability Engineering", 5th E	dition , V	Viley , 2011.											

COURS	SE O	UTCO	MES:	e student	s will be	able to							()	BT Map	oed evel)
CO1	defi	ine qua	ality concepts	and expl	lain qual	lity assu	irance p	rocess						Inderstan (K2)	ding
CO2	use	contro	ol chars for se	olving pro	cess co	ntrol pro	blems							Applying(	K3)
CO3	apply sampling techniques by considering producers and consumers risk														K3)
CO4	4 construct a reliability model and perform failure data analysis													Applying(	K3)
CO5	CO5 explain the reliability improvement techniques													Applying(	K3)
					Ма	apping	of COs	with PC	Os and	PSOs					
COs/Po	os	PO1	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2

COS/Pos	PUT	P02	P03	P04	PU5	P06	P07	P08	P09	P010	POTT	PUIZ	P501	P502
CO1	3	2			2								2	3
CO2	2		3								2	1		3
CO3	3	1			2						2	1	2	3
CO4	1	2	3								2			3
CO5	3	2									2			3

1 - Slight, 2 - Moderate, 3 - Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY													
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %						
CAT1	20	50	30				100						
CAT2	20	30	50				100						
CAT3	20	30	50				100						
ESE 20 30 50 100													
* ±3% may be varied (CAT	1, 2 & 3 – 50 mark	(s & ESE – 100 ma	rks)										

		22MEE31 - MULTI – VARIATE ARTIFICIAL INTELLIGE	NCE DA	TA ANALYS	SIS										
Program & Branch	me າ	BE & Mechanical Engineering	Sem.	Category	L	т	Ρ	Credit							
Prerequi	sites	Nil	7	PE	3	0	0	3							
Preamble	;	This course aims to data reduction or simplify the process withou	it compro	omising the va	aluat	ole info	rmatio	on.							
Unit – I		REGRESSION						9							
Simple F Correlatio Case Stu	Regresson Ana Idies.	sion and Correlation – Estimation using the Regression Line, Ilysis –Multiple Regression Equation, Modelling Techniques, Maki	Correla ing Infer	ition Analysis ences about	s, M the I	ultiple Popula	Regre tion P	ession and arameters-							
Unit – II		MULTIVARIATE METHODS						9							
An overvi	ew of I	Multivariate Methods, Multivariate Normal Distribution, Eigen Value	es and E	igen Vectors	with	AI – C	ase S	tudies.							
Unit – III	FACTOR ANALYSIS         9           Component Analysis – Objectives, Estimation of Principal Components, Testing for Independence of Variables, Eactor         9														
Principal Component Analysis – Objectives, Estimation of Principal Components, Testing for Independence of Variables, Factor Analysis Model – Factor Analysis Equations and Solution – Al Exploratory Factor Analysis – Confirmatory Factor Analysis- Case Studies.															
Unit – IV		DISCRIMINANT ANALYSIS						9							
Discrimin Modelling	ant An I (SEM	alysis – Discrimination for Two Multivariate Normal Populations – I ) - Case Studies.	Discrimir	nant Function	s – S	Structu	red Eo	quation							
Unit – V		CLUSTER ANALYSIS						9							
Cluster an Artificial In	nalysis ntellige	G – Concept development – Necessity – Decision Process – Steps ence Applications.	s – Illust	trative Examp	oles a	and Ca	ases -	- Advanced							
								Total:45							
ТЕХТ ВО	OK:														
1.	Dallas	E Johnson, Applied Multivariate methods for data analysis, Duxbu	ry Press	, 2018.											
REFERE	NCES:														
1. ,	Joseph	n F. Hair, Jr. William C. Black Barry J. Babin, Rolph E. Anderson, N	Aultivaria	ate Data Anal	ysis,	Pears	on Ed	ition, 2019.							
2.	Richar	d I Levin, Statistics for Management, PHI, 2011.													

COURS On com	E OUTO	COME of the	ES: course	, the stud	lents w	ill be able	e to							BT Maj (Highest	oped Level)
CO1	infer th	he pa	ramete	rs which	used in	regressi	on analy	/sis						Understar	ding (K2)
CO2	select	appro	opriate	methods	for diffe	erent dat	a type							Understar	ding (K2)
CO3	interpr	ret the	e result	s of facto	r analys	sis and m	nake deo	cision						Understar	ding (K2)
CO4	exami	ne the	e real w	vorld data	set an	d make o	decision	s in vari	ous er	ngineerin	g applic	ations		Analyzing	g (K4)
CO5	sort ar	nd gro	oup 'sin	nilar' obje	cts or v	variables	are crea	ated, ba	sed up	oon mea	sured ch	aracteristics	s.	Analyzing	g (K4)
Mapping of COs with POs and PSOs															
COs/PC	Os         PO1         PO2         PO3         PO4         PO5         PO6         PO7         PO8         PO9         PO10         PO11												PO12	PSO1	PSO2
CO1	3	3	2		1										3
CO2	3	3	2		1										3
CO3	2	2	3		1										3
CO4	2	2	3		1	1								1	3
CO5	2	2	3		1	1								1	3
1 – Sligł	nt, 2 – N	lodera	ate, 3 -	Substan	tial, BT	- Bloom'	s Taxon	omy							
						ASSE	SSMEN	Τ ΡΑΤΤ	ERN -	THEOR	Y				
Test Ca	/ Bloom tegory*	n's	Rei	memberi (K1) %	ng l	Jndersta (K2)	anding %	Apply (K3)	ving %	Analyz (K4) 9	ing l %	Evaluating (K5) %	Crea (K6	ating 6) %	Total %
	CAT1			25		35		40	)						100
(	CAT2			20		35		45	5						100
(	CAT3			20		25		35	5	20					100
	ESE			20		25		30	)	25					100
* ±3% m	ay be v	aried	(CAT 1	, 2 & 3 –	50 mai	rks & ES	E – 100	marks)						<u> </u>	

		22MEE32 - HYBRID VEHICLE TECHNOL	OGY										
Progra Branch	mme &	BE & Mechanical Engineering	Sem.	Category	L	т	Ρ	Credit					
Prereq	uisites	Nil	7	PE	3	0	0	3					
					1								
Preamb	ble	This course provides the basic knowledge on the components of h storage and simulation models of driving cycles.	ybrid vel	hicles, modeli	ing f	unda	menta	als, energy					
Unit – I		Introduction and Components of Hybrid Vehicles						9					
Introdu Compo Transm	iction: G onents of hission Sy	eneral Architectures - Vehicle System Components and Analysis - C f Hybrid Vehicles: Prime Mover - Electric Motor with DC/DC Cor /stem in Hybrid Vehicle.	controls on verter a	of Hybrid Veh Ind Inverter -	icle Ene	ergy	Stora	ge System					
Unit – I	I	Hybrid Vehicles System Modeling						9					
Modelir Body –	ng - Inter PID-Base	rnal Combustion Engine - Electric Motor- Battery System - Transmis ed Driver Model.	sion Sys	stem - Final D	Drive	and	Whee	el - Vehicle					
Unit – I	II	Power Electronics and Electric Motor Drives						9					
Unit - III         Power Electronics and Electric Motor Drives         9           Power Electronics: Power Electronic Devices- DC/DC Converter - DC–AC Inverters         Electric Motor Drives: BLDC Motor and Control - AC Induction Motor and Control - Plug-In Battery Charger Design - Plug-in Hybrid Vehicle Battery System and Charging Characteristics.         9													
Unit – I	V	Energy Storages System Modeling and Control						9					
Method Estimat	ls of Det tion of Ce	ermining State of Charge- Estimation of Battery Power Availabilit Il Core Temperature - Battery System Efficiency.	ty - Batt	ery Life Prec	lictio	n - (	Cell B	alancing -					
Unit – V	/	Simulation of Driving Cycles						9					
Simulat Emissic	ion Syste	m - Typical Test -Driving Cycles - Preliminary Sizing of Main Compo lectric Mileage Calculations.	onents of	Hybrid Vehic	le -	Fuel	Econo	omy -					
								Total:45					
TEXT B	BOOK:												
1.	Wei Liu,	" Hybrid Vehicle System Modeling and Control", 2 <sup>nd</sup> Edition, John W	/iley & S	ons, Inc., Nev	v Jei	sey,	2017.						
REFER	ENCES:												
1.	lqbal Hu	sain, "Electric and Hybrid Vehicles", 3 <sup>rd</sup> Edition, CRC Press, Boca R	aton, 20	21.									
2.	Mehrdao 2 <sup>nd</sup> Editio	d Ehsani, YiminGao,Stefano Longo, Kambiz Ebrahimi, "Modern Elec on, CRC Press, Boca Raton, 2018.	tric, Hyb	rid Electric ar	nd Fi	uel C	ell Ve	hicles ",					

COURS On com	SE OL	JTCOM on of the	IES: e course	, the stude	ents w	ill be able	to						(H	BT Mappe lighest Le	ed vel)
CO1	sum	marize	about th	ne layout a	ind su	o systems	of hybr	id vehic	les				Und	erstanding	(K2)
CO2	mod	lel the l	nybrid ve	hicle syste	em us	ng variou	s syster	n compo	onents	;			ŀ	Applying(K	3)
CO3	clas	sify and	d explain	electronic	c devid	es and m	otor driv	/es					Und	erstanding	(K2)
CO4	iden	ntify the	parame	ters influe	ncing	he energy	/ storage	e Systei	ns				A	Applying(K	3)
CO5	infei	r the re	sults fror	n simulatio	on of c	lriving cyc	les						A	Applying(K	3)
Manning of COs with POs and PSOs															
COs/P	Mapping of COs with POs and PSOs           COs/POs         PO1         PO2         PO3         PO4         PO5         PO6         PO7         PO8         PO9         PO10         PO11         PO12         PS01         PS02														
CO1	1	3	2	1											3
CO2	2	3	2	1											3
CO3	3	3	2	1											3
CO4	1	3	2	1											3
CO5	5	3	2	1											3
1 – Slig	ht, 2 -	– Mode	rate, 3 -	Substant	ial, BT	- Bloom's	Taxono	my							
Tee						ASSES	SMENT		ERN -	THEORY	/ 			and in a	Tatal
C	atego	ory*	RE	(K1) %	ng	(K2)	%	(K3)	%	(K4)	mg i %	(K5) %		(K6) %	10tai %
	CAT	1		20		50		30	)						100
	CAT	2		20		50		30	)						100
	CAT	3		20		50		30	)						100
	ESE			20		40		40	)						100
* ±3% r	may b	e varie	d (CAT 1	, 2 & 3 – 5	50 ma	rks & ESE	– 100 r	marks)							

		22MEE33 - INTRODUCTION TO AIRCRAFT S	SYSTEM	S											
Progra Branch	mme & N	BE & Mechanical Engineering	Sem.	Category	L	т	Ρ	Credit							
Prereq	uisites	Fluid Mechanics and Hydraulic Machines	7	PE	3	0	0	3							
Preamb	ble	This course provides knowledge on various aircraft systems, basi	ic princip	oles of flight a	nd ai	rcraft	perfor	mance.							
Unit – I		Introduction to Aircrafts						9							
Basic ( Devices Plant L Configu these C	Component s - Types location- M urations-Bip Configuratic	ts of an Aircraft- Structural Members - Aircraft Axis System - A of Aircrafts - Lighter than Air/Heavier than Air - Aircrafts Conven /ing Vertical Location- Intake Location- Tail Unit Arrangements- olane- Variable Sweep- Canard Layout- Twin Boom Layouts- Spa ons.	ircraft M Itional D Landing In Loade	otions- Contr esign Configu g Gear Arrang ers- Advantag	ol S uratio geme es a	urfac ons B ents- nd D	es and ased c Uncon isadvai	High lift on Power ventional ntages of							
Unit –	Unit – II         Aircraft Systems         9           Aircraft Systems - Types of Aircraft Systems - Mechanical Systems-Engine Control System- Fuel System- Hydraulic System- Electrical Systems         Fuel System- Fuel System- Hydraulic System-														
Aircraft Electric	Aircraft Systems - Types of Aircraft Systems - Mechanical Systems-Engine Control System- Fuel System- Hydraulic System-         Electrical Systems- Electronic and Avionics Systems.         Jnit – III       Basic Principles of Flight         9														
Unit – I	cal Systems- Electronic and Avionics Systems.           III         Basic Principles of Flight         9           foil Nomenclature- Types of Aero foil- Wing Section- Aerodynamic Center - Aspect Ratio- Significance of Speed of Sound- Air														
Onit - III       Basic Frinciples of Flight       9         Aero foil Nomenclature- Types of Aero foil- Wing Section- Aerodynamic Center - Aspect Ratio- Significance of Speed of Sound- Air         Speed and Ground Speed- Properties of Atmosphere- Lifting surfaces-Lift and Drag- Angle of Attack- Pressure Distribution Over a         Wing Section- Centre of Pressure and its Effects- Generation of Lift- Drag- Pitching Moments- Types of Drag- Lift Curve- Drag         Curve- Lift/Drag Ratio Curve- Factors Affecting Lift and Drag.         Unit - IV       Stability and Control															
Stability Gliding	and Cont and Turnir	rol: Degree of Stability- Lateral, Longitudinal and Directional Stabili	ty- Cont	rols of Aircraf	t- Ta	xying	– Lano	ding -							
Unit – Y	V	Aircraft Performance and Maneuvers						9							
Taking Effects Incorre	off- Climbin of Weight ct Angles c	ng- Power Curves- Maximum and Minimum Speeds of Horizontal F on Performance- Effects of Altitude on Power Curves- Forces actir f Bank- Aerobatics- Inverted Maneuvers- Maneuverability.	Flight- Ef ig on an	fects of Char Aero plane D	iges uring	of En g a Ti	gine Po urn- Co	ower and rrect and							
								Total:45							
TEXT E	BOOK:														
1.	Kermode	A.C, "Mechanics of Flight", 11th Edition, Pearson Education, New I	Delhi, 20	06.											
REFER	ENCES:														
1.	Shevell, F	Richard S "Fundamentals of Flight", 2 <sup>nd</sup> Edition, Pearson Education	, New D	elhi, 2004.											
2.	John Dav	id Anderson, "Introduction to Flight", McGraw-Hill Higher Education	n, New D	elhi, 2005.											
3.	lan Moir internatio	& Allan Seabridge, "Aircraft Systems: Mechanical - Electrical anal, England, 2011.	and Avio	onics Subsys	tems	s Inte	gratior	n", Willey							

COUR: On con	SE OU	JTCOM	IES: e course	, the stude	ents wi	ll be able	to						(Н	BT Mappe ighest Lev	d vel)
CO1	ident	tify the	various	aircrafts c	ompon	ents and	its types	5					Unde	erstanding	(K2)
CO2	desc	ribe va	rious air	craft syste	ms an	d its funct	ioning						Unde	erstanding	(K2)
CO3	demo	onstrate	e the flig	ht mechai	nics ar	d infer the	e princip	les					A	pplying (K	3)
CO4	illust	rate the	e stability	/ and cont	rol of a	aircrafts w	ith vario	us actu	ation n	nechanis	ms		A	pplying (K	3)
CO5	inves cond	stigate lition	the perfo	ormance a	nd cor	ntrol of vai	rious aire	crafts w	ith res	pect to v	arious w	orking	A	pplying (K	3)
Mapping of COs with POs and PSOs															
COs/F	Os/POs         PO1         PO2         PO3         PO4         PO5         PO6         PO7         PO8         PO9         PO10													PSO1	PSO2
CO	1	3													3
CO	2	3													3
CO	3	3	2	1											3
CO	4	3	2	1											3
CO	5	3	2	1											3
1 – Slig	ght, 2 -	– Mode	erate, 3 -	Substant	ial, BT	- Bloom's	Taxono	my							
						ASSES	SMENT	PATTE	ERN - T	THEOR	,				
Tes C	t / Blo atego	oom's ory*	Re	ememberi (K1) %	ng	Understa (K2)	anding %	Apply (K3)	ving %	Analyz (K4) S	ing l %	Evaluating (K5) %	g C	reating (K6) %	Total %
	CAT1	1		30		70									100
CAT2 20 50 30														100	
	CAT	3		20		50		30	)						100
	ESE			10		50		40	)						100
* ±3%	may be	e varie	d (CAT 1	, 2 & 3 –	50 mai	'ks & ESE	– 100 r	marks)			1				

		22MEE34 - MECHATRONICS AND	ΙΟΤ											
Programr Branch	me &	BE & Mechanical Engineering	Sem.	Category	L	т	Ρ	Credit						
Prerequis	sites	Nil	7	PE	3	0	0	3						
Preamble	<b>)</b>	This course provides the importance of sensors, actuators, control sindustrial automation System.	systems, c	controllers and	loT (	comp	onent	s involved in						
Unit – I		Automation and Mechanical Measurements						9						
Automatic Advanced Mechanica	on: Auto d Automa al Measu	mation in Production System - Principles and Strategies of Autom ation Functions - Levels of Automations. urements: Measurement of Displacement - Velocity - Force - Strain -	nation - B · Tempera	asic Elements ture - Pressure	sofa ə – Fl	n Au ow.	tomat	ed System -						
Unit – II	(	Control System						9						
Open Loo System –	op and ( Proporti	Closed Loop Control - Block Diagrams - Transfer Functions - Lap onal Integral (PI) and Proportional Integral Derivative (PID) Controlle	place Tran ers.	isforms - Matl	hema	tical	Mode	I of Physical						
Unit – III		Microprocessor and Its Interfacing						9						
Organization of 8085 – Addressing Modes – Instruction Set – Simple Programs involving Logical - Branch/Call - Sorting - Evaluating Arithmetic Expressions and String Manipulation Instructions - A/D and D/A Converters.														
Unit – IV         Programmable Logic Controller (PLC)         9														
Introduction	on - Arch grammin	hitecture of PLC – I/O Modules – Distributed I/O Modules – Progran og - Math Instructions - Logical Instructions - Timer and Counter – Se	nming of F election of	PLC - Convers PLC.	ion o	f Rela	ay Lo	gic to Ladder						
Unit – V		IoT and Machine Learning						9						
loT: Defini between le	hition – ( IoT and I	Characteristics – Physical Design – Logical Design – Functic M2M IoT applications and case studies IoT applications and case stu	onal Block udies Over	. Machine to N view of machi	Nachi ne lea	ne(M arning	2M) · g	– Difference						
								Total:45						
TEXT BO	OKS:													
1.	Bolton V	N., "Mechatronics: A Multidisciplinary Approach", 4th Edition, Pearso	n Educatio	on, UK, 2016 f	or Un	it I.								
2.	Nagoor	Kani.A., "Control Systems" 3rd Edition, RBA Publication, Chennai, 20	017 for Ur	it II.										
3.	Ramesł Internat	n Gaonkak., "Microprocessor Architecture, Programming and A ional Publishers, New Delhi, 2013 for Unit III.	Application	is with the 8	085"	6 <sup>th</sup> 1	Editio	n, New Age						
4.	Frank D	D.Petruzella., "Programmable Logic Controllers" 5 <sup>th</sup> Edition, Mc Graw	v Hill, Nev	v Delhi, 2019 f	or Ur	nit IV.								
5.	Vijay Ma 2015 fo	adisetti, Arshdeep Bahga, "Internet of Things: A Hands-On Approac r Unit V.	h", 1 <sup>st</sup> Edi	tion, Orient Bla	acksw	an P	vt. Lto	l., New Delhi						
REFEREN	NCES/ N	IANUAL / SOFTWARE:												
1.	Francis	H. Raven, "Automatic Control Engineering", 5th Edition, McGraw-Hill	I, New De	hi, 2018.										

COURSE On comple	OUTCOM etion of th	<b>IES:</b> le course	e, the stu	dents w	ill be able	e to							BT (Higł	Mapped nest Level)
CO1	identify th	ne suitat	ole senso	rs base	d on the f	functiona	al requir	ement	in indust	rial auto	mation syste	em	Арр	lying (K3)
CO2	apply kno	owledge	about the	e differe	nt forms	of contro	ol syster	n in rea	al time in	terfacin	9		Арр	lying (K3)
CO3	develop t	he prog	ramming	and inte	erfacing c	of 8085 n	nicropro	cessor	and for	automa	tic system d	lesign	Арр	lying (K3)
CO4	develop t	he vario	us progra	ammes	using pro	gramma	ble logi	c contr	oller.				Арр	lying (K3)
CO5	present t	he conc	epts of in	ternet o	f things a	nd mach	nine leai	rning					Unders	standing (K2)
					Ма	pping o	f COs v	vith PC	)s and P	SOs				
COs/POs	POS PO1 PO2 PO3 PO4 PO5 PO6 PO7 PO8 PO9 PO10 PO11 I													PSO2
CO1	3				3								3	
CO2	1		2		3								3	
CO3			2		3								3	
CO4			2		3								3	
CO5	1		2		3								3	
1 – Slight,	2 – Mode	erate, 3	<ul> <li>Substar</li> </ul>	ntial, BT	- Bloom'	s Taxon	omy							
					AS	SESSM	ENT PA	TTER	N – THE	ORY				
Test / I Cate	Bloom's gory*	Re	member (K1) %	ing l	Jndersta (K2)	nding %	Apply (K3)	/ing %	Analyzi (K4) 9	ing E %	Evaluating (K5) %	Crea (K6	iting ) %	Total %
CA	AT1		20		40		40	)						100
CA	\T2		20		40		40	)						100
CA	<b>\T</b> 3		20		50		30	)						100
E	SE		20		40		40	)						100
* ±3% ma	y be varie	d (CAT	1,23-	50 mark	s & ESE	– 100 m	narks)							

	22MEE35 - MODELING AND ANALYSIS OF MANUFAC	CTURING	SYSTEMS												
Programme & Branch	BE & Mechanical Engineering	Sem.	Category	L	т	Ρ	Credit								
Prerequisites	Manufacturing Technology, CAD/CAM/CIM for Automation	7	PE	3	0	0	3								
						1									
Preamble	This course provides the knowledge on design and analysis method quality related performance measures in manufacturing systems.	lologies fo	or the purpose	e of co	nputir	ng qu	antity and								
Unit – I	Manufacturing Systems and Models						9								
Types and Princ Uses of Model -	ciples of Manufacturing Systems - Types and uses of Manufacturing N Model Building.	Nodels - F	Physical Mode	els - M	athem	atica	I Models -								
Unit – II	Material Flow Systems						9								
Assembly Lines - Reliable Serial Systems - Approaches to Line Balancing - Sequencing - Mixed Models. Transfer Lines and General Serial Systems - Paced Lines without Buffers - Unpaced Lines. Shop Scheduling with many Products.															
Unit – III	Material Flow on Flexible Manufacturing Systems (FMS)         9														
FMS - System Components - Planning and Control. Group Technology - Assigning Machines to Groups - Assigning Parts to Machines. Facility Layout - Quadratic Assignments Problem Approach - Graphic Theoretic Approach.															
Unit – IV     Supporting Components     9															
Machine Setup AGV Systems. V	and Operation Sequencing - Integrated Assignment and Sequencing. Narehousing - Storage and Retrieval Systems - Order Picking.	Material I	Handling Sys	tems –	Conv	eyor	Analysis -								
Unit – V	Generic Modeling Approaches						9								
Analytical Queu Process Models	ing Models - A Single Workstation - Open Networks - Closed Networ - Simulation System - Example Manufacturing System.	ks. Empir	rical Simulation	on Moc	els - I	Event	t Models -								
							Total:45								
TEXT BOOK:															
1. Rona Sons	ld G. Askin, and Charles R. Standridge, "Modeling and Analysis of M NewYork,1993.	lanufactur	ing Systems	', 1 <sup>st</sup> E	dition	, Joh	n Wiley &								
REFERENCES:															
1. Meng Scien	chu Zhou, "Modeling, Simulation, and Control of Flexible Manufa tific Publishing Co. Pvt. Ltd., 2000.	cturing S	ystems: A P	etri Ne	et App	oroac	h", World								
2. Groov 2016	ver, Mikell P., "Automation, Production Systems, and Computer-Inte	grated M	anufacturing"	, Pear	son E	ducat	tion India,								

COURSE On comp	E OU	TCOME n of the	E <b>S:</b> cours	e, the stud	lents will	be able t	to							BT Map (Highest I	ped _evel)
CO1	sur	nmarize	e the ty	/pe of mar	nufacturii	ng systen	ns and m	odels					U	nderstand	ing (K2)
CO2	der	monstra	ite the	assembly	lines, tra	ansfer line	es and sh	op scheo	duling					Applying	(K3)
CO3	infe	er the m	ateria	flow syste	ems in F	MS and v	arious fa	cility layc	out				Ui	nderstand	ing (K2)
CO4	des	scribe th	ne mat	erial flow	supportir	ng compo	nents thr	ough mu	ltiple wo	ork statior	).		Ui	nderstand	ing (K2)
CO5	Sin	nulate tł	he seq	uence of v	vorkflow	using ge	neric mo	deling ap	proach					Applying	(K3)
Manning of COs with POs and PSOs															
COs/PC	Mapping of COs with POs and PSOs           COs/POs         PO1         PO3         PO4         PO5         PO6         PO7         PO8         PO9         PO10         PO11         PO12         PS01         PS02														
CO1		3	2	1										3	
CO2		3	2	1											3
CO3		3	2	1											3
CO4		3	2	1											3
CO5		3	2	1											3
1 – Sligh	ıt, 2 –	Moder	ate, 3	– Substan	tial, BT-	Bloom's	Taxonom	у			1	1	1	<u> </u>	
						ASSE	SSMENT	PATTE	RN - TH	IEORY					
Test Ca	t / Blo atego	oom's ory*		Remembe ng (K1) %	eri L %	Indersta (K2) 9	nding %	Apply (K3)	ing %	Analyzi (K4) %	ng ‰	Evaluati (K5) %	ng (	Creating (K6) %	Total %
	CAT	1		40		40		20							100
	CAT	2		40		40		20							100
	CAT	3		40		40		20							100
	ESE	Ξ		30		40		30							100
* ±3% m	ay be	e varied	(CAT	1, 2 & 3 -	50 mark	s & ESE	– 100 ma	arks)							

22MEE36 - MICRO ELECTRO MECHANICAL SYSTEMS														
Programm & Branch	BE & Mechanical Engineering	Sem.	Category	L	т	Р	Credit							
Prerequisi	Physics for Mechanical Engineering, Engineering Mechanics	7	PE	3	0	0	3							
Preamble	This course provides introduction to the basic concepts of sensors introduces the phenomenon of fabrication, manufacturing and students to design and develop a micro product for various applica	, actuato packagi tions.	ors and scalin ing of micro	ig lav Sys	vs of stems	micro s s. It far	ystem. It niliarizes							
Unit – I	Microsystems						9							
Microsystems: Overview-Microsystems - Working Principle of Microsystems - Scaling Laws - Scaling in Geometry - Scaling in Rigid Body Dynamics - Scaling in Electrostatic Forces - Scaling in Electricity - Scaling in Fluid Mechanics - Scaling in Heat Transfer.														
Unit – II Micro sensors and Actuators														
Micro sensors and Actuators: Micro Sensors - Micro Actuation Techniques - Micro Pump - Micro Motors - Micro Valves - M Grippers - Micro Accelerometers.														
Unit – III Micro System Fabrication														
Micro System Fabrication: Substrates - Single Crystal Silicon Wafer Formation - MEMS Materials - Photolithography - Ion Implantation - Diffusion – Oxidation – Chemical Vapour Deposition (CVD) - Physical Vapor Deposition - Deposition by Epitaxy - Etching Process.														
Unit – IV	Micro System Manufacturing and Design						9							
Micro Syst Abforming Device Lev	em Manufacturing and Design: Bulk Micro Manufacturing - Surface Mi (LIGA) – Stepped Lithographic Galvano Forming Abforming (SLIGA). M el - System Level - Packaging Techniques - Surface Bonding - Wire Bon	cromach icro Sysi ding - Se	ining – Litho tem Packagir ealing - Desig	grap ng - I In Cc	hic G Mater Inside	alvano ials - D erations	Forming ie level -							
Unit – V	Micro System Applications						9							
Micro Syste	m Applications: Automotive - Bio medical - Aerospace - Telecommunica	tion.												
							Total:45							
TEXT BOO	К:													
1. Tai	Ran Hsu., "MEMS and Microsystems: Design and Manufacture", 2 <sup>nd</sup> Ed	ition, Joh	n Wiley and	Sons	, Nev	v York,	2017.							
REFEREN	CES:													
1. Ma	arc Madou., "Fundamentals of Micro fabrication", 2 <sup>nd</sup> Edition, CRC press,	New Yo	rk, 2011.											
2. Zh IS	ang, Dan, Wei & Bin (Eds.), "Advanced Mechatronics and MEMS Device 3N -978-3-319-32178-3.	es", Sprin	nger, 2017.											

COUR: On con	SE OU	TCOM on of the	ES: e course	, the stude	ents wi	ll be able	to							(1	BT Mapp Highest L	ed evel)
CO1	expre	ess sca	ling law	s of micro	syster	n.									Applying(I	<3)
CO2	interp	oret the	concep	ts of micro	sens	ors and m	icro acti	uators.						Un	derstandir	ng (K2)
CO3	expla	ain the l	fabricatio	on proces	s of mi	crosystem	٦.								Applying(I	<b>〈</b> 3)
CO4	desc	ribe the	e micro r	nachining	proce	ss and pa	ckaging								Applying(I	<3)
CO5	Interp	pret the	e applica	tions of m	nicro s	ystem for	various	industri	es						Applying(I	<3)
Manning of COs with POs and PSOs																
COs/F	Iapping of COs with POs and PSOs           COs/Pos         PO1         PO2         PO3         PO4         PO5         PO6         PO7         PO8         PO9         PO10         PO11         PO12         PSO1         PSO2															
CO	1	3		3		2									3	
CO2	2	3				2									3	3
COS	3	3		3		1										3
CO4	4	3		3												3
COS	5	3				2									3	3
1 – Slig	ght, 2 -	- Mode	rate, 3 -	Substant	ial, BT	- Bloom's	Taxono	my								
						46666	OMENIT				,					
Tes	t / Blo	om's	Re	memberi	na	ASSES Understa	andina		- NN-		ina	Evaluating	n l	C	reating	Total
C	atego	ry*		(K1) %		(K2)	%	(K3)	%	(K4) 9	%	(K5) %	9	(	K6) %	%
	CAT1			20		40		40	)							100
	CAT2	2		20		40		40	)							100
	CAT	3		20		40		40	)							100
	ESE			20		40		40	)							100
* ±3% ı	may be	e varied	d (CAT 1	, 2 & 3 – 9	50 mai	ks & ESE	– 100 r	marks)								

		22MEE37 - REFRIGERATION AND AIR COND	ITIONIN	IG				
(Use	of Approve	ed Steam Table, Refrigeration and Air-Conditioning Data Book are	permitte	d in the End	Sem	lester	Exam	nination)
Progra Branch	mme & 1	BE & Mechanical Engineering	Sem.	Category	L	т	Ρ	Credit
Prereq	uisites	Engineering Thermodynamics, Thermal Engineering	7	PE	3	0	0	3
Pream	ble	This course imparts knowledge on the working cycles of refr conditioning systems. The method of selection of refrigerants covered through this course	igeratior and usa	n and the pr age of psych	roce	sses etric	involv charts	red in air- s are also
Unit –		Review of Fundamentals and Refrigeration Cycles						9
Review Conditi Compr	of Fundai on for Max ession Ref	mentals: First and Second Laws of Thermodynamics - Heat Engir kimum COP - Ton of Refrigeration. Refrigeration Cycles: Revers rigeration Cycle – Superheating - Sub cooling – Multistage - Multi E	ne - Hea se Carno Evaporat	t Pump - Re ot Cycle -Bell or - Cascade	frige Co Sys	ratior Iemai stem.	n Syste n Cyc	ems-COP- le - Vapor
Unit –	I	Non-Conventional Refrigeration Systems						9
Vapou Jet Rei and Pu	r Absorptio frigeration - Ilse Tube R	n Refrigeration (VAR) System - Aqua Ammonia - LiBr Water Syster Thermoelectric Refrigeration - Thermionic Refrigeration - Ejector I refrigeration and its Application.	ems- CC Refrigera	DP Estimatior ation – Magne	n of etic l	VAR Refrig	Syster eratio	m - Steam n – Vortex
Unit –		Refrigerants and System Components						9
Refrige ODP. I System	erants: Clas Different Ty n Compone	ssification-Properties - Environmental Impact - Montreal / Kyoto F pes of Refrigeration Tools - Charging Unit - Recovery Unit - Vacuu ents: Compressor - Types - Capacity Control - Types of Evap	Protocols Im Pump orators a Defrosti	- Eco Friendos. and Condens	dly F sers	Refrig with	erants their	s – GWP - Functional
Unit –	IV	Psychrometry and Duct Design	Denosti	ig.				9
Psychr Psychr Method	ometry: Pr ometric Ca ds of Duct I	operties of Air-Psychrometric Processes - Sensible Cooling and Ilculations for Simple Air Conditioning System. Duct Design: Dyn Design - Fan Total Pressure - Fan Characteristics in Duct Systems	Heating- amic an	-Humidificationd Frictional	n a Pres	nd De sure	ehumi Drop	dification - in Ducts -
Unit –	V	Air Conditioning System						9
Require System System Calcula	ements of ( is - Air Ha i Controls - ations.	Comfort Air Conditioning – Summer - Winter Air Conditioning - Wo ndling Unit - Split - Ductable Split - Transport Air Conditioning Sy - Heating and Cooling load Calculations (Summer and Winter co	orking Pi ystems - onditions	rinciples - Ce Indoor Air C only) - Ener	ntra Quali gy E	lized ity - fficie	Air Co Air Co ncy R	onditioning onditioning atio (EER)
								Total:45
TEXT	BOOK:							
1.	Arora C.F	, "Refrigeration and Air Conditioning", $4^{th}$ Edition, Tata McGraw Hi	ill, New [	Delhi, 2020.				
REFER	RENCES:							
1.	Prasad M	lanohar., "Refrigeration and Air Conditioning", 3 <sup>rd</sup> Edition, New Age	e Interna	tional Pvt. Lto	d, Ne	ew De	elhi, 20	021
2.	Roy J. D	ossat. , "Principles of Refrigeration", $4^{th}$ Edition, Pearson Education	n Asia, N	ew Delhi, 200	)9			
3.	Ibrahim [	Dincer., " Refrigeration Systems and Applications", 3 <sup>rd</sup> Edition, John	Wiley a	and sons, Eng	land	d, 201	7.	

COUR: On con	SE O	UTCON on of the	IES: e cours	e, the stud	ents w	ill be able	to							BT Mapp (Highest L	oed .evel)
CO1	ana	lyze the	e therm	odynamic r	efriger	ation cycl	es.							Analyzing	(K4)
CO2	illus	strate th	e work	ng of non-o	conver	tional refr	igeratior	n syster	ns with	their pra	actical ap	oplications.		Applying (	K3)
CO3	illus con	strate th	e chara ts	cteristics o	f refrig	erants an	d explai	n the fu	nctions	s of refrig	peration s	system		Applying (	K3)
CO4	per svs	form ca tems	Iculatio	ns in psych	romet	ric proces	ses and	duct de	sign in	simple	air-condi	tioning		Applying (	K3)
CO5	calo sys	culate th tem	ne cool	ng load fo	r air-co	onditioning	g system	ns and	discus	s the typ	es of air	-conditioni	ng	Applying (	K3)
						Mappin	g of CO	s with	POs a	nd PSO	S				
COs/P	os	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO	1	3	2												3
CO2	2	3													3
CO	3	3		1			2								3
CO4	4	3	2												3
CO	5	3	2												3
1 – Slig	ght, 2	– Mode	erate, 3	- Substant	ial, BT	- Bloom's	Taxono	my					1		1
						ASSES	SMENT	PATTE	ERN - T	THEORY	(				
Tes C	t / Blo atego	oom's ory*	F	ememberi (K1) %	ing	Understa (K2)	anding %	Apply (K3)	ying %	Analyz (K4) 9	ing %	Evaluating (K5) %	y (	Creating (K6) %	Total %
	CAT	1		10		30	)	40	)	20					100
	CAT	2		20		40	)	40	)						100
	CAT	3		20		40	)	40	)						100
	ESE	1		10		40	)	40	)	10					100
* ±3% I	mav b	e varie	d (CAT	1.2&3-	50 ma	rks & ESE	E – 100 r	narks)							÷

		22MEE38 - ENERGY AUDITING AND MANAG	GEMEN <sup>.</sup>	Г				
Program & Bran	mme ch	BE & Mechanical Engineering	Sem.	Category	L	т	Р	Credit
Prerequ	uisites	Engineering Thermodynamics, Thermal Engineering, Heat and Mass Transfer	7	PE	3	0	0	3
Preamb	le	This course provides insights on energy conservation measures in energy monitoring procedures to be followed by Energy Managers	n therma in indust	I & electrical ries.	utilit	ies, e	energy	audit and
Unit – I		Energy Audit						9
Introduc Energy Implem PAT Cy	ction - T Manage entation cle.	ypes - Methodology-Energy Management-Definition and Objectives er- Top Management Commitment and Support for Energy Action - Utility Rate Structures- Portable and Online Instruments for Surve	s-Manag on Plan ey-Enerç	erial Functior ning-Manage gy Monitoring	ns ar men and	nd Re t Too I Tar	espon ols fo geting	sibilities of r Effective j - EMIS –
Unit – I	I	Energy Conservation and Water Management						9
Energy - Energ Applian	Conserv gy Efficie ces. Wa	vation: Introduction – Energy Conservation Programme (ENCON) - N ency - Development of Energy Balance - Energy Conservation in ter Management: Water Audit-Indoor and Outdoor Water Manageme	Veed for Domes ent.	Energy Cons tic Sector-St	erva anda	tion- ards	Enerç and L	gy Security abeling of
Unit – I	II	Energy Audit Applied to Buildings						9
Building and Ra New Bu	j Enveloj diant Ba ildings -	be Analysis- Internal Heat Gain - Thermal Comfort - Air Quality and Arriers -Energy Conservation Building Code (ECBC) and its Guidelin IOT in Building Energy Management - Indian Green Building Counci	Air Tight les - Sta I (IGBC)	ness -Therma r Rating - En – Rating Sys	al Ins ergy tem	ulatio Sav	on - R ing M	eflective easures in
Unit – I	V	Electrical System Audit						9
Load N Assess Source:	lanagen ment of s and La	nent - Power Factor - Efficiency Improvements-Harmonics- Sele Electric Motors and Variable Speed Drives-Energy Efficient Motor mp Types – Electronic Ballasts - Energy Saving Opportunities in Ligl	ection o rs- Light hting - C	f Electric Mo ing System A ase Study.	otor- Audit	Energ –Te	gy Pe rmino	erformance logy- Light
Unit – \	/	Energy Efficiency in Thermal Utilities						9
Perform Fans - E	ance As Blowers-	sessment of Thermodynamic Systems – Boilers –Furnaces – Compi Heat Exchangers.	ressors -	HVAC Syste	ms -	Wat	er Pu	mps -
								Total:45
TEXT B	00K:							
1.	Sonal D	Desai, "Handbook of Energy Audit", 1 <sup>st</sup> Edition, McGraw Hill Educatio	on, New	Delhi,2015 fo	r Un	its II,		
2.	"Guide Manage	Books (Volume - 1 to Volume - 4) for National Certification E ers", 4 <sup>th</sup> Edition, India, 2015 for Units I, IV,V	Examinat	ion for Ener	gy A	Audito	ors ar	nd Energy
REFER	ENCES:							
1.	Albert - 2013.	Thumann, Terry Niehus &,William J. Younger, "Handbook of Energy	Audits",	9 <sup>th</sup> Edition, F	airm	iont F	Press,	Lilburn,
2.	Stephe York, 2	n A. Roosa, Steve Doty &Wayne C. Turner, "Energy Management H 018	andbool	x", 9 <sup>th</sup> Edition	, Riv	er Pu	ublishe	ers, New

COURS On com	SE OL	JTCON on of the	IES: e course	e, the stude	ents wi	ll be able	to						(۲	BT Mappe lighest Le	ed vel)
CO1	expl	lain the	energy	audit proc	edures	and usa	ge of En	ergy Au	ıdit Ins	truments	5.		Und	erstanding	(K2)
CO2	appl	ly the v	arious t	echniques	and sta	andards f	or energ	y conse	ervatio	n and wa	iste man	agement.	ŀ	Applying(K	3)
CO3	appl	ly the e	nergy a	nd green a	udit pr	nciples ir	n buildin	gs.					ļ	Applying(K	3)
CO4	expl	lain the	proced	ure for con	ducting	g electrica	al audit.						ŀ	Applying(K	3)
CO5	asse	ess the	perform	nance of th	ermal	utilities.							ŀ	Applying(K	3)
						Mappin	g of CO	s with	POs a	nd PSO	5				
COs/P	Os	PO1	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1		3		2		3					1	2	3
CO2	2	1	3				2	3					1		3
COS	3	1		3			2	3					1	3	
CO4	1	1	2	1			2	3					1	3	
COS	5	1	3	3			2	3					1	3	
	1		1		1		1				1	1			1
						ASSES	SMENT	PATTE	ERN -	THEORY	,				
Tes C	t / Blo atego	oom's ory*	R	ememberi (K1) %	ng	Understa (K2)	anding %	Apply (K3)	ying %	Analyz (K4) 9	ing %	Evaluating (K5) %		reating (K6) %	Total %
	CAT	1		30		40		30	)						100
	CAT	2		30		30		40	)						100
	CAT	3		30		30		40	)						100
	ESE			30		30		40	)						100
* ±3% r	nay b	e varie	d (CAT	1, 2 & 3 – 9	50 mar	ks & ESE	– 100 r	narks)			· ·				

	22MEE39 - MAINTENANCE EN	SINEERING					
Programn Branch	e & BE & Mechanical Engineering	Sem.	Category	L	т	Ρ	Credit
Prerequis	tes Nil	7	PE	3	0	0	3
Preamble	The course describes the industrial maintenance system w with the reliability of engineering components and its safety a	ith recent trend dopted in indus	s of maintena trial maintena	nce ao	ctivitie	s. It	also deals
Unit – I	Principles and Maintenance System Planning						9
Introductio Importanc Maintaina Rate.	n to Repair and Maintenance – Maintenance as Business – Obje and Benefits of Sound Maintenance Systems - Maintenance S ility – Inherent and Overall Availability – Mean Time Between Failu	ctives and Prin vstems – React res - Mean Tim	ciples of Plar ive - Preventi e to Repairs -	ned M ve or Mean	lainter Proac Down	tive \$ Time	e Activity - Systems – e - Hazard
Unit – II	Maintenance Techniques						9
Total Proc Seven Mc Acquisition Matrix.	uctive Maintenance (TPM) – Relationship between Overall Equipm dern Tools - Applications - Ladder of Maintenance Improvement - C for Effective Management of Computerized Maintenance Manage	ent Effectivenes computerized O ment System (	s (OEE) and ' nline Health M CMMS) - Log	World Ionitori ic Tree	Class ng of Anal	Main Mach ysis	ntenance – nine - Data - Criticality
Unit – III	Condition Based Maintenance						9
Condition and its An Methods -	Monitoring (CM) Techniques - Vibration Analysis – Ultrasonic Det alysis – Motor Condition Monitoring (MCM) - Cost Comparison with Temperature Sensitive Tapes – Pistol Thermometers – Wear-Debr	ection Techniqu and without CM s Analysis.	es - Thermog I - On-load Te	raph - sting a	Lubri nd off	cation - Lo	n Methods ad Testing
Unit – IV	Failure Analysis and Repair Methods of Basic Elemen	ts					9
Failure A Analysis - Analysis ( Repair M Equipmen	alysis: Defect/Failure Definition; Failure - Rate - Mode -Reporting Event Tree Analysis - Root Cause Analysis - Failure Mode and Eff MECA) - Electrical Stress Analysis – Failure of System and its Roo ethods: Sideways – Spindles – Gears - Lead Screws and Bearin Records – Job Order Systems.	- Date Collecti ect Analysis (FN Cause Analysi gs – Repair Me	on - Failure A 1EA) – Failure s. thods for Mat	nalysis Mode erial H	s - To , Effec andlin	ols - ct and ng Eq	Fault Tree d Criticality juipment –
Unit – V	Reliability Engineering and Safety in Maintenance						9
Reliability Curve. Sy Safety in Safety - C	Engineering: Definition - Failure Data - Failure Density - Failure Ra tem Reliability – Series - Parallel and Mixed Configuration – Reliab naintenance: Definition – Methods of Enhancing Safety – Moder ode and Standards - Hazards and its Management – Case Studies.	te - Mean Failu lity Increasing T n Industrial Sce	re Rate - Type echniques. narios - Safe	es of Fatty Tool	ailure: s – C	s - Fa Juant	ailure Rate
							Total:45
TEXT BO	K:						
1.	Srivastava S.K., "Maintenance Engineering (Principles - Practic New Delhi, 2021.	es and Manag	ement)", 2 <sup>nd</sup>	Edition	ı, S.	Char	nd & Co.,
REFEREN	CES:						
1.	Bhattacharya S.N., "Installation, Servicing and Maintenance", 2 <sup>nd</sup> E	lition, S. Chand	& Co., New D	elhi, 20	018.		
2.	Venkataraman.K., "Maintenance Engineering and Management", P	H Learning Pvt.	Ltd., New De	lhi, 201	2.		
3.	Srinath L.S., "Reliability Engineering", 1 <sup>st</sup> Edition, East-West Press	New Delhi, 201	6.				

COURSE On comp	E OU	TCOME n of the	E <b>S:</b> course,	the stud	ents will	be able t	0							BT Map (Highest I	ped _evel)
CO1	des	scribe th	ne princi	ples and	function	s of main	tenance	in industr	у.				U	nderstandi	ng (K2)
CO2	sel	ect and	implem	ent main	tenance	manager	nent syst	ems.						Applying	(K3)
CO3	cho	cose the	e approp	riate cor	ndition ba	ased mair	ntenance	system t	o enha	nce mach	ine life			Applying	(K3)
CO4	ana	alyse th	e variou	s failures	s and ide	ntify the	suitable r	epair me	thods					Analyzing	(K4)
CO5	Illu	strate th	ne functi	onal con	cepts of	reliability	and safe	ty engine	ering				U	nderstandi	ng (K2)
						Manni	ing of CC	)s with F	one and						
COs/PC	Ds	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		3		2											3
CO2		3	2	1		1								3	2
CO3		3	2	1		1								3	2
CO4		3	3	1										2	3
CO5		3	1	1										2	3
1 – Sligh	t, 2 –	- Moder	ate, 3 –	Substan	tial, BT-	Bloom's <sup>-</sup>	Taxonom	у							
/		<u> </u>	_			ASSE	SSMENT		RN - TH	IEORY					
Test / Cate	egory	om′s y*	Reme	embering (1) %	g U	nderstai (K2) %	naing %	Apply (K3)	ing %	Analyzi (K4) %	ng %	Evaluatii (K5) %	ng v	(K6) %	l otal %
C	AT1			20		40		40							100
C	AT2			20		40		40							100
C	AT3			20		25		35		20					100
E	SE			15		40		35		10					100
* ±3% m	ay be	e varied	(CAT 1,	2&3-	50 mark	s & ESE	– 100 ma	arks)							

		22MEE40 - INDUSTRIAL SAFETY ENG	INEERIN	IG				
Program & Branc	nme h	BE & Mechanical Engineering	Sem.	Category	L	т	Р	Credit
Prerequi	isites	Nil	7	PE	3	0	0	3
	I			I				
Preamble	e	The course explores the awareness and knowledge on safety in the industry while performing various types of operations in ir	aspects, ndustry.	procedures a	and g	uideli	nes to	be followed
Unit – I		Safety Management						9
Evolution Respons Inspectio Safety C	n of Ma sibilities on- Majo Organiza	anagement Thoughts- Need for Safety- Progress in Modern Planning for Safety-Formulation of Safety Policy- Job Safety A or Accident Hazard Control- Hazard and Operability (HAZOP) s tion Safety Audit -Safety Education and Training-Good Houseker	n Safety malysis- Study- H eping- Pe	Concept -S Safety Samp azard Rankir ersonal Prote	Safety ling 1 ig (Do ction	<sup>7</sup> Mar Fechn OW a and F	nagen ique ind M irst A	nent and its Plant Safety OND index)- id.
Unit – II		Accident Causation and Prevention						9
Nature a Theory - Monitorin Model - 3 <b>Unit – III</b> Operatio Safety ir Use of H Construc Measurin	And Cau Accide ng Mod 5E's of <i>J</i> n Safety n Mecha land and ction Ele	uses of Accidents - Incidents of Accident- Factors - Root Caus nt Prevention Steps - Organization- Fact Finding- Analysis of Fa els- Kepner-Tregoe Model - Error Reduction Model- Performa Accident Prevention. Case Study of Major Accidents. <b>Safe Handling of Materials and Tools</b> /- Personal Protective Equipment -Safe Methods of Lifting & Har anical Handling-Lifting Machines- Tackles-Cranes-Conveyors-Tr d Power Tools. Machine Guarding-Basic Need & Importance- P ectrical Safety- Reactor Control and Explosion Prevention Sys uments - Noise and Vibration Measurement and Control- A	se Analy acts- Sele ance Cyundling-Sa rucks-Ca Principles stem- Ra ir Polluti	sis - Heinrich ection of Rem cle Model- U fe Use of Acc uses and Co of Machine ( adiation Shiel ion Control-	n's an ledy- lpdate cesso introl Guarc ding Air S	nd Fra Appli ed Sa ries o of To ling-M and o Sampl	ank B cation afety I f Man ool Ac Materia Contro	rd's Domino of Remedy- Management <b>9</b> ual Handling cidents-Safe als for Guard ol- Radiation nd Pollution
Measurir	ng Instru	iments.					•	
Unit – IV	/	Safety in engineering industry						9
Safety ir Cutting S Maintena System Laborato	n Mecha Safety in ance of - Stora ory –Saf	anical Working - Safety Measures in Machining Process- Safe n Foundry Shops - Safety Measures in Heat and Cold Process Machines - General Health Hazards and Control Measures i ge Vessels and their Safety Aspects- Safety in Boilers- Safe e Transfer and Transportation of Chemicals.	ety in Us - Safety in Engine Storage	e of Power <sup>-</sup> in Usage of eering Indust & Handling	Tools Dies ry - I of C	-Safe - Sa Hazai Gas C	ty in fe Op rd Co Cylinde	Welding and erations and mmunication ers-Safety in
Unit – V		Fire and explosion						9
Nature, S Code De Systems Rate Ca Maintena	Stages a esign fo - Contr alorimete ance and	and Spread of Fire - Classification of Fire and Extinguishers - S r Fire Safety- Fire Detection and Alarm Systems - Fire Load I ol of Fire and Explosion in Flammable Substances - Explosive T er Ignition Test - Electrical Fires- Fire Emergency Action P d Training for Fire Protection.	Statutory Determin Testing - Plan & D	Provisions a ation - Fire S Thermal Sens Drill Rig Expl	nd In Suppr sitivity losior	dian 3 essio / Ana n –Ty	Stand n or E lysis - pes	ards - NFPA Extinguishing Accelerated Inspection,
								Total:45
TEXT BO	OOK:							
1.	Mistry. I	K.U "Fundamentals of Industrial safety and health", 2 <sup>nd</sup> Edition, S	Siddharth	Prakashan F	Publis	her,G	ujarat	,2009.
REFERE	NCES:							
1.	Jane B Englan	luent, Nigel &Balchin C., "Health and Safety in Welding and Allied, 2002.	ed Proce	sses", 5 <sup>th</sup> Ed	ition,	Wood	d Hea	d Publishing,
2.	Rao S, Publish	Jain R.K. & Saluja H.L., "Electrical Safety - Fire Safety Enginee ers, Delhi, 1997.	ring and	Safety Mana	geme	ent", 2	<sup>nd</sup> Edi	tion, Khanna
3.	Method	lologies for Risk and Safety Assessment in Chemical Process Ind	dustries,	Commonwea	lth So	cience	e Cou	ncil, UK
4.	Loss P	revention in Process Industries-Frank P. Less Butterworth-Hein L	JK, 2 <sup>nd</sup> E	dition 1990 (\	/ol.l,	&	I).	

COUR: On con	SE OL	UTCON on of th	IES: e cour	se, the stu	udents	will be ab	ole to							BT Map (Highest	ped Level)
CO1	outli	ine the	signifi	cance of s	afety i	n industry	-						U	nderstand	ing(K2)
CO2	iden	ntify the	factor	s causing	accide	ents and p	orevent t	hem fro	m occi	urring.				Applying	(K3)
CO3	choo	ose the	safe o	perating	practic	es in mate	erial har	ndling ar	nd tool	usage.				Applying	(K3)
CO4	iden	ntify the	safety	measure	s in the	e enginee	ring ind	ustry.						Applying	(K3)
CO5	emp	oloy the	preve	ntion stra	tegies	for fire an	d explos	sion.						Applying	(K3)
						Мари	oing of (	COs wi	th POs	and PS	Os				
COs/P	Os	P01	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	3	2				2	1						3	3
CO2	2	3	3	3										3	3
COS	3	3	3	3										3	3
CO4	1	3	3											3	3
CO5	5	3	3	3										3	3
1 – Slig	ght, 2 ·	– Mode	erate, 3	8 – Substa	antial, E	3T- Bloom	ı's Taxo	nomy							
						ASS			TERN	- THEOF	εγ 				<u> </u>
Les C	t / Blo atego	oom′s ory*	R	emembe (K1) %	ring	Understa (K2)	anding %	Apply (K3)	ving %	Analyzir (K4) %	ng E	valuating (K5) %	g C (	reating K6) %	l otal %
	CAT	1		25		35		40	)						100
	CAT	2		30		40		30	)						100
	CAT	3		20		30		50	)						100
ESE 25 35 40 100								)						100	

\* ±3% may be varied (CAT 1, 2 & 3 – 50 marks & ESE – 100 marks)

		22MEE41 - INTRODUCTION TO AIRCRAFT ST	RUCTUF	RES				
Progra & Bran	mme ch	BE & Mechanical Engineering	Sem.	Category	L	т	Ρ	Credit
Prereq	uisites	Engineering Mechanics, Strength of Materials, Design of Machine Elements	7	PE	3	0	0	3
Pream	ble	The course offers the fundamentals of aircraft design process, mate joints, associated vibrations and flutter	erials , p	roperties, failu	ires	struc	ctural m	embers,
Unit –		Overview of the Aircraft Design Process, Aircraft Loads, Aircra	ft Struc	tures Descri	ptio	n		9
Introduce Design Genera Require engine- and En Joints.	ction- Ph -Design al Requir ements- - Actuato npennage	ases of Aircraft Design- Aircraft Conceptual Design Process- Co Methodologies-Airworthiness- Definition- Airworthiness Regulatior ements- Requirements Related to Aircraft Design Covers- Perfor Landing Requirements- Fatigue and Failsafe Requirements- Aeroor r Loads-Maneuver Loads- VN diagrams-Gust Loads- Types of Struct e Ribs- Spars- Frames- Stringers- Longeron- Splices- Types of S	nceptua ns- Reg ormance dynamic ctural Me structura	I Stage- Prel Julatory Bodio e and Flight Loads- Inert embers of Fu I Joints- Type	imin es-T Rec ial L sela e of	ary E ype quirer Loads ge ar Load	Design- of Cert nents- s- Load nd Wing ds on S	Detailed tification- Airframe s due to g Section Structural
Unit –	II	Aircraft Materials and Properties						9
Introdu Strengt	ction- Ba h- Static-	sic Construction- Material Forms-Metallic Materials and Forms- Alloy Stress Strain Curves	Designa	ations-Mecha	nica	l Prop	perties-	
Unit –		Static and Fatigue Failures						9
Fatigue Failure Axial E	e Properti s- Fatigue ffects- Iso	es-Crack Growth- Brief Review of Principal Stresses-Principal Strain e Theory- Introduction to Low Cycle Fatigue- Stress Life and Strain L othermal and Thermo mechanical Fatigue- Introduction to High Cycle	s- Mohr' ife Tech Fatigue	s Circle for St niques- Mear e.	ress Str	and ess E	Strain-	Fatigue Multi-
Unit –	IV	Box Beams, Buckling of Thin Sheets						9
Box Be of Thin of Stiffe	ams- Intr Sheets- ened Pan	oduction- Shear Flow Due to Shear-Shear Flow Due to Torsion-Brea Buckling of Flat Plate in Compression and Shear- Buckling of Curve els-Post Buckling- Effective Width- Concept of Diagonal Tension-Buc	dt Batho ed Plate: ckling Ur	- Single and I s in Compres nder Combine	Multi sion d Lo	cell and ads.	Boxes- Shear-	Buckling Buckling
Unit – '	V	Aircraft Structural Joints, Advanced materials, Vibrations and	Flutter					9
Introduand Cli and Cli and Flu	ction to F ps-Introd itter.	asteners- Splices- Eccentric joints-Bolt Group Analysis-Welded joint uction to Composite Materials- Matrices-Fibers-Forms- Characteris	s- Bonde tics of C	ed joints- Lug composite Ma	Ana teria	alysis als-St	- Tensic udy of	on Fitting Vibration
								Total:45
TEXT	BOOK:							
1.	Daniel F	P.Raymer, "Aircraft Design-A Conceptual Approach", 6th Edition, AIA	A Educa	tion, series, L	ISA,	2012	2.	
REFER	RENCES:							
1.	Megso	n T.H.G, "Aircraft Structures For Engineering Students", 6 <sup>th</sup> Edition, E	Butterwo	rth Heineman	n, U	SA, 2	2017.	
2.	Michae	I Niu, "Airframe Structural Design", 2 <sup>nd</sup> Edition, Conmilit Press, Hong	Kong, 1	988.				
3. Peery, "Aircraft Structures", 1 <sup>st</sup> Edition, Dover publications, New York, 2011.								

L

COUR	SE OL	JTCOM	ES:											BT Mapp	ed		
On con	npletic	on of the	e course,	the stude	nts will	be able	to						()	lighest Le	evel)		
CO1	brief	about	overview	of the airc	craft des	sign prod	cess, air	craft loa	ads and	structu	res		Ur	derstandir	ng (K2)		
CO2	sele	ct and i	dentify ai	rcraft mat	erials ar	nd their	propertie	es						Applying (ł	<3)		
CO3	pred	ict stati	c and fat	igue failur	es of air	craft me	embers						ļ	Applying (H	(3)		
CO4	appl	y the sh	near flow	in box bea	ams and	d bucklir	ng of thir	n sheets	6				ŀ	Applying (H	(3)		
CO5	iden	tify the	nature of	aircraft st	ructural	joints, v	/ibration	s and fl	utter of	aircraft			Applying (K3)				
						Mappin	g of CO	s with	POs an	d PSO:	5						
COs/F	os	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2		

CO1

\* ±3% may be varied (CAT 1, 2 & 3 – 50 marks & ESE – 100 marks)

CO2	3	3	1								3
CO3	3	2	2								3
CO4	3	2	2								3
CO5	3	2	2								3
					ASSESSMEN	<b>PATTERN</b>	- THEOR	(			
Test / Bl Catego	oom's ory*	Re	memberin (K1) %	g L	Jnderstanding (K2) %	Applying (K3) %	Analyz (K4)	ing %	Evaluating (K5) %	reating (K6) %	Total %
CAT	1		20		60	20					100
C 4 T											
CAI	2		20		30	50					100
CAT	2 3		20 20		30 30	50 50					100 100

Programme & BranchBE & Mechanical EngineeringSem.CategoryLTPCreditPrerequisitesNil7PE3003
Prerequisites Nil 7 PE 3 0 0 3
Preamble This course provides knowledge on new product development, product planning and the process of concept generation through identifying the product specification. Furthermore this course provides various ways to optimize the product design using mathematical techniques.
Unit – I Development Processes and Organizations 9
Introduction to New Product and Product design - Characteristics of Successful Product – The Challenges in Product Development - Product Development Process – Adapting Generic Product Development Process - Product Development Process Flows - Product Development Organizations.
Unit – II Product Planning 9
Types of Opportunities - Structure of Opportunity Identification – Opportunity Identification Process – Product Planning Process – Four Types of Product Development Projects – Steps in Product Planning – Identifying Customer Needs.
Unit – III Product Specifications and Concept Development 9
Product Specifications – Target and Final Specifications. Concept Generation: Five Step Method - Concept Selection - Concept Screening – Concept Scoring – Concept Testing.
Unit – IV Introduction to Optimization 9
Introduction to Optimum Design - Global and Local – Problems - General Characteristics of Mechanical Elements – Adequate and Optimum Design – General Principles of Optimization – Formulation of Objective Function – Design Constraints – Classification of Optimization Problem – Saddle Point – Single Variable Optimization – Multi Variable Optimization with no Constraints.
Unit – V Unconstrained Optimization Techniques 9
Single Variable and Multi variable Optimization with Constraints – Techniques of Unconstrained Minimization - Golden Section - Pattern and Gradient Search Methods - Interpolation Methods – Quadratic Function Method.
Total:45
TEXT BOOKS:
1. Eppinger, S.D. and Ulrich, K.T. " Product design and development", 6 <sup>th</sup> Edition, McGraw-Hill Higher Education, 2020 for Units I, II, III
2. Rao Singaresu S. "Engineering Optimization – Theory and Practice". 4 <sup>th</sup> Edition, New Age International Pvt. Ltd., New Delhi, 2015 for Units IV, V
REFERENCES:
1. Devdas Shetty, "Product Design For Engineers", 1 <sup>st</sup> Edition Cengage Learning, 2015.
2. Kalyanamoy Deb. "Optimization for Engineering Design Algorithms and Examples". 2 <sup>nd</sup> Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2021.

COURSE OUTCOMES: On completion of the course, the students will be able to											()	BT Mapped (Highest Level)				
CO1	infer the basic need for new product design and development process											Understanding (K2)				
CO2	identify opportunities and customer needs for new product development											Applying (K3)				
CO3	discover the product specification and develop concepts for new product											Analyzing (K4)				
CO4	solve optimization problems for design and manufacturing applications											Applying (K3)				
CO5	make use of unconstrained optimization techniques to identify optimum value												Applying (K3)			
Manning of COs with POs and PSOs																
COs/POs PO1 PO2				PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	
CO1		3	1	3											3	
CO2		3	1				2	1							3	
CO3		3	1				2	1							3	
CO4		3	2					2							3	
CO5		1	1	3		2								2		
1 – Sligh	nt, 2 -	- Moder	ate, 3 –	Substan	tial, BT-	Bloom's	Taxonom	у								
						ASSE	SSMENT		RN – Tł	IEORY						
/ Test Cat	Test / Bloor Category		Joom's Remembering gory* (K1) %		ng U	Understanding (K2) %		Applying (K3) %		Analyzing (K4) %		Evaluating (K5) %		Creating (K6) %	Total %	
CAT1				10		60		30							100	
CAT2		Г2 10			10		50		30					100		
CAT3		3 10			40		50							100		
ESE			10		30		40		20				100			
* ±3% m	ay be	e varied	(CAT 1	, 2 & 3 –	50 mark	s & ESE	– 100 ma	arks)								

22MEE43 - NANOTECHNOLOGY FOR MECHANICAL ENGINEERS													
Programme & Branch	BE & Mechanical Engineering	L	т	Ρ	Credit								
Prerequisites	Nil	7	PE	3	0	0	3						
Preamble	Preamble The course imparts the basics of Nanotechnology. It emphasize on the fabrication procedures, characterization techniques, technical properties and applications of several nanostructured materials												
Unit – I	it – I Fundamentals of Nanotechnology 9												
Nanoscience and Nanotechnology – Fundamentals - Classification and General Themes of Nanotechnology - Nanoscale Science - Fabrication and Processing Technology - Size Dependence of Materials Properties - Characterization Tools - Properties of Nanomaterials - Structural Properties - Thermal Properties - Chemical Properties - Mechanical Properties - Magnetic Properties - Optical Properties - Electronic Properties - Biological Properties.													
Unit – II Nanoscale Fabrication and Characterization 9													
Nanoscale Fabrication - Bottom-up Approach - Chemical Synthesis - Self-Assembly - Top-down approach – Photolithography - Electron Beam Lithography - Focused Ion Beam Lithography - Extreme Ultraviolet Lithography – Nano Imprint Lithography - X-ray Lithography - Soft Lithography. Characterization of Nanomaterials - Atomic Structure and Chemical Composition - Vibrational Spectroscopies - Ultraviolet-Visible Spectroscopies - Electron Microscopy - Zeta Potential Analyzer - Laser Granulometry													
Uttraviolet-visible Spectroscopies - Electron Microscopy - Zeta Potential Analyzer - Laser Granulometry.         9           Unit - III         Metal and Ceramic Nanoparticles         9													
Classifications of Nanostructured Materials – Nano powders - Metal Nanopowders - Metal Oxide Nanopowders – Nanoporous Materials - Silica - Transition Metal Oxides - Metal Sulfides – Metal Aluminum Phosphates - Silicon Nitrides - Aluminum Oxides – Nano dusts – Nanowires - Zinc oxide Nanostructures.													
Unit – IV	Carbon Nanoparticles						9						
Carbon Allotropes - Molecule Structures - Physical and Chemical Properties - Synthesis Methods - Electric Arc Method - Laser Ablation Method - Solar Energy Method. Carbon Nanotubes – Structure and Synthesis - Arc Discharge Method - Laser Ablation Method - Chemical Vapor Deposition Method. Properties: Electrical Conductivity - Optical Properties - Vibrational Properties - Mechanical Strength - Specific Heat and Thermal Conductivity – Applications - Defects in Carbon Nanotubes - Fullerenes - Synthesis – Properties – Applications.													
Unit – V	Nanocomposites and Nanofluidics						9						
Overview of Nanocomposites - Metal Matrix composites: Fabrication Techniques – Solid State Methods – Semi-Solid State Methods – Liquid State Methods. Polymer Matrix Nanocomposites: Solution Mixing Method – Melt Mixing Method – Insitu Polymerization – Electrospinning – Selective Laser Sintering Technique. Properties: Mechanical Testing – Wear Properties – Permeability – Thermal Stability – Flammability. Nano Fluidics: Synthesis – Properties – Applications													
							Total:45						
TEXT BOOK:													
1. Vijay K Varadan, Sivathanu Pillai A, Debashish Mukherji, Mayank Dwivedi, Linfeng Chen, "Nanoscience and Nanotechnology in Engineering". 1 <sup>st</sup> Edition. World Scientific, Singapore, 2010.													
REFERENCES:													
1. Maria Switz	Stepanova, Steven Dew, "Nanofabrication Techniques and Principles' erland, 2012.	", 1 <sup>st</sup> Editio	on, Springer I	nternat	ional I	Publis	shing,						
2. Thar Publ	gadurai, T.D., Manjubaashini, N., Thomas, S., Maria, H.J, "Nanostructu shing, Switzerland, 2020.	ured Mater	ials", 1 <sup>st</sup> Editi	on, Sp	ringer	Inter	national						
3. Paul Gruy	Paulo Davim J. and Constantinos A. Charitidis, "Nanocomposites - Materials, Manufacturing and Engineering", 1 <sup>st</sup> Edition, De Gruyter, Germany, 2013.												

COURSE OUTCOMES: On completion of the course, the students will be able to											BT Mapped (Highest Level)				
CO1	interpret the fundamental of nanotechnology											U	Understanding (K2)		
CO2	present the different techniques involved in nanoscale fabrication and characterization												Jnderstanding (K2)		
CO3	demonstrate the synthesis route, properties and applications of metal and ceramic nanoparticles Applying (K3)												(K3)		
CO4	de na	describe the synthesis route and correlate the structure – property relationship of carbon Applying (K3)												(K3)	
CO5	se na	select appropriate materials and fabrication techniques to prepare nanocomposites and nanofluidics for desired applications       Applying (K3)												(K3)	
						Марр	ing of CC	Os with F	POs and	PSOs					
COs/P	os	PO1	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	P011	PO12	PSO1	PSO2
CO1		3	1												2
CO2		3				3								3	2
CO3		3	3	1	2	3								3	3
CO4		3	3	1	2	3								3	3
CO5		3	2	1		3	1							3	3
1 – Sligl	ht, 2 -	Moder	ate, 3 –	Substan	tial, BT	- Bloom's	Taxonom	iy							
						ASSE	SSMEN	ΓΡΑΤΤΕ	RN - TH	EORY					
Test / Cat	Test / Bloo Category		Bloom's Remembering gory* (K1) %		g	Understanding (K2) %		Applying (K3) %		Analyzing (K4) %		Evaluating (K5) %		Creating (K6) %	Total %
CAT1				40		60	60								100
CAT2		2 20			40		40							100	
CAT3		3 20			40		40							100	
ESE				30		40		30							100
* ±3% m	hav be	e varied	(CAT 1	2&3-	50 mai	ks & ESE	– 100 ma	arks)							
			22MEE44	4 - NON	I-DESTRUCTI	VE EVALUATION	TECHNIC	UES							
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Programn Branch	me & BE &	Mechani	cal Engine	ering			Sem.	Category	L	т	Ρ	Credit			
Prerequis	sites Engir Techi	eering nology	Materials	and	Metallurgy,	Manufacturing	7	PE	3	0	0	3			
Preamble	This c inspec	course cov ct and eva	ers the prir luate defect	nciples ts witho	and procedure ut causing dan	es of various non-contrage to the engine	lestructive ering com	e testing meth ponents.	nods us	sed in	engi	neering to			
Unit – I	Introc	Introduction and Liquid Penetrant Testing 9													
Non-Destr Examinati Principles Emulsifiat Standards	restructive Testing (NDT) - Importance - Principles - Limitations - Safety considerations - Preparation of Test Materials - Visual nation - Basic Principles - Types of Defects - Optical Aids used and Applications – Standards - Liquid Penetrant Testing (LPT) - oles - Procedure for LPT - Light Sources and Special Lighting - Calibration – Penetrant Testing Methods: Water washable - Post ifiable Method - Solvent Removable Developers - Properties of Liquid Penetrant - Sensitivity - Applications and Limitations – ards.														
Unit – II	Magn	etic Parti	cle Testing									9			
Principles - Magneti Principles	bles - Theory of Magnetism - Characteristics of Magnetic Fields - Types of Defects - Surface and Sub-surface Cracks - Limitations netizing Techniques - Circular and Longitudinal Magnetization Techniques - Procedures - Equipment Calibration - Sensitivity - oles and Methods of Demagnetization – Residual Magnetism - Applications and Limitations - Standards - Case Studies.														
Unit – III	Ultras	Ultrasonic Testing 9													
Principles Beam Insp - Immersio Diffraction	of Ultrasonic pection – Flav on Testing - ( n (TOFD) - Lim	f Ultrasonic Testing – Properties of Sound Beam - Transducers - Inspection Methods - Techniques for Normal and Angle ction – Flaw Characterization - Equipment and Tools of Ultrasonic Testing - Methods of Display - A Scan - B Scan - C Scan Testing - Calibration – Advanced Ultrasonic Testing Methods - Phased Array Ultrasonic Testing (PAUT) - Time of Fight IOFD) - Limitations – Standards – Application.													
Unit – IV	Radio	ography										9			
Electroma Film - Exp Indicators Case Stud	agnetic Radiat cosure Charts s (IQI) - Types dies.	ion Sourc - Equipm of Defects	es - X-ray F ent and too s - Applicati	Producti Is of Ra ons and	ion and Gamr adiography Tes d Limitations -	na Ray Sources - ting - Radiographi Safety in Industrial	Properties c Imaging Radiogra	s - Radiation - Inspection phy - Neuron	- Atten Techni Radio	uatior ques graph	n and - Ima y – S	Effects in ge Quality tandards -			
Unit – V	Other	NDT Tec	hniques ar	nd Sele	ction Methods	6						9			
Eddy Curr Probe - Se Principle - Application Selection Automotiv	rent: Principle ensitivity - Ad - Techniques ns and Standa of NDT Met e - Manufact	s - Electro vanced Te - Instrum ards - Leal hods: Col turing Indu	omagnetic II est Methods ientations - k Testing M mparison o istries – Ca	nduction - Applic • Applic ethods f NDT se Stud	n - Electrical C ications & Limi ations and St – Detection an techniques - lies.	conductivity - Magr tations - Standard andards - Thermo d Standards. Selection of Instr	netic Perm s - Other ography - rumentatic	neability - Ins Techniques: Principles - on. Applicatic	trumen Acoust Equipr ns of	tation ic Em nent NDT:	- Teo issior - Teo Ae	chniques - n Testing - chniques - rospace -			
												Total:45			
TEXT BO	OKS:														
1.	Baldev Raj, . New Delhi, 2	Jayakuma 019 for Un	r T. & Thav its I, II, III &	vasimut IV.	hu M., "Practio	cal Non Destructiv	e Testing	", 3 <sup>rd</sup> Edition,	Naros	a Pul	olishi	ng House,			
2.	Paul E. Mix, I	P.E., E.E "	Introductior	n to Nor	n destructive To	esting: A Training (	Guide" 2 <sup>nd</sup>	Edition, Wile	y, 200	5 for L	Jnit V				
REFEREN	NCES:														
1.	Hull Barry &	John Vern	on., "Non-D	estruct	ive Testing", 3 <sup>r</sup>	<sup>d</sup> Edition, Macmilla	n, Londor	n, 2015.							
2.	Hellier C., "H	andbook c	of Non-Dest	ructive	Evaluation", 3 <sup>r</sup>	<sup>d</sup> Edition, McGraw-	Hill Educa	ation, 2020.							
3.	Shull Peter J. 2002.	., "Non-De	structive Ev	/aluatio	n: Theory - Teo	chniques and Appl	cations",	Marcel Dekka	ar Inc.,	New \	′ork,	USA,			

COURS On comp	E OU	TCOME	ES: course,	the stud	ents will	be able t	to							BT Map Highest I	ped _evel)
CO1	dep me	oict the thods for	significa or variou	nce of N is applica	DT methations.	ods and	deliver kr	nowledge	e of liquio	d penetra	int/visual	inspectio	n Ur	nderstandi	ng (K2)
CO2	cor	npare tł	ne vario	us magn	etic parti	cle testin	g method	ls to iden	tify the	defects			Ur	nderstandi	ng (K2)
CO3	illus	strate th	ne princi	ple of ult	rasonic t	esting an	nd its mod	lern meth	nods				Ur	nderstandi	ng (K2)
CO4	der	nonstra	te radio	graphic p	orinciples	s and its v	various in	spection	method	s			Ur	nderstandi	ng (K2)
CO5	der ide	nonstra ntify the	ite the p approp	rinciples riate ND	of eddy T inspec	current, a tions me	acoustic e thod for v	emission, arious er	thermog ngineerir	graphy te	chniques ations	and		Applying	(K3)
	Mapping of COs with POs and PSOs														
COs/P0	Os	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		3		1		3								3	2
CO2		3		1		3								3	2
CO3		3		1		3								3	2
CO4		3		1		3								3	2
CO5		3		1		3								3	3
1 – Sligh	nt, 2 –	Moder	ate, 3 –	Substan	tial, BT-	Bloom's <sup>·</sup>	Taxonom	у							
						ASSE	SSMENT		RN - TH	EORY					
/ Test Cat	/ Bloom'sRememberingUnderstandingApplyingAnalyzingEvaluatingCreatingTotalategory*(K1) %(K2) %(K3) %(K4) %(K5) %(K6) %%														
С	AT1			40		60									100
С	AT2			40		60									100
С	AT3			20		60		20							100
E	ESE			25		50		25							100
* ±3% m	ay be	varied	(CAT 1,	2&3-	50 mark	s & ESE	– 100 ma	arks)							

		22MEE45 - TURBOMACHINES									
Program Branch	nme &	BE & Mechanical Engineering	Sem.	Category	L	т	Р	Credit			
Prerequ	lisites	Thermal Engineering	7	PE	3	0	0	3			
Preambl	le	This course provides the knowledge on the energy transfer prir axial flow compressors and axial & radial flow turbines. Effic based on velocity triangles are also covered.	nciples c ciency ca	f centrifugal alculations fo	fans, or the	blow e rota	ers, cer iting ma	ntrifugal & achineries			
Unit – I		Energy Principles						9			
Energy Applicat	Transfe tions – S	r between Fluid and Rotor – Classification of Fluid Machinery – Stage Velocity Triangles – Work and Efficiency.	Dimens	ionless Para	mete	rs –	Specific	: Speed –			
Unit – II		Centrifugal Fans and Blowers						9			
Types – Design Parameters – Types of Impeller Blades – Volute and Diffusers – Losses Fan Noise – F Bearing – Fan Drives.											
Unit – III         Centrifugal Compressor         9											
Constru Factor -	ction De	etails – Stage Velocity Triangles – Stage Parameters – Entha of Diffuser – Stage Losses – Performance Characteristics.	alpy Dia	gram – D	egree	e of F	Reactior	n – Slip			
Unit - I	V	Axial Flow Compressor						9			
Stage Design	Velocity Problen	Diagrams – Enthalpy – Entropy Diagrams – Stage Losses and Performance Characteristics.	and Effi	ciency – W	ork d	lone -	– Simp	le Stage			
Unit - V	1	Axial and Radial Flow Turbines						9			
Stage \ Charact	Velocity teristics.	Diagrams – Reaction Stages – Losses and Efficiencies – Blade	Design	Principles –I	Perfo	rmano	e				
	Total:45										
TEXT B	IEXT BOOK:										
1.	Yahya S	. M., "Turbines, Compressors and Fans", 4 <sup>th</sup> Edition, Tata McGraw-	· Hill, Ne	w Delhi, 201	7.						
REFER	ENCES:										
1.	Seppo A	. Korpela "Principles of Turbomachinery", 2 <sup>nd</sup> Edition, John Wiley&	Sons, U	SA, 2019.							
2.	Erick Die	ck, "Fundamentals of Turbomachines", 1 <sup>st</sup> Edition, Springer, Nether	lands, 2	015.							

COUR: On con	SE OL	JTCON	IES: e course	e, the stud	ents wil	be able	to							BT Mapp (Highest L	oed .evel)
CO1	expla	ain the	energy p	orinciples	and clas	sify the	turbo ma	achiner	/					Understar	nding (K2)
CO2	illust	trate the	e princip	les and ap	plicatio	ns of the	centrifu	gal Fan	s and E	Blowers				Applying	(K3)
CO3	illust	trate the	e constru	uction deta	ails and	do perfo	rmance	calcula	tions o	f centrif	<sup>f</sup> ugal cor	npressor		Applying	(K3)
CO4	draw	v the ve	locity tri	angle and	calcula	te the ef	ficiency	of axial	flow co	mpress	or			Applying	(K3)
CO5	sket	ch the v	velocity of	diagrams	for axial	and rad	ial flow t	urbines	and de	etermine	their ef	ficiencies		Applying	(K3)
	Mapping of COs with POs and PSOs														
COs/P	Os	PO1	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	P011	PO12	PSO1	PSO2
CO	1	3	2	2										3	3
CO	2	3		3										1	3
CO	3	3		3										1	3
CO4	4	3		3										1	3
CO	5	3		3										1	3
1 – Slig	ght, 2	– Mode	erate, 3 -	- Substant	ial, BT-	Bloom's	Taxonc	my							
						ASSE	SSMEN <sup>®</sup>	Τ ΡΑΤΤ	ERN –	THEOR	Y				
Tes C	t / Blo atego	oom's ory*	Re	Remembering (K1) %Understanding (K2) %Applying (K3) %Analyzing (K4) %Evaluating (K5) %C									reating K6) %	Total %	
	CAT	1		10 50 40											100
	CAT	2		10		4	0	5	C						100
	CAT	3		10		4(	0	5	C						100
	ESE			10		40	0	5	C						100
* ±3% ı	* ±3% may be varied (CAT 1, 2 & 3 – 50 marks & ESE – 100 marks)														

	22MEE46 - ENERGY CONSERVATION IN HVA	C SYST	EM									
Programme & Branch	BE & Mechanical Engineering	Sem.	Category	L	т	Ρ	Credit					
Prerequisit	es Engineering Thermodynamics, Thermal Engineering	7	PE	3	0	0	3					
		I	L	1								
Preamble	This course provides significant information on energy conserva adoptable for Heating, Ventilation and Air-Conditioning (HVAC) sys	tion, ene stems.	ergy audit an	d ma	anage	ement	oractices					
Unit – I	Fundamentals of Thermodynamics						9					
Introduction Conditioning	to Energy Conservation – Second Law of Thermodynamics – Exergy Systems and Cycles – Heat pumps – Psychrometry.	Analysis	– Reversibili	ty ar	nd Irr	eversib	ility – Air					
Unit – II	Climates and Buildings						9					
Climate – Materials –	ypes - Factors that Determine Climate - Climatic Variations – Therm Effect of Geographic Locations – Building Aesthetics and Infiltration.	al Prope	erties and En	ergy	Con	tent of	Building					
Unit – III	Indoor Environmental Requirements 9											
Thermal Co Energy Targ	Comfort – Ventilation and Air Quality – Air Conditioning Requirement – Energy Management Options – Energy Audit and argeting – Design Consideration in Different Climatic Conditions.											
Unit – IV	Heating and Ventilation Systems						9					
Energy Con Induction S	servation and Feasibility Analysis – Conventional Ventilation Syster stems – Indoor Air Quality – Duct Design and Installation.	ns – Co	onstant Volun	ne a	nd V	ariable	Volume					
Unit – V	Air conditioning Systems						9					
Energy Cor System – E Factor – Eff	servation in Air Handling Units – Fans - Air Condition Apparatus– Windo nergy Efficient Motors – Cooling Load Estimation – Bypass Factor - Roo ective Room Sensible Heat Factor.	w Air Co m Sensik	ndition Syste	m – or – 1	Centr Grand	al Air C d Sensi	Condition ble Heat					
							Total:45					
TEXT BOO	κ:											
1. Fay Ana	e C.McQuiston, Jerald D.Paeker and Jeffrey D.Spitler, Hessam Taheri lysis and Design", 7 <sup>th</sup> Edition, John Wiley & Sons Inc., Singapore, 2023.	an ,"Hea	iting, Ventilati	ng,	and A	Air Con	ditioning:					
REFERENC	ES:											
1. Ca	rter Stanfield, David Skaves, AHRI, "Fundamentals of HVACR", 4th Editi	on, Pear	rson, Canada	,202	0.							
2. Jar Yoi	F. Kreider & Peter S. Curtiss, "Heating and Cooling of Buildings: Desig x, 2010.	gn for Eff	iciency", 2 <sup>nd</sup>	Editi	on, C	RC Pre	ess, New					
3. AS	IRAE Handbook, "HVAC Systems and Equipment 2011, HVAC Applicat	ions", AS	SHRAE Inc., A	Atlan	ta, 20	)19.						
<u> </u>												

COURS On com	DURSE OUTCOMES:     BT Mapped       1 completion of the course, the students will be able to     (Highest Level)														
CO1	defi	ine the f	fundame	ental therm	odyna	amic princi	ples.						Unde	erstanding	(K2)
CO2	det clim	ermine nates.	the the	rmal prop	erties	and ener	rgy cont	ent of	buildin	g matei	rials for	different	A	pplying(K3	3)
CO3	pre	pare the	e require	ment of in	door e	environme	ntal con	ditions k	based	on stand	ards.		A	pplying(K3	6)
CO4	ana	lyze the	e duct de	esign in he	ating	and ventila	ation sys	stems.					An	alyzing (K	4)
CO5	per	form the	e cooling	load calc	ulatior	ns involved	d in air-c	onditior	ning sy	stems.			An	alyzing (K	4)
	Mapping of COs with POs and PSOs														
COs/P	Os	P01	PO2	PO3	PO	4 PO5	PO6	P07	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	3											3		3
CO2	2	1		2				3					1		3
CO3	3	1		2			2	3					1		3
CO4	1	1		3				2					2		3
COS	5	1		2			3						2		3
1 – Slig	jht, 2	– Mode	erate, 3 -	- Substant	ial, B1	- Bloom's	Taxono	my		4					
						ASSES	SMENT	PATTE	RN – 1	THEOR	ſ				
Tes C	Test / Bloom's Category*Remembering (K1) %Understanding (K2) %Applying (K3) %Analyzing (K4) %								Evaluating (K5) %	g C	reating (K6) %	Total %			
	CAT	1		20		50	)	30	)						100
	CAT	2		15		45	;	40	)						100
	CAT	3		15		30	)	30	)	25					100
	ESE	Ξ		15		30	)	40	)	15					100
* 000		ESE 15 30 40 15 100													

 $^{\ast}$  ±3% may be varied (CAT 1, 2 & 3 – 50 marks & ESE – 100 marks)

		22MEE47 - INDUSTRIAL MARKETIN	NG								
Progran Branch	nme &	BE & Mechanical Engineering	Sem.	Category	L	Т	Ρ	Credit			
Prerequ	uisites	Nil	7	PE	3	0	0	3			
	1										
Preambl	le	This course deals with the behaviour of customers and marketing s real time engineering marketing problems and useful to design the	strategie channel	s. It improves of market ar	s the nd pr	skills oduct	for solv develop	ing the oment.			
Unit – I		Introduction						9			
Introduc Charact	ction to teristics c	Industrial Markets - Marketing System - Concepts - Character of Industrial and Consumer Markets – Market Demand – Cross Elast	ristics – ticity of E	Definition Demand - Bus	– E sines	xchai s Eth	nge Pro ics	ocesses –			
Unit – II	I	Industrial Purchasing						9			
Types o Units –	of Industr Models c	rial Customers - Purchasing Practices - Industrial Buyer Behaviour of Organizational Buying Behaviour - Modern Purchasing Terminolog	<sup>.</sup> – Indus gies- Ca	strial Buying se Studies.	Situa	tion -	- Decisi	on Making			
Unit – II	I	Marketing Planning and Research						9			
Marketir Informat of Marke	Marketing Planning: Business Marketing – Marketing Planning – Corporate Strategic Planning – Target Marketing – Marketing nformation Systems. Marketing Research: Market Evaluation - Role of IT in Marketing Information Systems - Definition and Process of Marketing Research - Research Instruments.										
Unit – I\	V	Product Development and Pricing						9			
Industria Industria Strategi	al Produ al Pricino ies.	cts and Services - Definition - New Industrial Product Developme g Characteristics - Influencing Factors in Pricing Decisions of Ind	nt – Pro ustrial M	duct Life Cy larkets - Cla	cle - ssific	Mark cation	eting S of Cos	trategies - ts, Pricing			
Unit – V	/	Channel Design						9			
Econom Distribut Program	nic Perfo tors - Sa ns – Cas	rmances and Channel Management Decisions- Industrial Logistics les Promotion – Personal Selling - Sales Force Management – Adv e Studies.	s System vertising	n - Role and in Marketing	Cha – In	racter dustri	istics of al Comr	f Industrial munication			
	Total:										
TEXT B	OOK:										
1.	Havalda	r, K. Krishna, "Industrial Marketing", 4 <sup>th</sup> Edition, Tata McGraw Hill, N	lew Delh	i, 2018.							
REFER	ENCES:										
1.	Philip K	otler, Gary Armstrong & Prafulla Agnihotri, "Principles of Marketing"	, 17 <sup>th</sup> Ed	ition , Pearso	on Ec	lucatio	on, 2020	Э.			
2.	Robert 2015.	R. Reeder, Briety & Betty H. Reeder, "Industrial Marketing", 4th Editi	on, Pren	tice Hall of Ir	ndia I	Pvt. Li	d, New	Delhi,			

COUR: On con	COURSE OUTCOMES:       BT Mapped         On completion of the course, the students will be able to       (Highest Level)														
CO1	exp	lain the	characte	eristics of i	ndustria	al marke	ting syst	tem					Un	derstandin	g (K2)
CO2	app	ly the p	urchasin	g practice	s for or	ganizatio	nal moc	dels						Applying (	K3)
CO3	dev	elop eff	ective m	arketing s	trategie	s and co	nduct re	esearch	to sup	port dec	ision mał	king		Applying (	K3)
CO4	Ider	ntify app	propriate	pricing m	odel for	a new p	roduct a	ind serv	vice				Un	derstandin	g (K2)
CO5	Infer	the rol	e of marl	keting cha	nnel in	deliverin	g produ	cts/serv	ice to d	custome	rs			Applying (	K3)
				1		Mappi	ng of C	Os with	POs a	and PSC	Ds		1		
COs/P	Os	P01	PO2	O2         PO3         PO4         PO5         PO6         PO7         PO8         PO9         PO10         PO11         PO12         PS01         PS02											
CO	1	3												3	2
CO2	2	2	3								3			3	2
CO	3	1	3			3					1			3	2
CO4	4	1	2			3					1		1	3	2
COS	5	1	2			1					1		1	3	2
1 – Slig	ght, 2	– Mode	erate, 3 –	Substant	al, BT-	Bloom's	Taxono	my							
						ASSE	SSMEN	Τ ΡΑΤΤ	ERN -	THEOR	Y		1		
Tes C	t / Blo atego	oom's ory*	Re	memberi (K1) %	ng l	Jndersta (K2)	anding %	Apply (K3)	ving %	Analyz (K4) 9	ing E %	valuating (K5) %	Cr (I	eating K6) %	Total %
	CAT	1		20		30		50	)						100
	CAT	2		20		30		50	)						100
	CAT	3		20		40		40	)						100
	ESE 20 35 45 100														
* ±3% ı	±3% may be varied (CAT 1, 2 & 3 – 50 marks & ESE – 100 marks)														

22MEE48 - DECISION SUPPORT SYSTEMS											
Progra Branc	amme & :h	BE & Mechanical Engineering	Sem.	Category	L	т	Ρ	Credit			
Prerec	quisites	Manufacturing Technology	7	PE	3	0	0	3			
Pream	nble	This course delivers the concept of decision systems through	intelliger	nt systems in ir	ndusti	ries.					
Unit –	· <b>I</b>	Decision Making						9			
Manag Proces	gerial Decis ss - Case S	sion Making, System Modelling and Support-Preview of the N Studies.	lodelling	Process - Pha	ases	of De	ecision	- Making			
Unit –	· 11	Decision Support System (DSS)						9			
DSS C Case S	S Components - Data Warehousing, Access, Analysis, Mining and Visualization - Modelling and Analysis - Development – se Studies related Support Systems.										
Unit –	Jnit – III Knowledge Management 9										
Group - Appli	Support S ication and	ystems - Enterprise DSS - Supply Chain and DSS - Knowledge Uses – Cases in Knowledge Management Decision Making.	e Manage	ement Method	s, Teo	chnol	ogies a	and Tools			
Unit –	١V	Intelligent Systems						9			
Artifici Repre	al Intellige	nce and Expert Systems - Concepts, Structure, Types - Kn DSS Cases in AI and Expert Systems.	owledge	Acquisition a	nd Va	alidat	ion, Kı	nowledge			
Unit –	V	Implementation of DSS						9			
Impler Suppo	nentation ort System ·	<ul> <li>Overview - Transformation – E-Commerce Activities – S</li> <li>Benefits - Limitations – Case Study with examples – E-Procu</li> </ul>	Steps - Irement S	Integration an Success- Case	d Imp s.	bact	of Mar	agement			
	Total:45										
TEXT	BOOK:										
1.	Efraim Tur 2019.	ban and Jay E Aronson., "Decision Support and Intelligent Sys	stems", 8 <sup>t</sup>	<sup>h</sup> Edition, Pear	rson E	Educa	ation As	sia,			
REFE	RENCES:										
1.	Elain Rich	a and Kevin Knight., "Artificial intelligence", Tata McGraw Hill, 2	016.								

COURSE On comple	OUTCON etion of the	IES: e course	, the stu	idents will	l be able	e to						B (Hig	T Mappeo ghest Lev	d /el)
CO1	make dec semantic	isions in network:	the sen s.	ni structur	ed and	unstructur	ed prol	olem situa	tions usii	ng system	ns and	Unde	rstanding	(K2)
CO2	understar	nd variou	is compo	onents of	DSS an	d modelin	ig & ana	alysis pha	ses of D	SS		Unde	rstanding	(K2)
CO3	apply the	concept	s of kno	wledge m	anagem	ent metho	ods in E	SS.				Ap	plying(K3	)
CO4	perform th	ne meas	urement	s of know	ledge o	n artificial	intellig	ence syste	ems			Ap	plying(K3	)
CO5	incorpora	te the ma	anagem	ent suppo	ort syste	ms in indu	ustries.					Ар	plying(K3	)
	Mapping of COs with POs and PSOs													
COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1		1				1				1	3
CO2	2	2	1		1				1				1	3
CO3	2	2	1		1				1				1	3
CO4	2	2	1		1				1				1	3
CO5	2	2	1		1				1				1	3
1 – Slight,	2 – Mode	erate, 3 -	- Substa	ntial, BT-	Bloom's	Taxonon	ny							
					ASSE	SSMENT	PATT	ERN - THE	EORY					
Bloom's Category	s (K1) % Understanding (K2) % Applying (K3) % Analyzing (K4) % Creating (K6) % Total (K6) %													
CAT1		45		55									1(	00
CAT2		30		35		45							10	00
CAT3		30		30		40							10	00
ESE		25		30		45							10	00
* ±3% mag	* ±3% may be varied (CAT 1, 2 & 3 – 50 marks & ESE – 100 marks)													

	22MEX01 - RENEWABLE ENERGY SO (Offered by Department of Mechanical En	URCES gineering)					
			1	1		1	
Programme & Branch	All BE/BTech branches except Mechanical Engineering	Sem.	Category	L	т	Ρ	Credit
Prerequisites	Nil	5	OE	3	0	2	4
Preamble	This course discusses various technologies behind renewable integrating power from renewable energy plants with grid.	energy conve	ersion process	s and	the	challe	anges in
Unit – I	Grid Integration of Renewable Energy						9
Global Energy U – Variability – In Secure Commun	se- Energy Status in India -Lifetime of Fossil Fuels- Energy Conversi termittency - Dispatchability - Electric Grid Infrastructure - Integrat ication in the Smart Grid.	on Technolog ing Renewab	ies - Thermod le Energy into	ynam the (	ic Effi Grid -	cienc Sma	y art Grid -
Unit – II	Solar Energy and Wind Energy						9
Solar Energy: S Concentrating C PV System - S Environment Des Wind Energy: Ba - Wind Turbine	Solar Radiation – Measurements of Solar Radiation and Sunsh ollectors - Fundamentals of Solar Photo Voltaic Conversion – Solar tolar PV and Thermal Applications - Building Integrated Solar- sign (LEED) Certification. Isic Terms – Types - Horizontal Axis Wind Turbine-Vertical Axis Wind Generator and its Performance - Wind Turbine Applications - Red	nine - Solar r PV Systems Challenges d Turbine - Bu cent Develop	Thermal Col -Types- Desig - Economics ilding Integrate ments in Offs	lectors in of a - Lea ed Will	s –Fl a Sta dersh nd Tu Wind	at Pl ndalo nip in rbine Turb	ate and ne Solar Energy s ines and
Energy Storage	- Hybrid Systems - Challenges - Economics.	····•P·					
Unit – III	Bioenergy						9

Biomass Resources - Biomass Conversion Technologies - Factors Affecting Biogas Production -Biogas Plant - Types - KVIC Model -Deenbandhu Model - Cogeneration Plant in Rice Mill- Ethanol Production - Energy Recovery from Urban Waste. Transportation -Challenges - Economics.

#### Unit - IV **Geothermal Energy and Ocean Energy**

Geothermal Energy: Geothermal Resources-Structure of Earth's Interior - Electricity Production - Conversion Technology - Challenges - Economics.

9

Ocean Energy: Ocean Thermal Plants - Types-Tidal Plants - Types - Energy Estimation - Grid Interfacing of Tidal Power - Wave Energy Conversion Machines-Types - Buoy - Dolphin - Oscillating Water Column - Duck - Challenges - Economics. 9

#### Unit – V **Direct Energy Conversion Systems and New Energy Sources**

Direct Energy Conversion Systems: MHD Generators – Thermoelectric Power Generation.

New Energy Sources: Hydrogen - Generation - Storage - Transport and Utilization - Applications - Power Generation - Transport -Hydrogen Economy - Safety Issues - Fuel Cell - Principle - Types.

### LIST OF EXPERIMENTS / EXERCISES:

1.	Evaluate the cut in speed of the wind turbine.
2.	Analyze the effect of the variation of Tip speed ratio on the Coefficient of power of wind turbine.
3.	Determine the thermal energy gain at the focal point of a concentrating collector.
4.	Determine the efficiency of solar (Liquid/Air) collector.
5.	Plot the effect of variation of tilt angle on the PV module output.
6.	Plot the effect of variation of Solar intensity on the PV module output.
7.	Study on rooftop Solar PV plant.
8.	Study on weather monitoring station.
9.	Study the battery management system of solar PV module.
10.	Innovative model development based on renewable energy sources.
	Lecture:45, Practical:30, Total:75

TEXT BO	DOK:													
1.	John Twi	dell., "R	enewable	e Energ	y Resour	ces", 4 <sup>th</sup>	Edition, R	outledge	e ,New Yo	ork, 2021				
REFERE	NCES/ M	ANUAL	/ SOFTW	/ARE:										
1.	Kothari D Pvt. Ltd.,	).P., Sin New De	gal K.C., elhi, 2022	Rakes 2.	h Ranjan,	"Renew	able Ener	gy Sour	ces and E	Emerginę	g Technolog	ies", 3 <sup>rd</sup> E	dition, PH	I Learning
2.	Rai G.D.	"Non-C	onventio	nal Ene	ergy Sourc	ces", 6 <sup>th</sup>	Edition, Kł	nanna P	ublishers	, New De	elhi, 2022.			
3.	Laborato	ry Manu	al.											
COURSI On comp	E OUTCOI	MES: ne cours	e, the stu	Idents	will be able	e to							BT Map Highest I)	ped _evel)
CO1	explain th	ne conce	epts behir	nd the i	ntegration	of rene	wable ene	rgy .				Ν	Applying Anipulatio	(K3) on (S2)
CO2	describe performa	the worl nce of s	king and a olar and b	applica wind er	tions of so nergy syst	olar and v em	wind energ	gy syste	ms and e	valuate	he	Ν	Applying /lanipulatic	(K3) on (S2)
CO3	illustrate t	he bio-e	nergy pro	oductio	n techniqu	ies and t	he challer	nges in e	energy co	nversior	I		Applying	(K3)
CO4	explain the economic	ne worki cs and c	ng of geo hallenges	otherma S.	I and Oce	ean ener	gy conver	sion tec	hnologies	s along v	vith their		Applying	(K3)
CO5	explain th	ne direct	energy c	convers	ion syster	ms and n	new energy	y source	es.			Ν	Applying /lanipulatic	(K3) on (S2)
					Ma	nning of			and BSOs					
COs/PO	s PO1	PO2	PO3	PO4		PD6		POS		PO10	PO11	PO12	PSO1	PSO2
CO1	2	102	100	104	100	2	3	100	105	1010	1011	1012	1001	1002
CO2	1		2	3	2	3	3		3					
CO3	2					2	3							
CO4	2					2	3							
CO5	2					2	3							
1 – Sligh	t, 2 – Mod	erate, 3	<ul> <li>Substa</li> </ul>	ntial, B	T- Bloom'	s Taxon	omy							
					AS	SESSM	ENT PAT	TERN -	THEORY	,				
/ Test Cat	Bloom's egory*	Re	memberi (K1) %	ing	Understa (K2)	inding %	Apply (K3)	ing %	Analyzi (K4) %	ng %	Evaluating (K5) %	Cr (I	eating K6) %	Total %
С	AT1		20		40		40	)						100
C	AT2		20		40		40	)						100
C	AT3		20		40		40	)						100
E	ESE		20		40		40	)						100

\*  $\pm$ 3% may be varied (CAT 1, 2 3 – 50 marks & ESE – 100 marks)

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Preamb	ble	The co techniq	ours que	se s li	exp ke /	lore \N	es t DV	the A,	fu Fa	und Note	da or	im ial	en I D	ita les	ls o sigr	ofe n, F	exp Resp	erir por	me nse	enta e S	al d urfa	esi ice	gn, Me	sir ethc	ngle odc	e fa olog	act gy,	or a Ta	and guc	m hi l	ultif Vet	acto hod	ore	хре	erim	ent	S,	opt	im	izat	tion
UNIT –		Experie	ime	ent	al C	es	ign	F	un	da		<u>ier</u>	nta	als	<u>;</u>	De		<b>D</b>	rin	oin		of	De	<u></u>	~ 7	-										<b>F</b> <sub>2</sub>		rino (		etie	9
Sample	Size -	Normal	I P	rob	abi	⊏×i ity	Plo	ot -	Lir	ne:	ar	• R	leg	;gi jre	SS	ion	Mo	de	el.	cip	les	01	De	sig	rı- ı	lei			Jgy	- /		J V F	1-01	eps	5 II I		pe		ent	allu	лт -
UNIT –	II	Multifa	act	or I	Exp	eri	me	nta	al I	De	esi	ig	n																											ç	9
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UNIT –	III	Analys	sis	an	d Ir	te	pre	eta	tic	on	Μ	let	the	od	S																									ç	9
Measure Experim Numeric	es of nents-Y cal Exa	Variab 'ATE's amples.	oilit Ale	y-R gor	anl ithn	ting n fe	j N or J	/let AN	:hc O\	od- √A	-C \-F	olı Re	um gre	าท es	E sio	ffe n	ct Ana	Me alys	eth sis∙	od- -Ma	-Plc athe	ettin ema	ng atica	Me al I	etho Mo	od- de	An Is	aly: fror	sis n E	of Exp	V erin	aria nen	nce tal	e (. Da	AN ta-l	OVA Ilust	N) Trat	in ion	Fa Ti	acto hroi	orial ugh
UNIT –	IV	Specia	al E	xp	eriı	ne	nta	I D	es	siq	in:	s																												Ģ	9
Fraction Random	nal Fac n Facto	torial D ors - Rul	Des	igr fo	- Ex	Ve: pe	steo cteo	d D d N	)es lea	sig an	jns 1 S	s - Squ	- S uai	Spl res	lit s -	Plo Ap	t D prox	esi xim	ign nat	n-In e F	troc -Te	duc ests	tion 3.	۱ -	Re	esp	on	se	Su	rfac	e N	/letl	nod	olo	gy .	- E>	фe	rim	en	ts v	with
UNIT –	v	Taguch	hi	Me	ho	ds																																		ç	9
Steps in Parame	n Expe	erimenta d toleran	atio nce	on-l e de	Des esig	ign n c	us ono	sing cep	g ( ots	Or - (	rth Ca	iog asi	jor e {	nal Sti	I A udi	krra es.	ys-	Da	ita	Ar	naly	sis	-Ro	bu	st	De	sig	jn ·	- C	ont	rol	and	N t	ois	ə F	acto	ors	-S/N	1	Rati	ios-
List of I	Exerci	ses / Ex	хр	eriı	ner	ts	:																																		
1. Des	sign of	experim	ner	nts	for	turi	ning	j o	pe	ra	tic	วทร	s b	by .	Та	guo	chi r	me	tho	od.																					
2. Des	sign of	experim	ner	nts	for	mil	ing	op	ber	rat	tio	ns	s b	уT	Гас	guc	hi n	net	tho	d.																					
3. Opt	timize t	the para	amo	ete	rs v	hic	h a	affe	cts	s t	the	эq	านส	alit	y c	of C	NC	tu	rni	ng	оре	erat	tion	ı by	ν Ta	agı	JC	i m	eth	od.											
4. Opt	timize t	the para	am	ete	rs v	hic	:h a	affe	cts	s t	the	эq	านส	alit	ty c	of C	NC	m	illir	ng	оре	rat	ion	by	the	еT	ag	uch	ni m	eth	od.										
5. Pro	cess p	aramete	er	opt	miz	ati	on	in t	uri	nir	ng	j u:	sir	ng	ce	ntra	al co	om	ipo	site	e de	esig	gn n	net	ho	d.															
6. Pro	cess p	aramete	er	opt	miz	ati	on	in t	uri	nir	ng	j u:	sir	ng	the	e B	ox–	Be	hn	ke	n de	esig	gn r	net	tho	d.															
7. Pro	cess p	aramete	er	opt	miz	ati	on	in s	sur	rfa	ace	эg	jrir	ndi	ing	by	Re	spo	on	se	Su	fac	e N	/letl	hoo	d															
8. Mat	themat	ical mod	de	de	vel	opr	ner	nt fe	or	tu	Irni	inç	g c	pe	era	tior	n																								
9. Mat	themat	ical mod	de	de	vel	opr	ner	nt fe	or	mi	illi	ng	<b>j</b> 0	ре	rat	tion	1																								
10. Mat	themat	ical mod	de	de	vel	opr	ner	nt fe	or	dr	rilli	ing	JО	pe	erat	tior	١																								
																															Le	ctu	re:4	15,	Pra	ctic	al	30,	Т	otal	:75
TEVT D																																									
	Dougla:	s C. Mo	onte	aor	ner	/. "	Des	sia	n a	and	d /	An	ıal <sup>,</sup>	VS	is (	of F	xne	erin	ne	nts	<u>"</u> 1	0 <sup>th</sup>	Edi	itio	n, .	Joł	n '	Nile	ev :	and	SO	าร.	Uni	ted	Sta	ites	. 20	)20			
REFER	ENCES	S/MANU	UA	L/S	OF	T۷	A	RE	:						<u> </u>		p`				· , ·	-			, 、				-, (		20	,			2.0		,		-		
1. F	Phillip J	J.Rose,	"Т	ag	uch	i Te	ech	niq	lne	es	fo	or (	Qu	ıali	ity	Eng	gine	eeri	ing	<b>]</b> ", 1	2 <sup>nd</sup>	Edi	itior	n, N	/IcC	Gra	w	Hill	, 20	05											
2. N	Nicolo I	Belaven	ndr	am	,"Q	Jal	ty I	oy∣	De	si	igr	ו; ד	Та	gu	ıch	i te	chr	niqu	ues	s fo	or in	dus	stria	al e	xp	eriı	me	nta	tior	n", F	Prer	ntice	e Ha	all,	Lor	ldor	ı, 1	995	5.		
3. [	Krishna Delhi, 2	aiah, K a 2014.	and	1S	nah	ab	Jde	en	, F	<b>)</b> , '	"A	.pp	olie	94	De	esig	in o	fΕ	хр	eri	mei	nts	and	d Ta	agı	uch	ni N	1eth	nod	s",	PH	lea	arni	ng	oriv	ate	Lto	1., N	lev	V	
4. L	abora	tory Mar	inu	al.																																					

COURSE	OUTCO	MES:										В	T Mapped	
On comple	etion of th	ne cours	e, the stu	idents v	vill be abl	e to						(Hi	ghest Lev	el)
CO1	underst	and the	fundame	ntal cor	ncepts in	experime	ental desig	gn.				Unde Man	rstanding	(K2) S2)
CO2	identify	and des	sign the s	single a	nd multifa	actor exp	eriments.					Ap Man	oplying (K3 ipulation (	) 52)
CO3	select s mathen	uitable a natical m	analysis a nodel usir	and inte	rpretatior ssion and	n method: alysis.	s for expe	erimental	results a	and also o	develop	Ap Arti	oplying (K3 culation (S	) (4)
CO4	apply th surface	ne conce methoc	epts of sp I	ecial ex	periment	designs	and cond	luct expe	eriments	using res	ponse	Ap Mar	oplying (K3 hipulation (	) S2)
CO5	analyze experim	e the cor nents us	ncepts of ing tague	taguchi hi meth	experime od	ent desig	n for prac	tical prol	olems an	d conduc	rt -	An Man	alyzing (K4 ipulation (\$	4) S2)
					Ма	pping of	COs wit	h POs a	nd PSOs	5				
COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	P011	PO12	PSO1	PSO2
CO1	3	3	2	2					2					
CO2	2	3	2	3	1				2					
CO3	2	3	2	3	1				2					
CO4	2	3	2	3	1				2					
CO5	2	3	2	3	1				2					
1 – Slight	, 2 – Mod	lerate, 3	– Substa	antial, B	T- Bloom	's Taxon	omy							
					AS	SESSME	ENT PAT	TERN - <sup>-</sup>	THEORY	,				
Test / E Cate	Bloom's gory*	Re	memberi (K1) %	ing	Understa (K2)	nding %	Apply (K3)	/ing %	Analyz (K4) 9	ing %	Evaluating (K5) %	) Ci (	reating K6) %	Total %
CA	T1		15		40		45	5						100
CA	T2		10		35		55	5						100
CA	NT3		10		25		45	5	20					100
E	SE		15		25		40	)	20					100
* ±3% ma	y be vari	ed (CAT	1,23–	50 mar	ks & ESE	E – 100 m	narks)							

	22MEO01 - FUNDAMENTALS OF ERGO (Offered by Department of Mechanical En	NOMICS gineering	1)				
Programme & Branch	All BE/BTech branches except Mechanical Engineering	Sem.	Category	L	т	Ρ	Credit
Prerequisites	Nil	7	OE	3	0	0	3
		1	I	11			
Preamble	This course provides the basic concepts of ergonomics and various comfortable and safe workplace.	us tools ai	nd techniques	involv	ed in	desi	gning
Unit – I	Introduction to Ergonomics						9
Fundamentals o Workplace - Erg	of Ergonomics / Human Factors - Disciplines - Physical - Cognitiv onomic Principles - Applications - Ergonomic Evaluation - Question	ve and Or naire Surv	rganizational - /ey.	Need	ls of	Ergo	nomics in
Unit – II	Anthropometry						9
Human Body - Measuring Tech	Structure and Function - Types of Anthropometric Data - Applicat iniques - Statistical Treatment of Data and Percentile Calculations.	ion of Ant	hropometry in	Desi	gn - /	Anthr	opometric
Unit – III	Posture and Movement						9
Posture : Biom Movement: Lift Assessment (RE	echanical Background - Physiological Background - Sitting - Stand ng - Carrying - Pulling - Pushing - Repetitive Motions - Rapid Uppe EBA) and Ovako Working Posture Assessment (OWAS) Method.	ing Chang er Limb As	ge of Posture ssessment (RI	- Han JLA) ·	d and - Rap	l Arm bid E	Postures ntire Body
Unit – IV	Work Counter Behavior and Perception						9
Work Counter: Issues. Information Pr	Environmental Issues - Physical Work Capacity - Factors Affectin rocessing and Perception: Interaction with Machines - Mental Wor	g Work C kload.	apacity - Com	munio	cation	and	Cognitive
Unit – V	Work System Evaluation and Safety						9
Work system E Workplace Eval Safety: Occupa India - Case Stu	<b>Evaluation:</b> Contribution of Ergonomics to Workstation Design - A uation Tools - Case Studies. tional / Ergonomic Safety and Stress at Various Workplace - Health dies.	nalysis of Managem	Workplace Do nent Rules - So	esign cope c	- Wo of Erg	rk Er onon	nvelopes - nics in
							Total:45
TEXT BOOK:							
1. Bridger	Robert. "Introduction to Human Factors and Ergonomics", United K	ingdom, C	CRC Press, 20	17.			
REFERENCES							
1. Pamela Francis	a McCauley-Bush, "Ergonomics: Foundational Principles, Application 5, CRC Press, New York, 2011.	ns, and Te	chnologies", 1	<sup>st</sup> Edi	tion, T	Faylo	r &
2. Dul, Ja Taylor	n, and Weerdmeester, Bernard. "Ergonomics for Beginners: A Quicl & Francis, 2017.	< Reference	ce Guide", 3 <sup>rd</sup>	Editio	n. Un	ited k	Kingdom,

COUR: On con	SE OL	UTCON on of the	IES: e course	, the stude	ents wil	l be able	to						(	BT Mapp Highest L	oed evel)
CO1	defir	ne ergo	nomics a	and its con	nponer	ıts.							Ur	nderstandir	ng (K2)
CO2	mak	e use o	of anthrop	cometry of	f data ii	n product	design.							Applying	(K3)
CO3	exar	mine the	e commo	on risk fact	tors and	d areas fo	or ergon	omic im	prover	ment.				Applying	(K3)
CO4	appl	y ergon	iomic pri	nciples in	assigni	ng task t	o the wo	orkers						Applying	(K3)
CO5	plan	the ess	sential e	lements fo	r an ef	fective er	gonomic	s progr	amme					Applying	(K3)
			1		1	Mappi	ng of C	Os with	POsa	and PSC	Ds				
COs/F	os	P01	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO	1	3	2				2						1		
CO	2	2		2		3	3						1		
CO	3	2			1	2	3	2					1		
CO	4	2					3	1					1		
CO	5	2				2	3						1		
1 – Slig	ght, 2	– Mode	erate, 3 -	Substant	ial, BT-	Bloom's	Taxono	my							
						ASSES	SSMEN	ΓΡΑΤΤ	ERN -	THEOR	RY				
Tes C	t / Blo atego	oom's ory*	Re	ememberi (K1) %	ng	Understa (K2)	anding %	Apply (K3)	ving %	Analyz (K4) <sup>o</sup>	ing l %	Evaluating (K5) %	Cr (	reating K6) %	Total %
	CAT	1		20		45		35	5						100
	CAT	2		20		40		40	)						100
	CAT	3		20		40		40	)						100
	ESE	-		10		45		45	5						100
* ±3% I	may b	e varie	d (CAT 1	,2&3-	50 mar	ks & ESE	– 100 r	narks)					•		

	22MEO02 - PRINCIPLES OF MANAGEMENT AND INDUS (Offered by Department of Mechanical Eng	TRIAL P	SYCHOLOG	Y			
Programme & Branch	All BE/BTech branches except Mechanical Engineering	Sem.	Category	L	т	Ρ	Credit
Prerequisites	NIL	7	OE	3	0	0	3
			I				
Preamble	The course provides the principles, theory and practice of mana covers the skills to meet the challenges of management, environment.	gement f human	ollowed in org behavior in	jani: a d	zatior	is. In e and	addition, it I complex
Unit – I	Principles of Management						9
Definition and Management Th	Significance of Management - Evolution of Modern Managemer ought - Approaches to the study of Management - Basic Functions	nt - Scie of Manag	ntific Manage gement.	emei	nt - I	Devel	opment of
Unit – II	Planning and Organizing						9
Planning: Object Organization St	tives and Strategies - Policies and Planning Premises - Decisior ucture- Premises - Departmentalization - Decentralization - Organiz	n Making ational C	<ul> <li>Organizing</li> <li>Culture</li> </ul>	g: N	ature	and	Process –
Unit – III	Staffing, Leading and Controlling						9
Staffing: Selecti	on and training - Placement - Performance Appraisal - Career Str	rategy -	Organizationa	l De	evelop	oment	. Leading:
Managing Huma and Operations	in Factor - Leadership – Communication. Controlling: Process of Co Management - Preventive Control - Industrial Safety.	ontrolling	- Controlling	Tecl	nniqu	es - P	roductivity
Unit – IV	Industrial Psychology- Job Analysis and Organization Devel	opment					9
Industrial Psych Behavior. Job A Process – Orga	ology: Introduction - Concept and Meaning - Characteristics and nalysis: Importance- Conducting Job Analysis – Job Evaluation – nization Development: Managing Change – Empowerment – Down	d Scope Internal Sizing- V	- Historical I and External Vork Schedul	Deve Pay es.	elopm / Equ	ent - ity -	Individual The Legal
Unit – V	Employ Satisfaction, Motivation and Group Behavior						9
Employ Satisfa Communication Managing Stress	ction: Measuring Job Satisfaction – Consequences of Dissatis - Group Behavior, Teams, and Conflict - Stress Management- s.	faction. Predispo	Employee M osition – Sou	otiva rces	ation: – C	Orga onsed	anizational quences –
							Total:45
TEXT BOOKS:							
1. Harold Perspec	Koontz & Heinz Weihrich., "Essentials of Management: A tive",11th Edition, McGraw Hill Education Pvt. Ltd., New Delhi, 2020	n Intern ) for Unit	ational, Inno s I,II,III.	vatio	on a	nd L	eadership
2. Michael	G Aamodt., "Industrial Psychology", 7th Edition, Cengage Learning	, India, 2	013 for Units	V,V			
REFERENCE:							
1. Spector	P.E., "Industrial and organizational psychology: Research and prac	ctice". Jol	hn Wiley & Sc	ns,	2021		
L							

-															
COUR: On con	SE O npleti	OTCON on of th	<b>IES:</b> e cours	e, the stud	ents w	ill be able	to							BT Mapı Highest L	oed .evel)
CO1	inte	rpret the	e theory	and the p	ractice	of manag	ement.						U	nderstandi	ng (K2)
CO2	Infe	r the kr	nowledg	e of planni	ing an	d organizir	ng activi	ties in a	ın indu	istry			Uı	nderstandi	ng (K2)
CO3	pres	sent the	functio	ns of staffi	ng, lea	ding and o	controllir	ng of an	orgar	nization			U	nderstandi	ng (K2)
CO4	dev	elop an	intuitive	e understar	nding	of the job a	analysis	and em	ploye	e selectio	on in an c	organization	. Ur	nderstandi	ng (K2)
CO5	Ider	ntify em	ployee	satisfactior	n and ι	Inderstanc	the art	of mana	aging	groups.			U	nderstandi	ng (K2)
						Mappin	g of CC	)s with	POs a	nd PSO	s				
COs/P	POs	P01	PO2	PO3	PO	4 PO5	PO6	P07	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO	1	2					2				2	1			
CO2	2	2					2				2	1			
CO	3	2					2				2	1			
CO4	4	2					2				2	1			
CO	5	2					2				2	1			
1 – Slig	ght, 2	– Mode	erate, 3	- Substant	tial, B1	- Bloom's	Taxono	my	1			1		1	4
						VSSES	CMENIT	. рудте			/				
Τος	t/Bl	oom's	R	emember	ina	A33E3	anding		vina		ina	Evaluating		reating	Total
C	atego	ory*		(K1) %	ing	(K2)	%	(K3)	%	(K4)	%	(K5) %		(K6) %	%
	CAT	1		35		65									100
	CAT	2		35		65									100
	CAT	3		35		65									100
	ESE	Ξ		40		60									100
* ±3% ı	may t	be varie	d (CAT	1, 2 & 3 –	50 ma	rks & ESE	– 100 i	marks)							

		22MEO03 - WASTE HEAT RECOVERY SYSTEM A (Offered by Department of Mechanical Engi	ND STC neering	) )				
Progra & Bran	mme ch	All BE/BTech branches except Mechanical Engineering	Sem.	Category	L	т	Ρ	Credit
Prereq	uisites	Nil	7	OE	3	0	0	3
Preamb	ole	The course explores the fundamentals of waste heat technologies applicable for diverse industrial processe sustainability.	recove es to	ery and the enhance e	erma nere	al e gy e	nergy efficie	v storage ency and
Unit – I		Introduction						9
Therm Cycles Approa	odynam - Die ach.	ics Laws -Types of Waste Heat Sources - Principles of Energ sel Engines and Power Plant - Combined Plants- Potentia	gy Conv I for Ei	version - Rar nergy Conse	nkin erva	e Cy Ition	cle, ( -Tot	Combined al Energy
Unit – I		Waste Heat Recovery Systems		<u> </u>				9
Heat T Techn Heat B	ransfer ologies Boilers -	Fundamentals- Conduction, Convection, and Radiation- Se - Recuperators - Regenerators -Economizers - Plate Heat Exc Fluidized Bed Heat Exchangers - Heat Pipe Exchangers - He	lection change at Pum	Criteria for rs - Thermic nps – Sorptio	Wa Flu n S	ste I iid H ystei	leat eater ms.	Recovery s - Waste
Unit – I	II	Cogeneration						9
Introdu genera Combi Basic I	iction - ition Sys ned Cyc Perform	Topping Cycle -Bottoming Cycle – Combined Heat and Postems – Gas Turbine Co-generation Systems – Reciprocation cles Co-generation Systems – Advantages of Co-generation ance Calculations. Selection of Cogeneration Technologies.	ower (( ng IC I Techno	CHP) Cycle Engines Co- blogy- Co-ge	ger ger	Stear lerat atior	n Tu ion S n App	rbine Co- Systems – Dication
Unit – I	V	Thermal Energy Storage						9
Therm Materia Storag	al Energ als –Th e Syste	gy Storage, Sensible and Latent Heat - Sensible Heat Storag ermochemical Storage - Molten Salt, Metal Hydrides, Sorp ms – Potential for Energy Storage – Mass and Energy Balanc	ge Mate otion M e Anal	erials- Ice St laterials - H ysis of Therr	ora ybri nal	ge- I d Tł Enei	Phas herm rgy S	e Change al Energy torage.
Unit – V	/	Economic and Environmental Considerations						9
Investr Examp and Fi Energy	ment Co bles – P inancial / Storag	ost – Economic Concepts – Measures of Economic Performation rocedure for Optimized System Selection and Design – Load Framework. Sustainability and Environmental Impact of W le Systems.	nce – F Curves /aste H	Procedure fo - Sensitivity leat Recover	r Eo An ry,	cono alysi Co-g	mic / s – F Jener	Analysis – Regulatory ation and
								l otal:45
IEXIE	BOOKS:							
1.	Hussar	n Jouhara "Waste Heat Recovery in Process Industries "John	Wiley 8	& Sons, 2022	2. fc	or Un	its I,I	Ι.
2.	Horlock Publish		modyna	amics and ec	ono	omic	s" Kri	eger
3.	Ibrahim 2010. f	n Dincer and Mark A. Rosen, Thermal Energy Storage System or Unit IV.	is and A	Applications,	Joł	n W	iley 8	& Sons
4.	David F Kingdo	Flin, "Cogeneration - A User's Guide" Institution of Engineering m, 2009. for Unit V	g and T	echnology, L	.ond	lon,	Unite	d
REFER	ENCES:							
1.	Charles	s H.Butler, Cogeneration, McGraw Hill Book Co., 1984.						
2.	Institut	e of Fuel, London, Waste Heat Recovery, Chapman & Hall Pu	ublisher	s, London, 1	963	3.		
3.	Sengu	pta Subrata, Lee SS EDS, Waste Heat Utilization and Manage	ement,	Hemisphere	, W	ashii	ngtor	, 1983
4.	De Ne	vers, Noel., Air Polllution Control Engineering, McGrawHill, Ne	ew York	k,1995				

-															
COUR: On con	SE Ol npletic	UTCON on of th	IES: e course	, the stude	ents will	be able	to							BT Mapp Highest L	oed .evel)
CO1	unde stora	erstand age sys	the basi tems.	c thermod	ynamic	principle	es and c	oncepts	s of was	ste heat	recovery	and energ	<sup>jy</sup> Ui	nderstandi	ng (K2)
CO2	acqu	uire kno	wledge	pertaining	to varic	us waste	e heat re	covery	system	ns and th	neir appli	ications.		Applying(	(K3)
CO3	appl	y the p	rinciples	of energy	conver	sion and	distribut	tion to c	lesign (	of cogen	eration s	systems.		Applying(	(K3)
CO4	lden appl	tify and ications	l analyze 3.	the sensi	ble, late	ent, and f	hermoc	hemica	l storag	je syster	ms and t	heir	U	nderstandi	ng (K2)
CO5	Eval	luate th	e econor	nic viabilit	y and e	nvironme	ental im	pact of l	heat re	covery a	ind stora	ge system		Applying(	(K3)
															. ,
						Mappin	g of CO	s with	POs ai	nd PSO	S				
COs/P	Os	PO1	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO,	1	3	2												
CO2	2	3	2	1											
CO	3	3	2		2										
CO4	4	3		1											
COS	5	3	1	1				2							
1 – Slig	ght, 2	– Mode	erate, 3 -	Substanti	al, BT-	Bloom's	Taxono	my							
						ASSES	SMENT	PATTE	ERN - 1	HEOR	,				
Tes C	t / Blo atego	oom's ory*	Re	ememberi (K1) %	ng l	Jndersta (K2)	anding %	Apply (K3)	ying ) %	Analyz (K4) 9	ing %	Evaluating (K5) %	) C	reating (K6) %	Total %
	CAT	1		25		45		30	)						100
	CAT	2		15		40		45	5						100
	CAT	3		25		40		35	5						100
	ESE			25		40		35	5						100
* ±3% I	may b	e varie	d (CAT 1	, 2 & 3 - 5	50 mark	s & ESE	– 100 r	narks)							

## 22MEO04 - SAFETY MEASURES FOR ENGINEERS (Offered by Department of Mechanical Engineering)

								-
Program Branch	nme &	All BE/BTech branches except Mechanical Engineering	Sem.	Category	L	Т	Ρ	Credit
Prerequ	isites	Nil	8	OE	3	0	0	3
				I	1			
Preamble	е	The course explores the knowledge on safety aspects, proce industries, while performing various types of activities in electric personnel protection equipment's and risk assessment procedure	edures a cal, chem es.	nd guidelines iical industrie	s to es wit	be fo h app	llowed propriate	in various e personal
Unit – I		Safety Management and Accident Prevention						9
Safety M Sampling Accident	Managei g Techn nt Preve t Reporti	<b>ment</b> : Need for Safety - Safety and Productivity - Safety Manage ique - Incident Recall Technique - Plant Safety Inspection. <b>ntion</b> : Nature and Causes of Accidents - Accident Proneness - ( ng and Investigation - Safety Education and Training.	ement Te Cost of A	chniques - J ccident - Acc	ob S ciden	afety t Prev	Analysis	s – Safety Methods -
Unit – II		Electrical and Fire Safety						9
Safety M Atmosph Statutory Maintena	Veasures here - S yand oth ance and	azards of Electricity - Statutory Provisions - Indian Standards - Electric work - Overload and Other Protections - Portable E tatic Electricity - Energy Conservation and Safety Fire Phenomer standards - Design for Fire Safety - Fire Prevention and Protect Training for Fire Protection.	Electrical nena - C ion Syste	Apparatus - lassification m - Explosio	Elect of Fi n Phe	tric W re an	ork in H d Extingena - Ins	Hazardous guishers - spection,
Unit – III	I	Safety in Chemical Industry						9
Types of Material Pollution Maintena	of Chen (Property Hazard ance - W	nical Industry - Statutory Provisions - Indian Standards – /)Hazards and Controls – Storage Hazards & Controls - Process s & Controls - Instrumentation for Safe Plant Operations - Saf ork Permits of Hazardous Work- case studies	<ul> <li>Types</li> <li>Hazards</li> <li>Transference</li> </ul>	of Chemica & Controls - er of Chemic	al H Utility cals	azard / Haz · Insp	s & C ards & ection,	controls – Controls – Testing &
Unit – IV	/	Personnel Protection Equipment (PPE) and Test Standards						9
Need an Respirat Standard	nd Limita tory Equi ds	tion - Statutory Provisions - Indian & Other standards - Selection a pment - Training, Maintenance, Precaution and Care of PPE - Det	nd Classi ection Ec	fication - Nor uipment - PF	n Res PE Te	pirato sting	ory Equi Proced	pment - ures &
Unit – V	1	Risk Assessment						9
Basic Co Hazarda Emerger	oncepts ind Risk ncy Plan	of Risk - Safety Appraisal, Analysis and Control Techniques - Assessment Techniques - Reliability Engineering - Major Accid s.	Accident ent Haza	Investigation rd (MAH) Co	n, An ontrol	alysis ⊢- Or	and R n-site ar	eporting - nd Off-site
								Total:45
TEXT BO	OOK:							
1.	Mistry K	U., "Fundamentals of Industrial Safety and Health", 2 <sup>nd</sup> Edition, Sid	ddharth I	Prakashan, A	hme	dabac	l, 2008.	
REFERE	ENCES:							
1.	John Ca 2012.	dick, Mary CapelliSchellpfeffer& Dennis Neitzell, "Electrical Safety	Handboo	ok", 4 <sup>th</sup> Edition	n, Mo	Graw	-Hill Ed	ucation,
2.	Davies \	J. & Thomasin K., "Construction Safety Hand Book", 2 <sup>nd</sup> Edition,	Thomas <sup>-</sup>	Felford Ltd., L	ondo	on, 19	96	
3.	Rao S, J Publishe	ain R.K. & Saluja H.L., "Electrical Safety, Fire Safety Engineering ars, 2012.	and Safe	y Manageme	ent", 2	2 <sup>nd</sup> Ec	lition, Kl	hanna

COUR On cor	SE O	UTCON on of the	IES: e course	, the stud	ents wil	l be able	to							BT Map (Highest I	ped _evel)
CO1	perc	ceive the	e safety ı	managem	ent cor	ncepts an	d accide	ent prev	rention	method	S.		Ur	nderstandi	ng (K2)
CO2	app safe	ly appro e earthir	opriate m ng practic	easuring æs.	and /or	insulating	g equipr	nent, us	se of fi	re exting	uishers	and		Applying	(K3)
CO3	iden safe	ntify the e plant c	hazards	in chemic s.	al indu	stries dur	ing tran	sporting	g, stori	ng and p	rocessir	ng to ensure		Applying	(K3)
CO4	sele	ct the F	PE base	d on the	type of	industry a	and star	dards						Applying	(K3)
CO5	impl prep	lement t baredne	the techn ss with th	iques like he proper	e risk as knowle	ssessmer edge on a	nt disast accident	er mana preven	ageme tion.	nt and e	mergeno	су.		Applying	(K3)
						Маррі	ng of C	Os with	n POs	and PSC	Ds				
COs/F	os	PO1	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO	1	1					3	2	1						
CO	2	1					3	2	1						
CO	3	1					3	2	1						
CO	4	1					3	2	1						
CO	5	1					3	2	1						
				1 –	Slight,	2 – Mode	erate, 3 -	- Subst	antial,	BT- Bloc	om's Tax	onomy			
						ASSE	SSMEN	Τ ΡΑΤΊ	ERN -	THEOR	Y				
Tes C	atego	oom's ory*	Re	memberi (K1) %	ng	Understa (K2)	anding %	Apply (K3)	ying %	Analyz (K4) 9	ing %	Evaluating (K5) %	С	reating (K6) %	Total %
	CAT	1		15		45		40	)						100
	CAT	2		20		40		40	)						100
	CAT	3		30		30		40	)						100
	ESE	Ξ		30		35		35	5						100
* ±3%	may b	e varie	d (CAT 1	, 2 & 3 –	50 mar	ks & ESE	E – 100 r	marks)			<u> </u>				

# 22MEO05 - ENERGY CONSERVATION IN THERMAL EQUIPMENTS (Offered by Department of Mechanical Engineering)

Progra Branci	mme & ז	All BE/BTech branches except Mechanical Engineering	Sem.	Category	L	т	Р	Credit
Prereq	uisites	Nil	8	OE	3	0	0	3
				L			1	
Pream	ole	This course provides the knowledge on the methods to conserve evaluation of the performance parameters.	/e energy	/ in thermal e	quip	ment	t after	a detailed
Unit –		Basics of Energy						9
Energy Measu Energy Industr	<ul> <li>Forms of rement of E</li> <li>Performanties.</li> </ul>	of Energy – Power – Units – Estimation of Energy Requirement – Electrical Quantities - Energy Efficiency and Conservation – Plant nce – Energy Audit and Survey Instruments - Energy related CO	- Electrici Energy F 2 emissio	ity – Voltage Performance - ons – Strateg	– Cu - Pro ies f	urrent oduct or Er	t – Re ion Fa nergy	esistance – actor Plant Savings in
Unit –		Energy Conservation in Steam System						9
Steam - Perfo	Phase Dia rmance As	gram - Steam Distribution - Steam Pipe Design and Sizing – Stean sessment Methods -– Energy Saving Opportunities.	m Traps -	- Selection -	Ope	ratior	n – Ma	aintenance
Unit –		Energy Conservation in Boilers and Furnaces						9
Boiler: Assess Furnac	Water Tre ment using e: Perform	eatment – Water to Steam Conversion – Hot Water Systems – Hot Direct and Indirect Method – Energy Conservation Opportunities nance Evaluation – General Fuel Economy Measures- Estimation	Heat trans of fuel sa	sfer Coefficie vings.	nts -	– Boi	ler Pe	erformance
Unit –	IV	Energy Conservation in Air conditioners						9
Load C Energy	haracterist Conserva	tics and Calculation - Factors Affecting Cooling Rate - Air conditi tion Opportunities – Energy Monitoring and Control System.	oner – N	/orking – Typ	es –	- Effic	ciency	– Sizing -
Unit –	V	Cogeneration						9
Need - Cogen Perforr	<ul> <li>Classification</li> <li>Synance Association</li> </ul>	ation – Commercial Cogeneration Systems – Factors and Tech stems – Energy Savings through Cogeneration Systems - essment.	nnical Pa Relative	rameters Infl Merits of C	ueno Coge	cing nerat	the S tion S	election of Systems –
								Total:45
TEXT	BOOK:							
1.	Guide Bo Efficiency	oks for National Certification Examination for Energy Managers ar v, 2015.	nd Audito	rs, 4 <sup>th</sup> Edition	, Bui	reau	of Ene	ergy
REFEF	RENCES:							
1.	Sonal De	esai, "Handbook of Energy Audit", 1 <sup>st</sup> Edition, McGraw Hill Educati	on, New	Delhi, 2017.				
2.	Stephan / York, 201	A Roosa, Steve Doty, Wayne C Turner, "Energy Management Har 8.	ndbook",	9 <sup>th</sup> Edition, Ri	verl	Publi	shers,	New

COURSE OUTCOMES:BT MappedOn completion of the course, the students will be able to(Highest Level)															
CO1	infe	r the ba	isics of e	energy with	refere	ence to er	nergy co	nservat	ion.					Jnderstand	ing (K2)
CO2	expl	ain the	energy	conservati	on opp	ortunities	in stea	m syste	m.					Applying(l	K3)
CO3	disc	uss the	energy	conservat	ion opj	oortunities	s in boile	ers and	furnac	es.				Applying(I	<b>K</b> 3)
CO4	eluc	idate th	ne energ	y conserva	ation o	oportuniti	es in air	conditio	oners.					Applying(	K3)
CO5	qua	ntify the	e energy	savings th	nrough	cogenera	ation							Applying(	K3)
Mapping of COs with POs and PSOs															
COs/P	COS/POS PO1 PO2 PO3 PO4 PO5 PO6 PO7 PO8 PO9 PO10 PO11 PO12 PS01 PS02														
CO	SPOS         FOI         FOI														
CO2	2	2					1	3					1		
COS	3	2		2			1	3					1		
CO4	4	2		2			1	3					1		
COS	5	3		2			1	2					1		
1 – Slig	ght, 2 -	– Mode	rate, 3 -	Substanti	al, BT	Bloom's	Taxono	my		-1	I.				
								-							
						ASSES	SMENT	PATTE	ERN - '	THEORY	,				
Tes C	t / Blo atego	oom's ory*	Re	ememberi (K1) %	ng	Understa (K2)	anding %	Apply (K3)	ving %	Analyz (K4) 9	ing l %	Evaluating (K5) %	)	Creating (K6) %	Total %
	CAT	1		30		50		20	)						100
	CAT2 15 50 35 100														
	CAT3 15 50 35 100														
	ESE 15 50 35 100														
* ±3% I	may b	e varie	d (CAT 1	, 2 & 3 – 5	50 mar	ks & ESE	– 100 r	narks)	•						

## 22MEO06 - CLIMATE CHANGE AND NEW ENERGY TECHNOLOGY (Offered by Department of Mechanical Engineering)

Progra Branch	mme &	All BE/BTech branches except Mechanical Engineering	Sem.	Category	L	т	Ρ	Credit
Prereq	uisites	Nil	8	OE	3	0	0	3
			_					
Preamb	ble	This course provides an overview on global and national clima energy technologies for sustainable development are also covere	ate chang ed in this	ge implicatior course.	ns. li	n ado	lition,	the future
Unit – I		Climate Change						9
Prelimi Effect - Impact	nary Conc - Green H of Climate	epts of Climate Change - International Climate Policy - Causes ouse Gases in Atmosphere - Global Warming - Effects of Global Change on Agriculture – Forest - Water Resources - Monsoon Sy	s of Clim Warming /stem of I	ate Change g - Climate C India.	- Er hang	ihanc je Sc	ed G enario	reenhouse o of India -
Unit – I	1	Energy Transition						9
Person Energy Emissio	al Energy Transitior ons - Carb	Needs - Personal Carbon Dioxide Balance - Carbon Dioxide Sequ in Heat Sector - Transport Sector - Electricity Sector - Direct and on-free Technology.	lestration I Indirect	- Combined Emissions in	Heat Ene	and rgy S	Powe Sector	er System - - Net-zero
Unit – I		Renewable Energy System						9
Solar T Designi Power I	hermal Sy ing Grid-co Plants - Gr	stems - Domestic Solar Water Heating – Space Heating - Solar F onnected Systems - Renewable Power Plants – Solar Photovolta id-connected Wind Turbines - Geothermal Heat and Power Plants	PV Syster ic Power - Biomas	ms - Designir Plants - Cor ss Heat and F	ng S ncen Powe	tand- tratin er Pla	alone g Sola nts.	Systems - ar Thermal
Unit – I	V	Battery Technologies						9
Introdu Voltage Secono Applica	ction to Ba e Data - Se dary Batten ation – Batt	atteries – Electrochemical Principles and Reactions - Classification ervice Life - Ohmic Load Curve - Effect of Operating Temperature ies – Types - Discharge Curves - Terminal Voltages - Plateau N ery Performance Evaluation - Factors Affecting Battery Performan	on - Prim e on Serv Voltage - ice - Adva	ary Batteries /ice Life - Re Lead Acid E anced Batteri	- Ty serv atte <u>es fo</u>	pes - e Bat ries - or Ele	- Serv teries - Con ctric \	vice Time - – Types - struction – /ehicles.
Unit – V	V	Energy Storage Technology						9
Deman Efficien TES - F	d for Powe cy of Ener Planning ar	er Systems - Overview of Energy Storage Technologies - Energy S gy Storage systems -Thermal Energy Storage (TES) using Phase ad Implementation of TES - Environmental impact of TES systems	Storage N e Change	/lethods – Ele e Materials -	ectric Ener	al Ste gy C	orage onser	Systems - vation with
								Total:45
TEXT E	BOOKS:							
1.	Volker V. I,II,III.	Quaschning, "Renewable Energy and Climate Change", 2 <sup>nd</sup> Ed	dition, W	iley Publication	ons,	USA	, 201	9 for Units
2.	Beard Kir	by W, "Linden's Hand Book of Batteries", 5 <sup>th</sup> Edition, McGraw Hill	Book Co	mpany, New	York	, 201	9 for	Units IV,V.
REFER	ENCES:							
1.	Ibrahim I USA, 202	Dincer and Marc A. Rosen, "Thermal Energy Storage: Systems and 21	d Applica	tions", 3 <sup>rd</sup> Ec	ditior	, Wil	ey Pu	blications,
2.	Mehmet McGraw	Kanoglu, Yunus A. Cengel, John M. Cimbala, "Fundamentals and Hill Book Company, New York, 2020.	Applicati	ons of Renev	vable	e Ene	rgy",	1 <sup>st</sup> Edition,

COUR On cor	SE OI	UTCON on of th	<b>IES:</b> e cours	e, the stud	ents w	ill be able	e to							BT Map (Highest L	ped _evel)
CO1	expl	lain the	global	and Indian	climat	e change	scenario	C						Applying	(K3)
CO2	illus	trate th	e enerç	y transitior	n mech	nanism in	transpor	t and el	ectricit	y sectors	S.			Applying	(K3)
CO3	desi	ign rene	ewable	energy sys	tems	or heat a	nd powe	r.						Applying	(K3)
CO4	clas batt	sify the eries	batteri	es and exp	lain th	e perform	ance eva	aluation	metho	ods for pi	imary ar	nd seconda	ry	Applying	(K3)
CO5	CO5describe the working of electrical and thermal energy storage systems.Applying (K3)														
Mapping of COs with POs and PSOs															
COs/F	OS/POS PO1 PO2 PO3 PO4 PO5 PO6 PO7 PO8 PO9 PO10 PO11 PO12 PSO1 PSO2														
CO	1			1			2	3	1						
CO	2			3			1	3							
CO	3			3			1	3							
CO	4	3		2				1							
CO	5	3					1	3							
1 – Slig	ght, 2	– Mode	erate, 3	- Substan	ial, B1	- Bloom's	Taxono	my	1		1	L		- 4	
	-														
						ASSE	SSMENT	PATT	ERN - 1	THEORY	,				
Tes C	atego	oom's ory*	F	emember (K1) %	ing	Underst (K2	anding ) %	Apply (K3)	ying ) %	Analyz (K4) 9	ing %	Evaluating (K5) %	)	Creating (K6) %	Total %
	CAT	1		20		3	C	50	)						100
	CAT2 20 30 50 100														
	CAT3 20 30 50 100														
	ESE 20 30 50 100														
* ±3%	may b	e varie	d (CAT	1, 2 & 3 –	50 ma	rks & ES	E – 100 ı	marks)							

		22GEO01 - GERMAN LANGUAGE LEVE	EL 1									
		(Offered by Department of Electronics and Communica	tion Engir	neering)								
Progra Branci	ımme& n	All BE/BTech Engineering and Technology Branches	Sem.	Category	L	т	Ρ	Credit				
Prereq	uisites	Nil	All	OE	4	0	0	4				
Pream	ble	This course serves as an introduction to the German language a cultural aspects of Germany and German speaking countries. Or the basic day to day vocabulary. On keen learning one would be be able to reciprocate to basic questions	nd aware ne can lea able to ui	ness towards ( irn to introduce nderstand the	Germa one: sente	an life self a nce s	estyle nd ab structu	and e to gain re and				
Unit –	<u> </u>	Good Day (Guten Tag)						12				
Greetir Simple	ngs, Self-intro sentences, V	duction and introducing others, Numbers, Alphabets, Countries a erb conjugation and personal pronoun.	nd langua	ages spoken.	Gram	mar	– W c	uestions,				
Unit – II         Friends & Colleague ( Freund und Kollegen):         12           Uabbies         Desfassion         Martha         Second and Concepts         12												
Hobbie questic	es, Profession	, Week, Months, Season and Generate Profile. Grammar - Ar	ticles, Plu	ural, Verbs –	have	and	to be	, Yes/No				
Unit - III       n the City (In der Stadt):       12												
Name Negatio	of places/build on articles and	lings in the city, asking for directions, Understanding means of trar I Imperative	nsport. Gr	ammar – defir	nite ar	nd ind	definit	e articles,				
Unit –	IV	Food and Appointment (Essen und Termin):						12				
Food, Unders articles	Shopping, in standing time	itiate conversations to understand and do shopping. Gramma and reciprocating, Appointments, Asking excuse, Family. Gramma Modal verbs- <i>müssen, können, wollen</i>	ar – Acc ar – Prep	usative case, ositions: <i>am,</i>	Vert <i>um, v</i>	os w ronl	ith Ac bis, Po	cusative. ossessive				
Unit –	V	Socializing (Zeit mit Freunden):						12				
Plannir with Ac	ng together, B cusative case	irrthday, Invitation, Restaurant, looking for specific information in t e, Past tense of have and to be, Personal pronoun with Accusative.	texts. Gra	ımmar – Sepa	rable	verb	s, Pre	positions				
								Total:60				
TEXT	BOOK:											
1.	Stefanie De und Glossar	ngler, Paul Rusch, Helen Schmitz, Tanja Sieber, "Netzwerk Deut with 2 CDs", Goyal Publishers, Delhi, 2015.	sch als F	remdsprache	A1–u	rsbuo	ch, Ar	peitsbuch				
REFEF	RENCES:											
1.	https://ocw.n	nit.edu – Massachusetts Institute of Technology Open Courseware										
2.	https://www.	dw.com/en/learn-german - Deutsche Welle, Geramany's Internatio	nal Broad	lcaster								

COUR On co	SE OUTCOMES: mpletion of the course, the students will be able to	BT Mapped (Highest Level)									
CO1	understand structure of language and introducing each other	Remembering (K1)									
CO2	CO2 understand vocabulary on seasons and basic verbs Understanding (K2)										
CO3	ask for directions in a new place and avail transport as required	Understanding (K2)									
CO4	understand food habits of German and ask for appointments.	Understanding (K2)									
CO5	CO5 learn to socialize in a German speaking country Understanding (K2)										
CO5	CO4       Understand food habits of German and ask for appointments.       Understanding (K2)         CO5       learn to socialize in a German speaking country       Understanding (K2)										

	Mapping of COS with POS and PSOS													
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1								1	2	3		3		
CO2								1	2	3		3		
CO3								1	2	3		3		
CO4								1	2	3		3		
CO5								1	2	3		3		
1 – Slight, 2	1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy													

ASSESSMENT PATTERN - THEORY												
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %					
CAT1	75	25					100					
CAT2	25	75					100					
CAT3	25	75					100					
ESE 25 75 100 100												
* ±3% may be varied (C	* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)											

		22GEO02 - JAPANESE LANGUAGE L	EVEL 1											
	(Offered by Department of Electronics and Communication Engineering)  Programme&													
Progra Branch	mme& N	All BE/BTech Engineering and Technology Branches	Sem.	Category	L	т	Ρ	Credit						
Prereq	uisites	Nil	All	OE	4	0	0	4						
Preamb	ble	The basic level of Japanese which provides understanding one to greet, introduce oneself and other person and also p conversations	of Hiragana provides the	a, Katakana ar e ability to unc	nd 55 Iersta	Kanj nd ba	is also asic d	o enables ay to day						
Unit – I Introduction to Hiragana and Katakana: 12														
Chart 1, Chart 2, Chart 3, Annexures 1 and 2 and basic Japanese rules along with similar sounded vocabularies for each chart.														
Unit – II Introduction to Nouns, various particles and usages: 12														
Forming	Forming simple sentences, asking questions, positioning differentiation and owning fundamentals – new particles and usages													
Unit – III Introduction of Verbs, time and place markers: 12														
Usage particle	of action woi s in a senter	rds in sentences and framing them – place and time markers u ice.	sages – gi	ving and recei	ving -	- omi	ssion	of certain						
Unit – I	IV	Introduction of Adjectives, Adverbs and usages:						12						
Describ introduc	oing nouns a ction of the li	and verbs and framing them to relate day to day conversation kes and dislikes expressions	ons- positiv	e and negativ	/e en	ding	of the	e same –						
Unit – V	V	Introduction to Counters and Kanji:						12						
How to and qua	use number antifiers – 55	s-How to use quantifiers-Present form of adjectives and Nour kanji characters	ns-Other ne	ecessary partie	cles-⊦	low t	o use	numbers						
								Total:60						
TEXT E	BOOK:													
1.	1. "MINNA NO NIHONGO–Japanese for Everyone", 2 <sup>nd</sup> Edition, Goyal Publishers & Distributors Pvt. Ltd., New Delhi, 2017.													
REFER	ENCES:													
1.	Margherita	Pezzopane, "Try N5", 2 <sup>nd</sup> Edition, Tankobon Softcover, Japan,	2017.											
2.	Sayaka Kur	ashina, "Japanese Word Speedmaster", 2 <sup>nd</sup> Edition, Tankobon	Softcover,	Japan, 2018.										

COUR On co	SE OL mpleti	JTCON ion of t	IES: the cour	rse, the s	tudent	s will be	able to						()	BT Mapp Highest L	oed .evel)
CO1	read	and ur	nderstar	d typical	express	sion in Hir	agana a	nd Katal	kana				Ren	nembering	g (K1)
CO2	gree	t and ir	ntroduce	oneself a	and oth	ər							Und	erstandin	g (K2)
CO3	comi	munica	te day te	o day con	versati	ons – bas	ic level						Und	erstandin	g (K2)
CO4	unde	erstand	the Kar	ijis in Jap	anese	Script							Und	erstandin	g (K2)
CO5	CO5 comprehend concept of numbers, days, months, time and counters Understanding (K2)														
						Маррі	na of C(	Os with	POs ai	nd PSOs					
COs/P	Os	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO	1								1	2	3		3		
CO2	2								1	2	3		3		
CO	3								1	2	3		3		
CO4	4								1	2	3		3		
COS	5								1	2	3		3		
1 – Slię	ght, 2 -	– Mode	erate, 3 -	- Substar	itial, BT	- Bloom's	Taxono	my							
-						ASSE	SSMEN		ERN - 1	HEORY					<b>T</b> ( )
C	atego	oom′s ory*	Re	member (K1) %	ing	Understa (K2)	anding %	Apply (K3)	/ing %	Analyz (K4) 9	ing %	Evaluating (K5) %		reating K6) %	l otal %
	CAT1	1		75		25									100
	CAT2	2		25		75									100
	CAT3 25 75 100														
	ESE 25 75 100 100														
* ±3%	may b	e varie	d (CAT	1,2,3 – 50	) marks	& ESE –	100 mai	rks)			<u> </u>		·		

		22GE003 - DESIGN THINKING FOR EN	GINEERS					
		(Offered by Department of Computer Science and	nd Engineerin	g)				
Programm Branch	e &	All BE/BTech Engineering and Technology Branches	Sem.	Category	L	т	Ρ	Credit
Prerequisi	tes	Nil	5	OE	3	1	0	4
Preamble		Design Thinking is human-centered problem solving tool of creation and stakeholder feedback to unlock creativity a idea/solutions.	which empha and innovatio	nsize on emp on, to devise	athy, es fe	coll asibl	abora le ar	ation, co- nd viable
Unit – I		Design Thinking and Explore:						9+3
Design Th Building for Mapping – Unit – II Empathize User Insigh	inking: ł r Design Opportur e: Methoc ats - User	<ul> <li>Key Principles and Mindset – Five Phases, Methods and Too Thinking – Explore: Methods &amp; Tools – STEEP Analysis – S nity Framing.</li> <li>Empathize</li> <li>Is &amp; Tools – Field Observation – Deep User Interview – Emp Persona Development.</li> </ul>	Is of Design Strategic Prior	Thinking – Us ities – Activity User Journey	ser G / Sys	Buide Stem	– Fo – Sta	oundation akeholder <b>9+3</b> Finding –
Unit – III		Experiment						9+3
Experimen Journey – F Unit – IV Engage: M Users.	nt: Metho Prototypin lethods 8	ds & Tools – Ideation – SCAMPER – Analogous Inspiration ng– Idea Refinement. Engage & Tools – Story Telling – Art of Story Telling – Storyboarding -	- Deconstru	ct & Reconst	ruct Coll	– Us	er E> Feedb	xperience 9+3 back from
Unit – V		Evolve						9+3
<b>Evolve</b> : Me Viability An	ethods & alysis – I	Tools – Concept Synthesis – Strategic Requirements –Evolve nnovation Tools using User Needs, CAP, 4S – Change Manag	ed Activity Sys Jement - Quic	stems – Activi k Wins. <b>Lecture:4</b>	ity Sy 5, Tu	/sten	n Inte al:15,	egration – <b>Total:60</b>
TEXT BOO	K:							
1. Lee	e Chong	Hwa, "Design Thinking The Guidebook", Design Thinking Mast	ter Trainers of	f Bhutan, 2017	7. (E·	-Bool	k)	
REFEREN	CES:							
Jea 1. Pre	anne Lieo ess, 2011	dtka and Tim Ogilvie, "Designing for Growth: A Design Thin	king Tool Kit	for Managers	s", C	olum	ibia l	Jniversity
2. Jea Co	anne Lieo Iumbia U	dtka, Tim Ogilvie, and Rachel Brozenske, "The Designing for ( niversity Press, 2014.	Growth Field	3ook: A Step-	by-S	tep F	Projec	t Guide",
I								

COUR On co	COURSE OUTCOMES:       BT Mapped         On completion of the course, the students will be able to       (Highest Level)														
CO1	Cor	nstruct	design cł	nallenge	and ref	rame th	ne des	ign chall	enge in	to design op	portunity.			Applying	g (K3)
CO2	Inte unc	rview t over th	he user, ne deep u	and kno ser insig	w the fe hts and	elings I needs	of user	s to fost	er deep	user unders	tanding and	be able to	)	Applying	g (K3)
CO3	Dev	velop io	leas and	prototyp	es by b	rain sto	orming	using the	e ideati	on tools.				Applyin	g (K3)
CO4	Org	anize	the user w	valkthro	ugh exp	erience	e using	ideal us	er expe	erience journ	ey.			Applying	g (K3)
CO5	Dev ear	velop s lier pha	mart strat ases.	egies &	implem	entatio	n plan	that will	deliver	achieve the	idea/solution	deduced	from	Applyin	g (K3)
Manning of COs with POs and PSOs															
Mapping of COs with POs and PSOs															
COS/P	COs/POs         FO         PO2         PO3         PO4         PO5         PO6         PO7         PO8         PO9         PO10         PO11         PO12         PS01         PS02														
CO1	CO1         3         3         1         3         2         1         3         1														
CO2	2	3	3	3	1					3	2	1		3	1
COS	3	3	3	3	1					3	2	1		3	1
CO4	1	3	3	3	1					3	2	1		3	1
COS	5	3	3	3	1					3	2	1		3	1
1 – Slię	ght, 2	– Moo	derate, 3	– Substa	antial, B	T- Bloc	m's Ta	axonomy					•		
						AS	SESS	MENT P	ATTER	N - THEOR	Y				
Te	ests		Rememi (K1)	bering %	Unde	erstano (K2) %	ling	Apply (K3)	/ing %	Analyzin g (K4) %	Evaluati ng (K5) %	Creat (K6) %	ing %	Tota	%
CA	\T 1		10			20		70	)					100	)
CA	AT 2		10			15		75	;					100	)
CA	CAT 3 10 15 75 100														
E	ESE 10 15 75 100														
* ±3%	may	be vari	ed (CAT	1,2,3 – 5	50 mark	s & ES	E – 10	0 marks	)			•			

	22GEO04 - INNOVATION AND BUSINESS MODEL	DEVELO	PMENT									
	(Offered by Department of Mechatronics Engi	ineering)										
Programme & Branch	All BE/BTech Engineering and Technology Branches	Sem.	Category	L	т	Ρ	Credit					
Prerequisites	Nil	6	OE	3	1	0	4					
Preamble	This course will inspire the students to think innovation concept	ts and id	eas for busine	ess m	odel	deve	lopments.					
Unit - I	Innovation and Design Thinking:						9+3					
Design Thinking a tools: Analogies –	aativity– Types of innovation – challenges in innovation- steps in t nd Entrepreneurship – Design Thinking Stages: Empathize – Defi Brainstorming – Mind mapping	nnovatio ne – Idea	n manageme ate – Prototyp	nt- 7 e – T	conc est. I	erns Desig	of design. In thinking					
Unit - II	User Study and Contextual Enquiry:						9+3					
Explanatory research – focus of customer needs –	rch – primary and secondary data – classification of secondary o proups – depth interviews – analysis of qualitative data – survey o prganize needs into a hierarchy –establish relative importance of t	data – so methods he needs	ources of seco – observatior s- Establish ta	ondar ns- Pr rget s	y da oces speci	ta – ( ss of i ficatio	qualitative dentifying ons					
Customer needs –organize needs into a hierarchy –establish relative importance of the needs- Establish target specifications         Unit - III       Product Design:       9+3												
Unit - III         Product Design:         9+3           Techniques and tools for concept generation, concept evaluation – Product architecture –Minimum Viable Product (MVP)- Product prototyping – tools and techniques– overview of processes and materials – evaluation tools and techniques for user-product interaction												
Unit - IV	Business Model Canvas (BMC):						9+3					
Lean Canvas and Reasons and reme	BMC - difference and building blocks- BMC: Patterns – Design -	<ul> <li>Strateg</li> </ul>	y – Process–	Busir	iess	mode	el failures:					
Unit - V	IPR and Commercialization:						9+3					
Need for Intellect Indications, Trade	ual Property- Basic concepts - Different Types of IPs: Copy Secrets and Industrial Design– Patent Licensing - Technology Co	Rights,	Trademarks	, Pat vatio	ents, n Ma	, Geo arketir	ographical ng					
			Lecture:4	45, Tı	utori	al:15	, Total:60					
TEXT BOOK:												
1. Rishikesh	a T.Krishnan, "8 Steps To Innovation: Going From Jugaad To Exc	ellence",	Collins India,	2013	-							
<b>REFERENCES:</b>												
1. Peter Drug	cker, "Innovation and Entrepreneurship", Routledge CRC Press, L	ondon, 2	014.									
2. Eppinger	2. Eppinger, S.D. and Ulrich, K.T. "Product design and development", 7 <sup>th</sup> edition, McGraw-Hill Higher Education, 2020.											
3. Alexande	er Osterwalder, "Business model generation: A handbook for visi	ionaries,	game change	ers, a	nd c	haller	ngers", 1 <sup>st</sup>					
edition, J	ohn Wiley and Sons; 2010											
4. Indian In	novators Association, "Patent IPR Licensing – Technology Comm	nercializa	tion – Innovat	ion N	larke	eting:						
Guide Bo	Guide Book for Researchers, Innovators", Notion Press, Chennai, 2017											

COUR	SE Ol	JTCON	IES:											BT Map	ped	
On cor	On completion of the course, the students will be able to											(	(Highest Level)			
CO1 understand innovation need and design thinking phases											Ur	Understanding (K2)				
CO2	identify, screen and analyse ideas for new products based on customer needs												Analysing (K4)			
CO3	develop and analyse the product concepts based on the customer needs and presents the overall architecture of the product.													Analysing (K4)		
CO4	predict a structured business model for MVP												Applying (K3)			
CO5	prac	tice the	procedu	ires for pr	otectior	n of their	ideas' l	PR						Applying	(K3)	
1																
	Mapping of COs with POs and PSOs															
COs/POs PO1 PO2 PO3 PO4 PO5 PO6 PO7 PO8 PO9 PO10 PO11 PO12 PS01 PS0												PSO2				
CO1	1			2			2						3			
CO2	2	3	3	3	3	2	2	2	2	3	3	3	3			
COS	3	2	2	3	3	3	3	3	3	3	3	3	3			
CO4	1				3	2	2	2	3	3	3	3	3			
COS	5				3	2	2		3	2	3	3	3			
1 – Sliç	ht, 2	– Mode	erate, 3 –	Substant	ial, BT-	Bloom's	a Taxono	omy								
	-															
						ASSES	SMENT	ΓΡΑΤΤΙ	ERN -	THEOR	(					
Tes	t / Blo atego	oom's orv*	Rei	memberii (K1) %	ng l	Indersta (K2)	anding %	Apply (K3)	/ing %	Analyzi (K4) 9	ing l	Evaluating (K5) %	) C	reating (K6) %	Total %	
CAT1			20		30		40	)	10			`		100		
CAT2			20		30		40	)	10					100		
CAT3			30		30		40							100		
ESE 20			20		30		30	)	20					100		
* ±3% I	may b	e varie	d (CAT 1	,2,3 – 50	marks	& ESE –	100 ma	irks)							1	

		22GEO05 - GERMAN LANGUAGE LEV	/EL 2										
(Offered by Department of Electronics and Communication Engineering)													
Progra Branc	amme& h	All BE/BTech Engineering and Technology Branches	Sem.	Category	L	т	Ρ	Credit					
Prerec	uisites	German Language Level 1	All	OE	4	0	0	4					
Pream	Preamble This course aims to help the learner to acquire the vocabulary as per the Common European framework of German language A1 level competence. This course will help to assimilate the basic grammar structures and ga vocabulary to understand and reciprocate in daily life situations on a broader sense. A thorough learner will be able to gain a comprehensive understanding of the German grammar and confidently articulate in day today situations												
Unit –	L – I Contacts(Kontakte): 12												
Understanding Letters, simple instructions, speaking about language learning, finding specific information in text, Acknowledging the theme and understanding conversations, Making appointments. Grammar – Preposition with Dative, Articles in Dative and Accusative possessive articles.													
Unit –	II	Accomodation(Die Wohnung):						12					
Unders feeling	standing Acco s, Colours. Gr	mmodation advertisements, describing accommodation and di ammar – Adjective with to be verb, Adjective with sehr/zu, Adject	rections, ive with A	responding to ccusative, pre	o an posit	invita ions v	tion, vith D	Expressing ative					
Unit –		Are you Working?(Arbeiten Sie):						12					
Daily S about	Schedule, spe Jobs. Gramma	eaking about past, understanding Job openings advertisements ar – Perfect tense, Participle II – regular and irregular verbs, Conju	s, Opinio unctions -	ns, Telephoni - <i>und, oder, al</i>	c cor per	nversa	ations	, Speaking					
Unit – IV Clothes and Style(Kleidung und mode): 12													
Clothe Gramn Dative	s, Chats on s nar – Interrog . Verbs with D	shopping clothes, reporting on past, Orienting oneself in Supe ative articles and Demonstrative articles, Partizip II – separable ative	rmarkets, e and noi	Information a n-separable ve	and r erbs,	esear Perso	ch at onal p	oout Berlin. pronouns in					
Unit –	V	Health and Vacation(Gesundheit und Urlaub):						12					
Personal information, Human Body parts, Sports, Understanding instructions and prompts, health tips. Grammar – Imperative with <i>du/lhr</i> , Modal verbs – sollen, müssen, nicht dürfen, dürfen. Suggestions for travel, Path, Postcards, weather, Travel reports, Problems in hotel, Tourist destinations. Grammar – Pronoun: <i>man</i> , Question words – <i>Wer, Wen, Was, Wem</i> , Adverbs – <i>Zuerst, dann, Später, Zum</i> <i>Schl</i>													
								Total:60					
TEXT	BOOK:												
1. Stefanie Dengler, Paul Rusch, Helen Schmitz, Tanja Sieber, "Netzwerk Deutsch als Fremdsprache A1–ursbuch, Ark und Glossar with 2 CDs", Goyal Publishers, Delhi, 2015.													
2.													
REFE	RENCES:												
1.	1. https://ocw.mit.edu – Massachusetts Institute of Technology Open Courseware												
2.	https://www.dw.com/en/learn-german - Deutsche Welle , Geramany's International Broadcaster												

COUR On co	BT Mapped (Highest Level)	
CO1	understand letters and simple texts	Remembering (K1)
CO2	assimilate vocabulary on Accommodation and invitation	Understanding (K2)
CO3	comprehend concept of time, telephonic conversation and job-related information	Understanding (K2)
CO4	understand how to do shopping in a German store	Understanding (K2)
CO5	understand body parts and how to plan personal travel	Understanding (K2)

					Марр	oing of C	Os with	h POs a	Ind PSC	)s				
COs/POs	P01	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1								1	2	3		3		
CO2								1	2	3		3		
CO3								1	2	3		3		
CO4								1	2	3		3		
CO5								1	2	3		3		
1 – Slight, 2	– Mode	erate, 3 -	Substan	tial, BT-	Bloom's	Taxonor	my							
ASSESSMENT PATTERN - THEORY														
Test / Bloom's Category*		Re	member (K1) %	ing	Understa (K2)	anding %	Apply (K3)	plying Analyzing Evalua (3) % (K4) % (K5		Evaluating (K5) %	Cr (I	eating K6) %	Total %	

Category*	(K1) %	(K2) %	(K3) %	(K4) %	(K5) %	(K6) %	Total 70			
CAT1	75	25					100			
CAT2	25	75					100			
CAT3	25	75					100			
ESE	25	75					100			

\*  $\pm$ 3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)
		22GEO06-GERMAN LANGUAGE LEVE	L 3					
		(Offered by Department of Electronics and Communicat	tion Engin	eering)				
Progra Branci	mme& າ	All BE/BTech Engineering and Technology Branches	Sem.	Category	L	т	Ρ	Credit
Prereq	uisites	German Language Level 2	All	OE	3	0	0	3
Pream	ble	This course provides enriching information about various everyda enhances the vocabulary and speaking ability to respond to and equips one to express opinions and negotiate appointments. With grammatical structure to answer confidently in everyday situation	ay situatio also seek h diligent is.	ns in personal information in learning one ca	and those an ca	profe e situ pture	ssiona ations all ba	al life and . It also Isic
Unit –		All about food (Rund Ums Essen):						9
Unders justify s Posses	tand informat something, To sive Articles in	ion about person, Speak about food, Introduce self and others, L speak about feelings, To express opinions, To answer questions n Dative, Yes/No questions, Reflexive verbs, Sentence with 'weil'	Jnderstan s on a tex	d and explain t, To describe	a pio a res	cture staura	base ant. (	story, To Grammar:
Unit –	II	School days ( Nach der Schulzeit):						9
Unders To Uno prepos	tand School r derstand Scho itions in Dativ	eports, Speak and write comments about schooldays, To speak a ool types in Germany and speak about it. Grammar: Modal v and Akkusativ.	about hab erbs in F	its, Understan Past tense, Po	d and sitior	l prov nal Vo	ride C erbs,	ity-Tipps, Two-way
Unit –	<b>III</b>	Media in everyday life (Medien in Alltag):	_					9
To spe Unders with 'da	eak about adv stand and Writ ass', Superlati	vantages and disadvantages of Media, formulate comparisons, e Movie reviews. Grammar: Comparative degree, Comparative Se ve degree.	Express entences	your own opir with 'Als' and '	nion, 'Wie',	Talk Subo	about ordina	: Movies, te clause
Unit –	IV	Feelings and expressions (Gefühle):						9
Expres city, Ex 'Wenn'	s thanks and kpress joy an , Adjectives to	congratulations, Talk about feelings, To understand information a d regrets, Understand and write Blog entries, Write appropriate be used along with definite articles.	bout festi heading	vals and spea . Grammar:	ik ab Subo	out it, rdinat	To d te Cla	escribe a luse with
Unit –	V	Profession and Travel ( Beruf und Reisen):						9
To hav career informa the way indefinit writing,	e a conversat preferences, ation, Express y to work, Des te articles, Pr speaking and	ion at ticket counter, To talk about leisure activities, To gather in Ideate the dream job, To prepare and make telephone calls, T uncertainty, Understand and give directions, Understand a news scribe a statistic, Understand information about a trip, Talk about to repositions, verb – 'werden', Subordinate clause – indirect quest I listening.	formation Fo unders spaper art ravel. Gra ions, All	from Texts, Ir stand text abo icle, Say your ammar: Adject units will inclu	itrodu out W own ive to de el	ice p orkpl opini be ι emer	eople ace. on, T ised a its for	, Express Ask for alk about long with reading,
								Total:45
TEXT I	BOOK:							
1.	Stefanie Der und Glossar	ngler, Paul Rusch, Helen Schmitz, Tanja Sieber, "Netzwerk Deut with 2 CDs", Goyal Publishers, Delhi, 2015	sch als F	remdsprache	A1–u	rsbuc	:h, Ar	peitsbuch
2.								
REFEF	RENCES:							
1.	Rosa-Maria	Dallapiazza , Eduard von Jan, Till Schonherr, "Tangram 2 (Germar	n)" , Goya	l Publishers, D	elhi,	2011	•	
2.	https://www.	dw.com/en/learn-german - Deutsche Welle , Geramany's Internatio	onal Broad	dcaster				

COURS On cor	SE OI mplet	UTCOM	ES: he cour	se, the st	udents	will be a	ble to							BT Map (Highest L	oed .evel)
CO1	unde	erstand	German	food style	e, resta	urant and	be able	express	onesel	f.			Re	membering	) (K1)
CO2	unde	erstand	Germa	n school s	ystem a	and discus	s about	habits a	nd prov	vide City-	Tipps		Ur	derstandin	g (K2)
CO3	anal	yze and	l compa	e media i	n every	day life.							Ur	derstandin	g (K2)
CO4	expr	ess fee	lings, de	scribe a c	ity and	write blog	entries.						Ur	derstandin	g (K2)
CO5	seel	k and pr	ovide inf	ormation	in a pro	fessional	setup, gi	ve direc	tions to	others a	ind talk	about travel	Ur	derstanding	g (K2)
	-					Mappi	ng of C	Os with	POs a	nd PSOs					
COs/P	os	P01	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	P010	PO11	PO12	PSO1	PSO2
CO1	1								1	2	3		3		
CO2	2								1	2	3		3		
COS	3								1	2	3		3		
CO4	4								1	2	3		3		
COS	5								1	2	3		3		
1 – Slic	ght, 2	– Mode	rate, 3 -	Substant	ial, BT-	Bloom's T	Faxonom	iy					1	ł	
								-							
						ASSE	SSMEN <sup>®</sup>	Τ ΡΑΤΤΙ	ERN - 1	HEORY					
Tes C	st / Blo Catego	oom's ory*	Re	memberi (K1) %	ing	Understa (K2)	inding %	Apply (K3)	/ing %	Analyzi (K4) 9	ing l %	Evaluating (K %	(5)	Creating (K6) %	Total %
	CAT	1		75		25									100
	CAT2 25 75 100														
	CAT3 25 75 100 100														
	ESE	Ξ		25		75									100
* ±3% I	may b	e varied	d (CAT 1	,2,3 – 50	marks a	& ESE – 1	00 mark	s)			1		l		-1

		22GE007-GERMAN LANGUAGE LEVE	L 4					
		(Offered by Department of Electronics and Communicat	tion Engir	neering)				
Progra Branc	amme& h	All BE/BTech Engineering and Technology Branches	Sem.	Category	L	т	Ρ	Credit
Prerec	uisites	German Language Level 3	All	OE	3	0	0	3
Pream	ble	This course imparts knowledge about interacting with external we behaviour and addressing relationships in personal and profession various media and at work. Enhance learner's grammatical exposi- concepts which would lay the foundation to have a better hold of be able to read and respond to reports, write simple formal and in engage in simple conversations in known situations.	orld, unde onal front. sure and the langu nformal le	erstanding vario It helps one to cover the core lage. With focu tters and text r	bus ci bund basic ised l nessa	ultura erstai gran earni ages	l aspe nd rep nmatio ng ono and b	ects, ports from cal e should e able to
Unit –	I	Learning (Lernen):						9
Unders everyd Gramn	standing and lay work life, T nar: Conjunctio	describing learning problems, Understanding and giving advice Falking about everyday working life, Understanding a radio report, pns- denn,weil, Konjuntiv II: Sollte( suggestions), Genitive, Tempor	e, Giving Understa al prepos	reasons, Unde anding and ma itions – bis, üb	erstai king er + /	nding a mir Akkus	repo ni-pres sativ,a	rts about sentation. b+dativ
Unit –	11	Athletic (Sportlich):						9
Expres and re attracti	sing enthusia acting, Making on. Grammar	sm, hope, disappointment, Understanding and writing fan comme g an appointment, Understanding a report about an excursion, L : Conjunctions – deshalb, trotzdem, Verbs with Dativ and Akkusati	ents, Form Inderstan v	ulating follow- ding difficult te	ups, exts,	Makii ntrod	ng su lucing	ggestions a tourist
Unit –		Living Together (Zusammen Leben):						9
To con informa	nplain, apologi ation, Write an	ze & give in, As for something, Understand experience reports, Re d correct a story. Grammatik: Konjunctiv II- könnte, Subordinate c	port on th	ne past, Talk al als and Wenn.	pout p	oets, l	Respo	ond to
Unit –	IV	Good Entertainment (Gute Unterhaltung):						9
Talk at about Interro <b>Unit –</b>	oout music sty a person, Ur gative Articles V	le, Buy concert tickets, Introduce a musician / band, Understand ne iderstand information about painting, Understand description of : Was fuer eine?, Pronouns – man/jemand/niemand and alles/etwa Passage of time and Culture (Zeitablauf & Kultur):	ewspaper f a pictur as/nichts	reports, Give e, Describe a , Relative sent	more pict ences	detai ure. s in N	led in Gr omina	formation ammatik: ativ 9
Talk al Unders about Give m listenin in Akk	bout wishes, E stand a text, I behavior, Exp hore information ng. Grammation usativ, Subord	Express wishes, Give Suggestions, Understand a conversation, Pla Exchange information, Talk about proverbs, write a story. Under ress intentions, Use the appropriate salutation, Understand tips i on, Discuss about clichés and write about them. All units will incl k: Konjunctiv II (Wishes, Suggestions), Verbs with prepositions, W inate clauses with damit and UmZu.	an someth rstand info n a text, lude elem - questior	ning together, ormation abou Talk about for nents for readin ns with preposi	To as t othe ms o ng, w tions	k oth er cu f add riting Rela	ers so Itures ressin , spea ative s	omething, , Discuss g others, aking and entences
								Total:45
TEXT	BOOK:							
1.	Stefanie Der Goyal Publis	ngler, Paul Rusch, Helen Schmitz, Tanja Sieber, "Netzwerk Deuts shers, Delhi, 2015.	sch als Fr	emdsprache A	1–urs	sbuch	n, Arbe	eitsbuch",
REFE	RENCES:							
1.	Rosa-Maria	Dallapiazza, Eduard von Jan, Till Schonherr, "Tangram 2 (German	ı)", Goyal	Publishers, De	lhi, 2	011.		
2.	https://www.	dw.com/en/learn-german - Deutsche Welle, Geramany's Internatio	nal Broad	lcaster				

COUR: On cor	SE OI mplet	UTCOM ion of t	ES: he cour	se, the st	udents	will be al	ble to							BT Map Highest L	oed .evel)
CO1	leve	rage lea	arning in	Workplac	e, unde	rstanding	reports	and mak	e pres	entation.			Rer	nembering	) (K1)
CO2	recip	orocate	to differ	ent situatio	ons, ma	ke appoin	tment ar	nd under	stand t	exts.			Uno	derstanding	g (K2)
CO3	hand	dle relat	ionships	and resp	ond app	oropriately	to exch	ange inf	ormatic	on			Uno	derstanding	g (K2)
CO4	fami	liarize to	o variou	s channels	s of ente	ertainmen	t						Und	derstandin	g (K2)
CO5	knov	w about	various	cultural a	spects,	usage of p	proverbs	and clic	hes.				Uno	derstanding	g (K2)
	1					Manni	ng of Ci	De with	POs a	nd PSOs					
COs/P	POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	POS a	PO9	PO1	) PO11	PO12	PSO1	PSO2
CO	1								1	2	3		3		
CO2	2								1	2	3		3		
CO	3								1	2	3		3		
CO4	4								1	2	3		3		
COS	5								1	2	3		3		
1 – Slig	ght, 2	– Mode	rate, 3 -	Substant	ial, BT-	Bloom's 1	Faxonom	ıy							
						ASSE	SSMEN		ERN - 1	THEORY					
C	atego	oom′s ory*	R	(K1) %	ing	Understa (K2)	naing %	Appiy (K3)	/ing %	Anaiyz (K4) 9	ing %	Evaluating (r %	(5) C	reating (K6) %	l otal %
	CAT	1		75		25									100
	CAT	2		25		75									100
	CAT	3		25		75									100
	ESE	Ξ		25		75									100
* ±3% I	may b	e varied	d (CAT 1	,2,3 – 50	marks 8	ESE – 1	00 mark	s)							

		22GEO08 - JAPANESE LANGUAGE LE	VEL 2					
		(Offered by Department of Electronics and Communic	ation Engir	neering)				
Progra Branci	ımme& า	All BE/BTech Engineering and Technology Branches	Sem.	Category	L	т	Р	Credit
Prereq	uisites	Japanese Language Level 1	All	OE	4	0	0	4
Pream	ble	The basic level of Japanese which provides understanding of H the ability to understand basic conversations and also enables of Casual form	liragana, K one to requ	atakana and 1 Jest other pers	10 Ka on ar	anjis a nd als	and pr to und	ovides erstand
Unit –		Introduction to groups of verbs:						12
tai forn action-	n-Verb group: nouns-Basic (	s-te form-Give and ask permission to do an action-Present con Questions	tinuous foi	rm-Restrict oth	ier pe	erson	from	doing an
Unit –	11	Introduction to Casual Form:						12
nai forr Casual	n-Dictionary f style	orm-ta form-Polite style and Casual style differences-Conversation	on in plain	style-Place of	usag	e of I	Polite	style and
Unit –	111	Express opinions and thoughts:						12
Introdu is right	ction to new p -Noun modifie	particle-Express someone one's thought-Convey the message of cations	one perso	n to another-A	sk so	omeo	ne if s	omething
Unit –	IV	Introduction to If clause and remaining Kanjis:						12
lf claus 50 Kan	se tara form-E ijis	express gratitude for an action done by other person-Hypothetical	situation-I	Particles to use	e in ca	ase o	of Moti	on verbs-
Unit –	V	Introduction to giving and receiving with te form and "when	n, even if"	usages:				12
Providi	ng to and get	ting from differences - Understanding of situations and framing se	ntences us	sing when and	even	ifeto	с.	
								Total:60
TEXT I	BOOK:							
1.	"MINNA NO	NIHONGO–Japanese for Everyone", 2 <sup>nd</sup> Edition, Goyal Publisher	rs & Distrib	utors Pvt. Ltd.	, New	Delh	ni, 201	7
REFER	RENCES:							
1.	Margherita F	Pezzopane, "Try N5", 2 <sup>nd</sup> Edition, Tankobon Softcover, Japan, 207	17.					
2.	Sayaka Kura	ashina, "Japanese Word Speedmaster", 2 <sup>nd</sup> Edition, Tankobon So	oftcover, Ja	pan, 2018.				

COUR On cor	SE OL mpleti	JTCOM	ES: he co	ourse, t	the stu	udents	will be a	ble to						(	BT Mapp Highest L	oed .evel)
CO1	diffe	rentiate	grou	ps of v	erbs ai	nd its f	orms							Rem	nembering	ı (K1)
CO2	unde	erstand	Polite	e form a	and Ca	asual fo	orm of Jap	anese						Und	erstanding	ว (K2)
CO3	com	prehenc	d pers	sonal co	ommui	nicatio	n and expi	ress gree	etings					Und	erstanding	ว (K2)
CO4	unde	erstand	the K	anjis in	n Japar	nese S	cript and I	f clause						Und	erstanding	g (K2)
CO5	com	prehend	d cono	cept of	"even	if", "wł	nen" and jo	ob-relate	d inform	ation				Und	erstanding	g (K2)
							Маррі	ng of C	Os with	POs a	nd PSOs					
COs/P	Os	P01	PO	2 F	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	P011	PO12	PSO1	PSO2
CO	1									1	2	3		3		
CO2	2									1	2	3		3		
CO	3									1	2	3		3		
CO4	4									1	2	3		3		
COS	5									1	2	3		3		
1 – Slig	ght, 2 -	– Mode	rate, 3	3 – Suł	bstanti	al, BT-	Bloom's T	Taxonom	ıy							
				_	<u> </u>		ASSE	SSMEN		ERN - 1	HEORY					
C	atego	oom′s ory*		Reme (K	mberii (1) %	ng	Understa (K2)	inding %	Apply (K3)	ying %	Analyzi (K4) 9	ing %	Evaluating (K5) %	(I	reating K6) %	l otal %
	CAT	1			75		25									100
	CAT	2			25		75									100
	CAT	3			25		75									100
	ESE				25		75									100
* ±3% I	may b	e varied	d (CA	T 1,2,3	8 – 50 r	marks	& ESE – 1	00 mark	s)							

	22GEO09 - JAPANESE LANGUAGE LE	VEL 3					
	(Offered by Department of Electronics and Communic	ation Engir	neering)				
Programme& Branch	All BE/BTech Engineering and Technology Branches	Sem.	Category	L	т	Ρ	Credit
Prerequisites	Japanese Language Level 2	All	OE	3	0	0	3
Preamble	The intermediate level of Japanese which provides understand which includes 150 Kanji's and provides the ability to comprehe	ng of all fo nd convers	rms ofverbs, a sations encoun	dverb itered	s, co in da	njunct aily life	ions, etc.
Unit – I	Introduction to Potential verbs:						9
Causes and Reaso Form-Customary Act	ns-Favouring Expressions-Expressing a State-Potential Verb ions-Nouns-Basic Questions and Kanji's.	Sentences	-Simultaneous	acti	ons-∖	/erb(	Groups-te
Unit – II	Introduction to Transitive and Intransitive verbs:						9
Consequence of ver Basic Questions and	bs- Embarrassment about Facts- Consequence of Verbs with a kanji's.	In Intention	s-Affirmative	Sente	nces	- Conj	unctions-
Unit – III	Introduction to Volitional forms:						9
Expressions of Spea	kers Intention-Expressing Suggestion or Advice-Usage of Advert	s and Qua	ntifiers-Basic (	Quest	ions a	and ka	anji's.
Unit – IV	Introduction to Imperative and Prohibitive verbs:						9
Commanding persor States Basic Questic	<ul> <li>Interrogatives-Expressions of Third Person-Actions and its O ons and Kanji's.</li> </ul>	ccurrence	- Possibilities	of an	Actio	on-Ch	anging of
Unit – V	Introduction to Conditional form and Passive verbs:						9
Description of Requ Questions and Kanji	irement and Speaker's Judgement, HabitualActions, Directions s.	s and sug	gestions-Passi	ve fo	rms	of Ve	rbs-Basic
							Total:45
TEXT BOOK:							
1. "MINNA NO	NIHONGO–Japanese for Everyone", 2 <sup>nd</sup> Edition, Goyal Publishe	rs & Distrib	utors Pvt. Ltd.,	, New	Delh	ni, 201	7.
REFERENCES:							
1. Margherita F	Pezzopane, "Try N5", 2 <sup>nd</sup> Edition, Tankobon Softcover, Japan, 20	17.					
2. Sayaka Kura	ashina, "Japanese Word Speedmaster", 2 <sup>nd</sup> Edition, Tankobon Sc	oftcover, Ja	pan, 2018.				

COUR On co	SE OI mplet	UTCOM	ES: he coι	irse, the s	tudents	will be a	ble to							BT Map (Highest	ped Level)
CO1	read	l and un	dersta	nd BasicVo	ocabulai	ies.								Rememberi	ng (K1)
CO2	unde	erstand	Conve	rsations us	ed in da	aily life.								Understand	ing (K2)
CO3	com	prehend	d perso	onal comm	unication	n and exp	ress gree	etings.						Understand	ing (K2)
CO4	unde	erstand	the Ka	nji's in Jap	anese S	script.								Understand	ing (K2)
CO5	com	prehenc	d Cohe	rent conve	rsations	in everyc	lay situat	ions.						Understand	ing (K2)
						Mappi	ing of C(	Os with	POs a	nd PSOs					
COs/F	POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1	0 PO11	PO1	12 PSO1	PSO2
CO	1								1	2	3		3		
CO	2								1	2	3		3		
CO	3								1	2	3		3		
CO	4								1	2	3		3		
CO	5								1	2	3		3		
1 – Slię	ght, 2	– Mode	rate, 3	<ul> <li>Substan</li> </ul>	tial, BT-	Bloom's	Taxonom	ıy							
Taa		! -		)	in a	ASSE	SSMEN		ERN - 1	HEORY				Creatin r	Total
C	St / Blo	oom <sup>r</sup> s ory*	F	(K1) %	ing	Understa (K2)	anding %	(K3)	ying ) %	Analyzi (K4) %	ng %	Evaluating (K %	.5)	(K6) %	l otal %
	CAT	1		75		25									100
	CAT	2		25		75									100
	CAT	3		25		75									100
	ESE	Ξ		25		75									100

\* ±3% may be varied (CAT 1,2,3 - 50 marks & ESE - 100 marks)

		22GEO10 -JAPANESE LANGUAGE LEV	/EL 4						
		(Offered by Department of Electronics and Communicat	tion Engir	eering)					
Progra Branci	imme& n	All BE/BTech Engineering and Technology Branches	Sem.	Category	L	т	Ρ	Credit	
Prereq	uisites	JAPANESE LANGUAGE LEVEL 3	All	OE	3	0	0	3	
				L					
Pream	ble	The intermediate level of Japanese provides understanding of ex which also includes 150 Kanji's and also provides the ability to ur	pressions	s of verbs, its p I relationship a	atteri mong	n, Re i the i	lations people	ships e.	
Unit –	I	Introduction to Reasoning:						9	
Causes	s and Sequen	ces-Causes and Effects-Interrogative Patterns-Adjective as a Nour	n -Basic C	Questions and I	Kanji'	s			
Unit –	11	Introduction to Exchanging of things:						9	
Expres Questio	sions for Givi	ng and Receiving of Things-Polite Expression of Request-Indicati s.	ng a Pur	pose of Action	s-Bas	sic Q	uantifi	ers-Basic	
Unit –		Introduction to States of an Action:						9	
Senten kanji's.	ce Pattern to	Indicate Appearance-Degree of Action and State-Adjectives as Ac	lverbs- Co	onvey informat	ion -E	Basic	Ques	tions and	
Unit –	IV	Introduction to Causative Verbs:						9	
Causat Questio	ive Forms of ons and Kanji'	Verbs-Asking Opportunity to do something-Hypothetical Questic 's.	ons-Judge	ement and Co	urse	of ar	n actio	ons-Basic	
Unit –	V	Introduction to Relationship in Social Status:						9	
Honori	fic expression	s- Respectful expressions- Humble expressions-Polite expressions	s-Basic Q	uestions and K	anji's	-			
								Total:45	
TEXT	300K:								
1. "MINNA NO NIHONGO–Japanese for Everyone", 2 <sup>nd</sup> Edition, Goyal Publishers & Distributors Pvt. Ltd., New Delhi, 2017.									
REFEF	RENCES:								
1.	Margherita F	Pezzopane, "Try N5", 2 <sup>nd</sup> Edition, Tankobon Softcover, Japan, 2017	7.						
2.	Sayaka Kura	ashina, "Japanese Word Speedmaster", 2 <sup>nd</sup> Edition, Tankobon Soft	cover, Ja	pan, 2018.					

COUR On co	SE OUTCOMES: mpletion of the course, the students will be able to	BT Mapped (Highest Level)
CO1	read and Understand Relationship of a Person.	Remembering (K1)
CO2	understand Conversations Used in Everyday Activities.	Understanding (K2)
CO3	comprehend Contents at Near Natural Speed.	Understanding (K2)
CO4	understand the Kanji's in Japanese Script	Understanding (K2)
CO5	comprehend Orally Presented Materials.	Understanding (K2)
		1

	Mapping of COs with POs and PSOs													
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1								1	2	3		3		
CO2								1	2	3		3		
CO3								1	2	3		3		
CO4								1	2	3		3		
CO5								1	2	3		3		
1 – Slight, 2	– Mode	rate, 3 –	Substant	ial, BT- E	3loom's T	Taxonom	ıy							
					ASSE	SSMEN	Γ ΡΑΤΤΙ	ERN - T	HEORY					

		ACCECOMEN							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %		
CAT1	75	25					100		
CAT2	25	75					100		
CAT3	25	75					100		
ESE	25	75					100		
* ±3% may be varied (C	±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)								

		22GE011 - FRENCH LANGUAGE LEVE	EL 1											
		(Offered by Department of Electronics and Communica	tion Engir	neering)										
Progra Branc	amme& h	All BE/BTech Engineering and Technology Branches	Sem.	Category	L	Т	Ρ	Credit						
Prerec	luisites	Fundamentals of French Language	All	OE	4	0	0	4						
Pream	ble	This course provides a foundation of the French language as we lifestyle of France and other French-speaking nations. The stude and acquire basic everyday vocabulary. By following the structur learning process, one can comprehend the structure of sentence	II as an ui ent will be red curricu es and res	nderstanding c learning how t lum and pract pond to basic	f the o intr icing comn	Frence oduce the sa	ch cul e him/ ame a ations	ture and herself s per the						
Unit – I       Introduction       12         French and French culture, alphabets, pronunciation, accents, rules, and terms for pronunciation (mas-fem), Salutations, numbers.       12														
French and French culture, alphabets, pronunciation, accents, rules, and terms for pronunciation (mas-fem), Salutations, numbers.														
Unit – II         Daily Life         12           Subject Propoun Eranconhonie's adjectives – colors week months seasons         12														
Subject Pronoun, Francophonie's, adjectives – colors, week, months, seasons.														
Unit - III     Articles and Verbs     12       Articles_Indefinite_definite_and contracted (oxemples) introductions to verbs_1\$ group of verb     11														
Articles - Indefinite, definite, partitive, and contracted, (examples), introductions to verbs, 1 <sup>st</sup> group of verb														
2 <sup>nd</sup> gro	oup of verbs,	irregular verbs (avoir, etre, faire) present yourself & nega	ative sent	ences. (faire	and .	Jouer	verb	with the						
Unit –	V	Food and Culture						12						
Prepos	sitions – prep	osition of places (country, cities and etc), Imperative mode, invit	tations, cu	ulture – food (	wine,	chee	ese	) Future						
(ieceii	( luture)							T. ( .) 00						
								Total:60						
TEXT	BOOK:													
1.	A1 – saison													
REFE	RENCES:													
1.	Apprenons	les francais – 0 and 1												
2.	Grammaire	- langue et de civilization francaises - Mauger G, Les idees - 0 an	nd 1											
	1													

COUR: On cor	SE Ol nplet	UTCOM	ES: he cour	se, the st	udents	will be al	ble to						(	BT Mapp Highest L	oed evel)
CO1	Und	erstand	the gra	mmatical s	structure	e of the la	nguage a	and intro	duce s	elf to oth	ers.		Rer	nembering	(K1)
CO2	Und	erstand	basic v	erbs and a	ppropri	ate vocab	ulary.						Unc	lerstanding	g (K2)
CO3	Ask	for dired	ctions a	nd arrange	e for trai	nsportatio	n, etc, as	s needeo	ł.				Unc	lerstanding	g (K2)
CO4	Und	erstand	the foo	d habits of	France	and ask	for appoi	ntments					Unc	lerstanding	g (K2)
CO5	Lear	rn to soo	cialize ir	French-s	peaking	countries	5						Unc	lerstanding	g (K2)
	Manning of COa with DOa and DEOa														
	Mapping of COs with POs and PSOs       COs/POs     PO1     PO3     PO4     PO5     PO6     PO7     PO8     PO9     PO10     PO11     PO12     PS01														
COs/P	COs/POs         PO1         PO2         PO3         PO4         PO5         PO6         PO7         PO8         PO9         PO10         PO11         PO12         PS01         PS02														
CO,	CO1         1         2         3         3         2														
CO2	2								1	2	3		3		2
COS	3								1	2	3		3		2
CO4	4								1	2	3		3		2
COS	5								1	2	3		3		2
1 – Slig	ght, 2	– Mode	rate, 3 -	Substant	ial, BT-	Bloom's 1	Faxonom	iy			1	1	1	1	I
			,					•							
						ASSE	SSMEN	Γ ΡΑΤΤΕ	ERN - T	HEORY					
Tes C	t / Blo atego	oom's ory*	R	ememberi (K1) %	ng	Understa (K2)	nding %	Apply (K3)	/ing %	Analyzi (K4) 9	ing %	Evaluating (K5) %	C	reating K6) %	Total %
	CAT	1		75		25									100
	CAT	2		25		75									100
	CAT	3		25		75									100
	ESE	Ξ		25		75									100
* ±3% I	may b	e varied	(CAT	,2,3 – 50	marks &	& ESE – 1	00 mark	s)			1		I		

		22GEO12 -FRENCH LANGUAGE LEVE	EL 2											
		(Offered by Department of Electronics and Communica	ation Engi	neering)										
Progra Branch	mme& 1	All BE/BTech Engineering and Technology Branches	Sem.	Category	L	т	Ρ	Credit						
Prereq	uisites	Fundamentals of French Language	All	OE	4	0	0	4						
Pream	ble	This course is designed to assist students in developing vocabulars Framework of Reference for Languages at the A2 level. This constructures as well as the acquisition of vocabulary necessary to circumstances. The learner will be able to develop a thorough confidently express themselves in everyday circumstances.	Ilary in accurse will a comprehe omprehe	cordance with aid in the integ and and respo nsion of Frenc	the C ratior nd in h grai	Comm of b ever mma	non E asic g yday r and	uropean Irammar						
Unit – I         French and You         12           Habits, Strengths & Weakness, Recommendations, Sentiments, Motivations, about favorite films and Types of screens in the movie         12														
Habits, Strengths & Weakness, Recommendations, Sentiments, Motivations, about favorite films and Types of screens in the movie world, Verbs (Regulars and irregulars), Reflexive Verbs, Prepositions														
Unit - II     Eat and Repeat     12														
Favorite foods, Recopies, Types of meals, Describing House and Kitchen, Presentation of the recipe, Comparatives, Possessive pronouns, Present continuous tense, Simple conditional form       12														
pronouns, Present continuous tense, Simple conditional form           Unit – III         Vacation         12														
Unit – IIIVacation12Invitations, presentation, Greetings, Goodbyes, Activities on vacation, past experiences, Describing favorite place, Recommendations on various tours, Past perfect, Past imperfect tense12														
Unit – I	IV	Likes and Views						12						
Favorite Tourist,	e persons & Pharmacist	things, Giving advice, Experience, Moods, Illness, Discomforts, t & Patient), Past perfect, Past indefinite, Imperative	Symptoms	s, Roleplay (D	octor	& Pa	atient,	Guide &						
Unit – V	V	Then and Now						12						
Habits, Past pe	customs, ci erfect and Pr	rcumstances of the past and present, Debates on past and prese resent comparatives.	ent situatio	ons and feeling	gs. Pa	ast in	nperfe	ect tense,						
								Total:60						
TEXT E	300K:													
1.	A2 – Saiso	n												
REFER	ENCES:													
1.	Apprenons	les francais – 0 and 1												
2.	Grammaire	e – langue et de civilization francaises – Mauger G .Les idees – 0	and 1											

COUR On co	SE O mple	UTCON	MES: the c	ours	e, the st	udents	will be a	able to							(۲	BT Mapı lighest L	ped Level)
CO1	Unc	derstand	d the	Fren	ch langu	age in c	leep and	its usag	e						Rem	nembering	g (K1)
CO2	Pre	paratior	n of th	neir F	avorite r	ecipes,	Know the	e Object	s used i	n Kitche	en and h	ouse.			Und	erstandin	g (K2)
CO3	Cor	nverse a	about	theiı	vacatior	n, their I	avorite [	Destinati	on						Und	erstandin	g (K2)
CO4	Unc	derstand	d com	plex	verbs ar	nd be al	ole to cor	nmunica	te abou	t their p	ast expe	eriences			Und	erstandin	g (K2)
CO5 Know the difference between Past and Present and Compare them. Understanding (K															g (K2)		
Mapping of COs with POs and PSOs																	
Mapping of COs with POs and PSOsCOs/POsPO1PO2PO3PO4PO5PO6PO7PO8PO9PO10PO11PO12PS01															PSO2		
CO	1									1	2	3			3		-
CO	2									1	2	3			3		
CO	3									1	2	3			3		
CO	4									1	2	3			3		
CO	5									1	2	3			3		
1 – Sli	ght, 2	– Mode	erate,	3 –	Substant	ial, BT-	Bloom's	Taxono	my								
							ASSES	SMENT	PATTE	ERN - T	HEORY						
Te	st / B Categ	loom's jory*		Re	member (K1) %	ing	Understa (K2)	anding %	Apply (K3)	ying )%	Analyz (K4) 9	ing %	Evaluating (K5) %		Cr (I	eating <6) %	Total %
	CA	T1			75		25								-		100
	CA	T2			25		75										100
	CA	Т3			25		75										100

100

25 \* ±3% may be varied (CAT 1,2,3 - 50 marks & ESE - 100 marks)

75

ESE

22GEO13- FRENCH LANGUAGE LEVEL 3

(Offered by Department of Electronics and Communication Engineering )

Progra Branci	ımme& n	All BE/BTech Engineering and Technology Branches	Sem.	Category	L	т	Ρ	Credit							
Prereq	uisites	Fundamentals of French Language	All	OE	3	0	0	3							
				L	1										
Pream	ble	This course gives knowledge regarding a variety of personal and improving vocabulary and speaking abilities to reply to and seek the ability to articulate yourself and arrange appointments. With p grammatical structures needed to respond confidently in everyda how Natives communicate.	l professic informatic persevera ay circums	onal circumstar on in those set nce, one can r stances. It almo	nces, tings. naste ost gi	as w It als r all c ves y	ell as o give of the ou an	s you essential idea of							
Unit –		Start Over						9							
Use of situation	periphrases, ons, Imperfect	Discuss a day in life, work, problems in the world, Predictions abou and future tense.	ut the futu	re (actions and	d situ	ations	s), Hyp	othetical							
Unit –	nit – II Prohibitions and More objective. Describe synopsis of Movie and its relation														
Prohibitions, Obligations, Habits to change, social customs, Use of the subjunctive, Describe synopsis of Movie and its relation to life, Debate on books vs movies, usage of connectors, Object Direct and Indirect.         Unit – III       Let's be Creative															
Unit –	Unit – III         Let's be Creative														
Unit - III       Let's be creative       9         Write a letter by describing the problem, talk about desires and Necessities, propose solutions, Recommendations and Suggestions, Create an Advertisement, Give Instructions, Imperative negative, Use of Object Direct, and Indirect       9															
Unit –	IV	Travel and Communication						9							
Talk at and Gu	out Tours, Ty uide, Tourists	rpes of tourism and communication, Send messages, petitions, Ta and Travel agents), Past Pluscumperfect, All Past tenses.	alk to peop	ole on the tele	ohone	e, Rol	eplay	(Tourists							
Unit –	V	Let's Talk						9							
Expres superla	sion of Interentives, Exclam	ests, Sentiments, Feelings, Sensations, Manias etc. Certain su atory phrases, subjunctives.	iggestions	to make a	bettei	futu	re, th	e use of							
								Total:45							
TEXT	BOOK:														
1.	B1 – Saison														
REFEF	RENCES:														
1.	Apprenons I	es francais – 0 and 1													
2.	Grammaire	– langue et de civilization francaises – Mauger G Les idees – 0 and	d 1												

COUR: On cor	SE O nplet	UTCOM tion of t	IES: he coui	se, the st	udents	will be a	ble to						(	BT Mapp Highest L	oed .evel)
CO1	Lea	rn on Fu	uture ter	ise.									Rem	nembering	ı (K1)
CO2	Und	lerstand	Permis	sions and	Prohibit	ions.							Und	erstanding	g (K2)
CO3	Kno	wing ab	out Lett	er writing,	Creating	g Ads, Ex	pressing	Desires	s, and Ir	nstructing	g Others.		Und	erstanding	g (K2)
CO4	Und	lerstand	ing rule	s for trave	and En	hancing o	communi	cations.					Und	erstanding	g (K2)
CO5	CO5 Expressing the feelings and emotions using advanced grammar Understanding (K2)														
	Mapping of COs with POs and PSOs														
COs/P	COs/POs         PO1         PO2         PO3         PO4         PO5         PO6         PO7         PO8         PO9         PO10         PO11         PO12         PS01         PS02														
CO1         I														2	
CO2	2								1	2	3		3		2
COS	3								1	2	3		3		2
CO4	4								1	2	3		3		2
COS	5								1	2	3		3		2
1 – Slig	ght, 2	– Mode	rate, 3 -	- Substant	ial, BT-	Bloom's <sup>-</sup>	Taxonom	ıy							
Tee	4 / DI	! -				ASSE	SSMEN		ERN - T	HEORY		<b>F</b> uelueting	<b>•</b>		Tatal
C	ateg	oom's ory*	ĸ	emember (K1) %	ing	Understa (K2)	inaing %	Аррі (K3)	wing %	(K4)	ing %	Evaluating (K5) %	(	K6) %	10tai %
	CAT	1		75		25									100
	CAT	2		25		75									100
	CAT	3		25		75									100
	ESE			25		75									100
* ±3% I	may b	oe varied	d (CAT	1,2,3 – 50	marks &	. ESE – 1	00 mark	s)							

	22GEO14 - SPANISH LANGUAGE LEV	EL 1													
	(Offered by Department of Electronics and Communication	ation Engir	neering)												
Programme& Branch	All BE/BTech Engineering and Technology Branches	Sem.	Category	L	т	Ρ	Credit								
Prerequisites	Fundamentals of Spanish Language	All	OE	4	0	0	4								
Preamble	Preamble       This course provides a foundation of the Spanish language as well as an understanding of the Spanish culture and lifestyle of Spain and other Spanish-speaking nations. The student will be learning how to introduce him/herself and acquire basic everyday vocabulary. By following the structured curriculum and practicing the same as per the learning process, one can comprehend the structure of sentences and respond to basic communications.         Unit – I       Greetings and Good byes (Los Saludos y Despidirse):       12														
Unit – I	Unit – I         Greetings and Good byes (Los Saludos y Despidirse):         12           Greetings,Self-Introduction         Formal and Informal ways of introducing oneself and others, Alphabets& Numbers, Countries and         12														
Greetings, Self-Introduction, Formal and Informal ways of introducing oneself and others, Alphabets& Numbers, Countries and Languages Spoken, Parts of Grammar – Noun, Personal Pronoun, Describe surroundings and its vocabulary															
Unit – II     Vida Cotidiana (Daily Life):     12															
Time of the day, Days of the week, Months of the year, Seasons, Verb (To be, To Have), Adverbs, Likes and Dislikes, Personality and physical description, simple sentences															
Unit – III         Friends and Family (Amigos y La Familia):         12															
Vocabulary of family Regular and Irregula	ν, Animals, Professions, Parts of the body, Opinions on family cu r verbs.	iltures, Arti	icles – Definite	e and	Inde	finite,	Hobbies,								
Unit – IV	In the City (En la Cuidad):						12								
Buildings in the city, Transport, Grammar	Name of the places, asking for directions, Helping each other, D - Possessive articles, prepositions	escription	of house and i	ts cor	npon	ents,	Modes of								
Unit – V	Food and Culture( La comida y cultura):						12								
Food (types and va customeretc.) Pas	rieties), shopping, ordering at a restaurant, inviting to parties, t tense (all three tenses-Past Participle, Indefinite past and past in	Roleplay ( nperfect- (t	as diner and to be and to ha	custo ive)	mer,	sales	man and								
							Total:60								
TEXT BOOK:															
1. Chicos Chic 28043 MAD	as Libro de Alumno nivel 1, Ma Angeles Palomino , edelsa, GR RID(ESPANA).	UPO DIDA	SCALIA, S.A.,	plaz	a cui	dad d	e salta,3-								
REFERENCES:															
1. <u>https://nueva</u>	adelhi.cervantes.es/en/spanish_courses/students/spanish_genera	l_courses/	spanish cours	es le	evel a	a1.htm	<u>1</u>								
· · ·															

COUR: On cor	SE OL mpleti	JTCOM	ES: he cours	se, the st	udents	will be a	ble to						(1	BT Mapp Highest L	oed .evel)
CO1	unde	erstand	the gram	nmatical s	tructure	of the la	nguage a	and intro	duce se	elf to othe	ers.		Rem	nembering	(K1)
CO2	unde	erstand	basic ve	rbs and a	ppropri	ate vocab	ulary.						Und	erstanding	g (K2)
CO3	ask f	for direc	tions an	d arrange	for trai	nsportatio	n, etc, as	s needeo	d.				Und	erstanding	g (K2)
CO4	unde	erstand	the food	habits of	Spain a	and Latin	countries	and as	k for ap	pointmer	nts		Und	erstanding	g (K2)
CO5	learr	n to soci	ialize in S	Spanish s	peakin	g countrie	S						Und	erstanding	g (K2)
	Manning of COs with POs and PSOs														
COs/P	Mapping of COs with POs and PSOs           COs/POs         PO1         PO3         PO6         PO7         PO8         PO10         PO11         PSO1         PSO2														
COS/POS         PO1         PO2         PO3         PO4         PO5         PO6         PO7         PO8         PO9         PO10         PO11         PO13           CO1														1001	2
CO	2								1	2	3		3		2
CO	3								1	2	3		3		2
CO4	4								1	2	3		3		2
COS	5								1	2	3		3		2
1 – Slig	ght, 2 -	– Mode	rate, 3 –	Substant	ial, BT-	Bloom's	Taxonom	iy							
Tee						ASSE	SSMEN		ERN - 1	HEORY		<b>F</b> ord to a time of			Tetel
C	atego	oom s ory*	Re	member (K1) %	ng	Understa (K2)	inaing %	(K3)	ying ) %	Analyz (K4) 9	ing %	Evaluating (K5) %		K6) %	i otai %
	CAT	1		75		25									100
	CAT	2		25		75									100
	CAT	3		25		75									100
	ESE	=		25		75									100
* ±3% I	may b	e varied	d (CAT 1	,2,3 – 50	marks a	& ESE – 1	00 mark	s)							

Progra Branci	amme& h	All BE/BTech Engineering and Technology Branches	Sem.	Category	L	т	Ρ	Credit						
Prereq	uisites	Fundamentals of Spanish Language	All	OE	4	0	0	4						
				I										
Pream	ble	This course aims to help the Learner to acquire the vocabulary a level competence. This course will help to assimilate the basicgra understand and reciprocate in daily life situations on a broader so comprehensive understanding of the Spanish grammar and conf	is per thef ammar sti ense. A th idently ar	framework of S ructures and g norough learne ticulate in day	Spanis ain vo r will today	sh lan bcabu be ab situa	guage lary to le to g tions.	e A2 o gain a						
Unit –		Spanish and You (El Español y tú)						12						
Habits, Strengths & Weakness, Recommendations, Sentiments, Motivations, About favorite films and Types of screens in the world, Verbs(Regulars and irregulars), Reflexive Verbs, Prepositions         Unit – II       Eat and Repeat (Comer y repetir)														
Unit – II Eat and Repeat (Comer y repetir)														
Unit – II         Lat and Repeat (Comer y repetir)           Favorite foods, Recipies, Types of meals, Describing House and Kitchen, Presentation of recipe, Comparatives, Possessive present continuous tense, Simple conditional form														
Unit – III     Its Vacation Time (Tiempo de vacaciones)														
Invitations, presentation, Greetings, Goodbyes, Activities on vacation, past experiences, Describing favorite place, Recommendation various tours, Past perfect, Past imperfect tense, Usage of Todavia or No														
Unit –	IV	Likes and Views (Gustasyvistas)						12						
Favorit Tourist	e persons &	hings, Giving advices, Experience, Moods, Illness, Discomforts, 3 & Patient), Past perfect, Past indefinite, Imperative	Symptom	s, Roleplay (D	octor	& Pa	atient,	Guide &						
Unit –	V	Then and Now( Antes y Ahora)						12						
Habits, Past pe	customs, cire	cumstances of the past and present, Debates on past and prese sent comparatives.	ent situatio	ons and feelin	gs. P	ast ir	nperfe	ect tense,						
								Total:60						
TEXT	BOOK:													
1.	AULA INTE Distributors	RNACIONAL 2 (A2) Jaime Corpas, AgusinGarmendia, Nuria S Pvt LTD, 86, UB Jawahar Nagar, Kamla Nagar, Delhi-110007.	anchez, (	Carmen Soria	no Go	oyal	Publis	hers and						
REFEF	RENCES:													
1.	https://nueva	adelhi.cervantes.es/en/spanish courses/students/spanish general	courses/	spanish cours	ses le	evela	a1.htm	<u>1</u>						

COUR On co	SE Ol mplet	UTCOM	IES: he co	ours	e, the st	udents	will be a	ble to						(	BT Mapp Highest L	oed evel)
CO1	unde	erstand	the S	Spani	ish langu	age in	deep and	its usage	e					Rem	nembering	(K1)
CO2	prep	are for	their	Favo	orite recip	oes, Kn	ow the Ob	jects us	ed in Kite	chen ar	nd house			Und	erstanding	g (K2)
CO3	con	verse ab	oout t	heir	vacation	, their F	avorite De	estinatio	า					Und	erstanding	g (K2)
CO4	unde	erstand	comp	plex	verbs an	d be at	le to com	municate	e about t	heir pa	st experie	ences		Und	erstanding	g (K2)
CO5	knov	w the dif	fferer	nce b	etween l	Past ar	d Present	and Cor	mparing	them.				Und	erstanding	g (K2)
Mapping of COs with POs and PSOs																
COs/F	COs/POs         PO1         PO2         PO3         PO4         PO5         PO6         PO7         PO8         PO9         PO10         PO11         PO12         PS01         PS02															
CO.	COS/FOS         FOI         FO2         FO3         FO4         FO3         FO6         FO3         FO6         FO3         FO1         FO12         FS01         FS02           CO1              1         2         3         3         2															2
CO	2									1	2	3		3		2
CO	3									1	2	3		3		2
CO	4									1	2	3		3		2
CO	5									1	2	3		3		2
1 – Slig	ght, 2	– Mode	rate,	3 – 8	Substant	al, BT-	Bloom's	Taxonom	iy							
				_			ASSE	SSMEN		ERN - 1	HEORY					· - · ·
Tes	st / Blo Catego	oom's ory*		Ren	nemberi (K1) %	ng	Understa (K2)	inding %	Apply (K3)	/ing %	Analyzi (K4) 9	ng %	Evaluating (K5) %	Cı (	reating K6) %	Total %
	CAT	1			75		25								<b>F</b>	100
	CAT	2			25		75									100
	CAT	3			25		75									100
	ESE	Ξ			25		75									100
* ±3%	may b	e varied	d (CA	T 1,2	2,3 – 50	marks	& ESE – 1	00 mark	s)							

		22GEO16 - SPANISH LANGUAGE LE	EVEL 3										
		(Offered by Department of Electronics and Communi	cation Engin	eering)									
Progra Branc	amme& h	All BE/BTech Engineering and Technology Branches	Sem.	Category	L	т	Ρ	Credit					
Prerec	quisites	Fundamentals of Spanish Language	All	OE	3	0	0	3					
Pream	ble	This course provides enriching information about various every enhances the vocabulary and speaking ability to respond to and equips one to express opinions and negotiate appointments. We grammatical structure to answer confidently in everyday situation speak.	day situation d also seek in ith diligent le ons. It almost	s in personal a nformation in tl arning one car gives a basic	ind pi nose n cap idea	rofess situat ture a on ho	sional tions. all bas ow Na	life and It also sic tives					
Unit – I         Start Over(Volver a Empezar)         9           Use of periphrases, Discuss a day in life, work, problems in the world, Predictions about future (actions and situations),Hypothetical													
Use of periphrases, Discuss a day in life, work, problems in the world, Predictions about future (actions and situations), Hypothetical situations, Imperfect and future tense.													
Unit – II     Prohibitions and More(Prohibiciones y mas)     9													
Prohibitions, Obligations, Habits to change, social customs, Use of subjunctive, Describe synopsis of Movie and its relation to real life, Debate on books vs movies, usage of connectors, Object Direct and Indirect.													
Unit – III     Let's be Creative (Seamoscreatives)     9													
Write a Create	a letter by de an Advertise	escribing the problem,talk about desires and Necessities, propo ement, Give Instructions, Imperative negative, Use of Object Direc	ese solutions	, Recommend ct.	ation	s and	d Sug	gestions,					
Unit –	IV	Travel and Communication (Viajar y comunicar)						9					
Talk at Guide,	bout Tours, 1 Tourists and	Types of tourism and communication, Send messages, petitions, Travel agents), Past Pluscumperfect, All Past tenses.	Talk to peop	le on telephon	e, Ro	le pla	ay(Tou	urists and					
Unit –	V	Let's Talk(Hablemos)						9					
Expres Exclan	ssion of Inter- natory phrase	ests, Sentiments, Feelings, Sensations, Manias etc. Certain sugg es, subjunctive.	estions to m	ake a better fu	ture,	use (	of sup	erlatives,					
								Total:45					
TEXT	BOOK:												
1.	Aula Intern Distributors	ational 3 (B1) [Paperback] Jaime Corpas, Agusin Garmendia, Nui 3 Pvt LTD, 86, UB Jawahar Nagar, Kamla Nagar, Delhi-110007.	ria Sanchez,	Carmen Soria	ino G	oyal	Publis	shers and					
REFE	RENCES:												
1.	https://nuev	vadelhi.cervantes.es/en/spanish_courses/students/spanish_gener	ral_courses/s	spanish cours	es le	vel_a	1.htm	<u>1</u>					

COUR On co	SE Ol mpleti	UTCON ion of t	IES: the co	urse,	, the stu	dents	will be ab	le to							BT Map (Highest I	ped _evel)
CO1	learr	n on Fu	ture te	nse.										F	ememberin	g (K1)
CO2	unde	erstand	about	Perm	nissions a	and Pr	phibitions.							ι	Inderstandir	ıg (K2)
CO3	knov	wing ab	out Le	tter w	/riting, Cr	eating	Ads, Expr	essing E	Desires a	and Inst	tructing (	Others.		ι	Inderstandir	ıg (K2)
CO4	unde	erstandi	ing rule	es for	r travel ar	nd Enh	ance com	municati	ons.					ι	Inderstandir	ıg (K2)
CO5	expr	essing	the fee	elings	and em	otions	using adva	anced gr	ammar					ι	Inderstandir	ıg (K2)
	Mapping of COs with POs and PSOs															
COs/P	COs/POs         PO1         PO2         PO3         PO4         PO5         PO6         PO7         PO8         PO9         PO10         PO11         PO12         PS01         PS02															
CO.	CO1         I															
CO	2									1	2	3		3		2
CO	3									1	2	3		3		2
CO4	4									1	2	3		3		2
CO	5									1	2	3		3		2
1 – Slig	ght, 2	– Mode	erate, 3	3 – Si	ubstantia	I, BT- I	Bloom's Ta	axonomy	/							
				-			ASSES	SMENT	PATTE	RN - TI	HEORY		<b>F</b> 1 4		0	<b>—</b>
Ie	est / B Categ	loom's jory*		Rei	memberi (K1) %	ing	Understa (K2)	inding %	Apply (K3)	ving %	Analyz (K4) 9	ing %	Evaluating (K5) %		(K6) %	lotal %
	CA	T1			75		25									100
	CA	T2			25		75									100
	CA	T3			25		75									100
	ES	SE .			25		75									100
* ±3%	may b	e varie	d (CAT	Г 1,2,	3 – 50 m	arks &	ESE - 10	0 marks	)	<u>.</u>						

		22GEO17 - ENTREPRENEURSHIP DEVELO	PMENT								
		(Offered by Department of Mechatronics Eng	ineering	g)							
Progra Branch	mme &	All BE/BTech Engineering and Technology Branches	Sem.	Category	L	т	Ρ	Credit			
Prereq	uisites	Engineering Economics & Management	7	OE	3	0	0	3			
Preamb	ble	The purpose of this course to create entrepreneurial awareness	s among	engineering s	tude	nts.		r			
Unit – I		Entrepreneurship Concepts:	_		_	<u> </u>		9			
Entrepreneurship & Entrepreneur- Role in Economic Development - Factors affecting Entrepreneurship- Creativity and Innovation											
- Entrepreneurship vs Intrapreneurship- Entrepreneurial Motivation factors – Types of Entrepreneurship & Entrepreneurs - Characteristics of Entrepreneurs - Entrepreneurship Development in India											
Characteristics of Entrepreneurs - Entrepreneurship Development in India         Unit - II       Entrepreneurial Ventures and opportunity assessment:       9											
Unit – II         Entrepreneurial Ventures and opportunity assessment:         9           New venture creation – Bootstrapping, Minipreneurship, Start-ups, Acquiring, Franchising & Social venturing - Venture         Venture											
New venture creation – Bootstrapping, Minipreneurship, Start-ups, Acquiring, Franchising & Social venturing - Venture											
development stages - Models of market opportunity- Opportunity assessment: Critical Factors In Opportunity Assessment, Idea vs Opportunity, Evaluation process, Global opportunities for entrepreneurs.											
Opportunity, Evaluation process, Global opportunities for entrepreneurs.         Unit – III       Business Plan:       9											
Unit - III         Business Plan:         9           Designing Business Model- Business Model Canvas- Objectives of a Business Plan - Business Planning Process - Structure of a											
Designing Business Model- Business Model Canvas- Objectives of a Business Plan - Business Planning Process – Structure of a Business Plan – Technical, Marketing, Financial Feasibility assessment - Competitive analysis - Common errors in Business Plan											
Business Plan – Technical, Marketing, Financial Feasibility assessment - Competitive analysis - Common errors in Business Plan formulation - Presentation of the Business Plan: The 'Pitch' - case studies											
Unit – I	V	Financing and accounting:						9			
Forms	of entrepren	eurial capital - Sources of Financial capital: debt financing- (	Commer	cial banks ar	nd ot	her s	sourc	es, equity			
financir	ig: Initial Pu	blic offering (IPO), Private placement - Venture capitalists - An	ngel inve	stors-New for	ms (	of fin	ancir	ig: Impact			
analysi	rs, Micro-fina s Taxation-F	ancing, Peer-to-Peer Lending, Crowd funding - Natural capit Direct and indirect taxes. Insolvency and Bankruntov- Case Study	ai. Prep	baring Financ	iai B	suage	еt, Br	eak even			
Unit –		Small Business Management:						9			
Definitio	on of Small S	Scale Industries: Strengths and Weaknesses, Sickness in Small E	Interpris	es: Symptoms	s -Ca	uses	and	remedies-			
Indian S	Startup Ecos	ystem – Institutions supporting small business enterprises, Busin	iess İnci	ubators - Gov	ernm	nent l	Policy	for Small			
Scale I	Enterprises ·	Growth Strategies in small industry - Expansion, Diversific	cation, J	loint Venture,	Mer	ger,	FDI	and Sub-			
Contrac	cting										
								Total:45			
TEXT E	BOOK:										
1.	1. Donald F. Kuratko,"Entrepreneurship: Theory, Process, Practice", 11 <sup>th</sup> Edition, Cengage Learning, Boston, 2020.										
REFER	REFERENCES:										
1.	Robert D. H Hill, Noida.	lisrich, Michael P. Peters & Dean A. Shepherd, Sabyasachi Sinha 2020.	a "Entrep	preneurship",	11 <sup>th</sup>	Editi	on, M	cGraw			
2.	Charantima Education,	th Poornima .M, "Entrepreneurship Development and Small Busin Noida, 2018.	ness En	terprises", 3 <sup>rd</sup>	Editi	on, F	Pearso	on			
3.	Gordon E &	Natarajan K, "Entrepreneurship Development", 6 <sup>th</sup> Edition, Hima	laya Put	olishing House	e, Mu	mba	i, 201	7.			

COUR On co	SE Ol mplet	UTCON ion of t	IES: he cour	se, the st	udents	s will be	able to							BT Map (Highest L	ped ∟evel)
CO1	unde	erstand	the impo	ortance of	entrep	reneursh	ip and c	lemons	trate th	ne traits o	of an ent	repreneur	Арр	olying (K3)	
CO2	iden	tify suit	able entr	epreneuri	al vent	ures and	busines	ss oppo	rtunity				Арр	olying (K3)	
CO3	asse	ess the	compone	ents of bu	siness	plan							Ana	alyzing (K4	.)
CO4	appr	raise the	e source	s of finand	ce and i	interpret	account	ting stat	ement	ts			Арр	olying (K3)	
CO5	interpret the causes of sickness of small scale enterprises and its remedies Understanding (K2)														
						Mappir	ng of CC	)s with	POs a	and PSO	s				
COs/F	POs	PO1	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
со	1						2	2	1	1		3	2		
CO	2	1	2	2	2		2	2	1	1		3	2		
CO	3	2	2	2	2	2	2	2	2	2	2	3	2		
CO	4	1	1	2	1		2	1	1	1	2	3	2		
CO	5	1	1	2	1		2	1	1	1	2	3	2		
1 – Slig	ght, 2	– Mode	erate, 3 -	Substant	ial, BT-	Bloom's	Taxono	omy				1			1
						ASSES	SMENT		ERN -	THEOR	Y				
Tes	t / Blo	oom's	Re	memberi	ng l	Jndersta	anding	Appl	ying	Analyz	ing	Evaluating	C	reating	Total
C	atego	ory*		(K1) %		(K2)	%	(K3)	) %	(K4) 9	%	(K5) %	(	(K6) %	%
	CAT1 20 40 40 100														
	CAT	2		20		30		30	)	20					100

\* ±3% may be varied (CAT 1,2,3 - 50 marks & ESE - 100 marks)

CAT3

ESE

		22GEX01 – NCC Studies (Army Wing)	-1							
		(Offered by Department of Electrical and Electronic	cs Engir	neering)						
Progra Branch	mme & າ	All BE/BTech Engineering and Technology Branches	Sem.	Category	L	Т	Ρ	Credit		
Prereq	uisites	Nil	5/6	OE	3	0	2	4		
Pream	ble	This course is designed especially for NCC Cadets. This course discipline, secular outlook, the spirit of adventure, sportsman sp cadets by working in teams, learning military subjects including	e will hel pirit and weapor	lp develop cha ideals of selfle n training.	arac ess :	ter, c servio	amara ce am	aderie, longst		
Unit - I		NCC Organisation & National Integration		*				9		
NCC C advanta Nationa Nationa	Organisation - ages of NCC al Integration- al Integration.	<ul> <li>History of NCC- NCC Organisation- NCC Training- NCC Un Training- NCC badges of Rank- Honours and Awards – Incentive Unity in diversity- contribution of youth in nation building- nation</li> </ul>	iform – es for N( nal integi	Promotion of CC cadets by ration council-	NC cent Ima	C cao tral an ages	dets - nd sta and S	<ul> <li>Aim and ate govt.</li> <li>Blogans on</li> </ul>		
Unit - II         Basic physical Training & Drill         9           Basic physical Training - various everyises for fitness (with Demonstration) Food - Hygions and Cleanliness         9										
Basic p Drill- W saluting WITH [	hysical Train ords of comn on the marc DEMONSTRA	ing – various exercises for fitness( with Demonstration)-Food – H nands- position and commands- sizing and forming- saluting- ma h- side pace, pace forward and to the rear- marking time- Drill wi NTION)	Hygiene a arching- t ith arms-	and Cleanline turning on the - ceremonial c	ss. ma Irill-	rch ai guaro	nd wh d mou	eeling- Inting. (		
WITH DEWIONSTRATION)       Unit - III     Weapon Training     9										
Main P holding PRACT	arts of a Rifle - safety preca ICE SESSIO	<ul> <li>Characteristics of 5.56mm INSAS rifle- Characteristics of .22 ril autions – range procedure- MPI and Elevation- Group and Snap N) - Characteristics of 7.62mm SLR- LMG- carbine machine our</li> </ul>	fle- loadi shooting 1.	ing and unload g- Long/Short	ding rang	– po je firii	sition ng( W	and /ITH		
Unit - I	v	Social Awareness and Community Development						9		
Aims o prevent NSAP- childrer	f Social serv tive measure PMGSY-Terro n from sexual	rice-Various Means and ways of social services- family planning s- NGO and their activities- Drug trafficking- Rural developm prism and counter terrorism- Corruption – female foeticide -down offences act- civic sense and responsibility	ing – Hl nent prog y –child	IV and AIDS- grammes - M abuse-RTI Ac	Ca IGN t- R	ncer REG TE A	its ca A-SG ct- Pr	auses and SY-JGSY- otection of		
Unit - \	1	Specialized Subject (ARMY)						9		
Basic s forces-	tructure of Ar Service tests	med Forces- Military History – War heroes- battles of Indo-Pak v and interviews-Fieldcraft and Battlecraft-Basics of Map reading	var- Para including	am Vir Chakra g practical.	I- Ca	areer	in the	e Defence		
				Lecture :4	5, P	ractio	cal:30	), Total:75		
TEXT E	TEXT BOOK:									
1.	National Ca	det Corps- A Concise handbook of NCC Cadets by Ramesh Pub	lishing H	House, New D	elhi	, 2014	4			
REFER	ENCES:									
1.	Cadets Han	dbook – Common Subjects SD/SW published by DG NCC, New	Delhi.							
2.	Cadets Han	dbook- Specialized Subjects SD/SW published by DG NCC, New	w Delhi							
3.	NCC OTA F	Precise published by DG NCC, New Delhi.								

COURS On cor	SE O	UTCOI	MES: the cours	se, the st	udent	s will be a	able to							BT Mapp (Highest L	oed .evel)
CO1	disp cont	lay ser tribute	nse of pat towards n	riotism, se	cular v	values and rough nat	d shall b tional un	be transf	formed social	l into mo cohesior	tivated y	outh who w	vill	Applying	, (K3)
CO2	dem deve	nonstra elop th	te Health e quality c	Exercises of immedia	, the s ate and	ense of d implicit (	iscipline obediena	, improv ce of or	ve bea ders	ring, sma	artness, i	turnout,		Applying	<mark>(K3)</mark>
CO3	basi	ic knov	ledge of	weapons	and the	eir use an	ıd handli	ing.						Applying	<mark>(K3)</mark>
CO4	und and	erstand ways t	ding abou o eradica	t social ev te such ev	ils and /ils	I shall inc	ulcate se	ense of	whistle	e blowing	g against	such evils		Applying	<mark>(K3)</mark>
CO5	acqı abo	uaint, e ut expa	expose &   ansion of /	provide kn Armed Fo	iowled rces, s	ge about ervice su	Army/Na bjects a	avy/ Air nd impo	force a ortant b	and to ac attles.	quire inf	ormation		Applying	<mark>(K3)</mark>
	Mapping of COs with POs and PSOs														
COs/P	POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO	1	3 3 3 3 3													
CO2	2					3									
COS	3	3	2	1	1										
CO4	4	3	2	1	1										
CO	5	3	2	1	1										
1 – Sliç	ght, 2	– Mod	erate, 3 –	Substanti	al, BT	- Bloom's	Taxono	my							
						ASSES	SMENT	PATTE	ERN - 1	THEORY	,				
Test /	Bloo	m's	Remem	bering (K	(1)	Understa	anding	Apply	ying	Analyz	ing	Evaluating		reating	Total
Cate	egory	<b>/*</b>		%		(K2)	%	(K3)	%	(K4) 9	%	(K5) %		(K6) %	%
С	AT1			-		-		-		-		-		-	-
С	AT2					-		-		-		-			-
C	AT3			-		-		-		-		-		-	-
E	CA13       Image: Call and the second s														

		22GEX02 - NCC STUDIES (AIR WI	NG) – I								
		(Offered by Department of Information T	Fechnolo	gy)							
Progra Branci	imme & h	All BE/BTech Engineering and Technology Branches	Sem.	Category	L	т	Ρ	Credit			
Prereq	uisites	Nil	5/6	OE	3	0	2	4			
			I					1			
Pream	ble	This course is designed especially for NCC Cadets. This co discipline, secular outlook, the spirit of adventure, sportsma cadets by working in teams, honing qualities such as self-di of labour in the cadets.	ourse will n spirit a iscipline,	help develop cha nd ideals of selfle self-confidence,	aract ess s self-	er, c servic relia	amara ce am nce ai	aderie, ongst nd dignity			
Unit–I		NCC Organization and National Integration						9+3			
NCC C advant History contrib	Drganization ages of NCC and Organ oution of youth	<ul> <li>History of NCC- NCC Organization- NCC Training- NCC</li> <li>Training - NCC badges of Rank - Honors' and Awards – Indization of IAF - Indo-Pak War-1971 - Operation Safed Solution building - national integration council - Images and</li> </ul>	Uniform centives f Sagar. Na Sogans	<ul> <li>Promotion of for NCC cadets bational Integrational Integrational Integration</li> <li>on National Integration</li> </ul>	NC oy ce on - grati	C ca entral Unit ion.	dets - I and ty in	<ul> <li>Aim and state govt.</li> <li>diversity -</li> </ul>			
Unit–II		Drill and Weapon Training						9+3			
Drill- W - salut mounti holding PRAC	Vords of comi ing on the ming.(WITH DI g - safety pre TICE SESSIC	mands - position and commands - sizing and forming - salutir narch - side pace, pace forward and to the rear - marking EMONSTRATION). Main Parts of a Rifle - Characteristics o cautions – range procedure - MPI and Elevation - Group ar DN).	ng - marc j time - I of .22 rifle nd Snap :	ching - turning on Drill with arms - e - loading and shooting - Long/	n the cere unloa Shoi	mare emor ading rt rar	ch and nial di g – po nge fir	d wheeling rill - guard osition and ring (WITH			
Unit–II	1	Principles of Flight						9+3			
Laws o Aircraf	of motion-For t recognition.	ces acting on aircraft – Bernoulli's theorem - Stalling - Primar	y control	surfaces – seco	ndar	y cor	ntrol s	urfaces -			
Unit-I	/	Aero Engines						9+3			
Introdu trends.	uction of Aero	engine -Types of engine - piston engine - jet engines - Turbo	o prop en	gines-Basic Flig	ht In	strun	nents	- Modern			
Unit-V	1	Aero Modeling						9+3			
History Radio	of aeromode Control Mode	eling - Materials used in Aero-modeling - Types of Aero-mode els - Building and Flying of Aero-models.	els – Stat	ic Models - Glide	ers -	Cont	rolline	e models -			
				• • • • •	45 3						
TEXT I	BOOK:			Lecture:	45, 1	utoi	rial:30	J, Total:75			
1.	"National C	adet Corps - A Concise handbook of NCC Cadets", Ramesh	Publishir	ng House, NewD	elhi,	2014	ŀ.				
REFEF	RENCES/ MA	NUAL / SOFTWARE:									
1.	"Cadets Ha	andbook – Common Subjects SD/SW", DGNCC, New Delhi.									
2.	"Cadets Ha	andbook – Specialised Subjects SD/SW", DGNCC, New Delhi	i.								
3.	"NCCOTA Precise", DGNCC, New Delhi.										

COUR On co	SE O mplet	UTCON	IES: the cou	rse, the st	udent	s will be a	able to							BT Mapp (Highest L	oed .evel)
CO1	buil cari	d sense ry out n	e of patri ation bu	otism, sec ilding throu	ular va Igh na	alues and itional unit	shall be y and so	transfo ocial col	rmed in nesion.	nto motiv	vated you	uth who wil	I	Applying	<mark>(K3)</mark>
CO2	den thei	nonstra ir use a	te the se nd hand	ense of dis ling	cipline	with sma	rtness a	nd have	e basic	knowled	lge of we	apons and	k	Applying	<mark>(K3)</mark>
CO3	illus	strate va	arious fo	rces and n	nomer	nts acting o	on aircra	aft						Applying	<mark>(K3)</mark>
CO4	outl	line the	concept	s of aircra	ft engi	ne and roo	cket pro	pulsion						Applying	<mark>(K3)</mark>
CO5	des	ign, bui	ld and f	y chuck gli	iders/r	nodel air p	lanes a	nd displ	ay stat	tic mode	s.			Applying	<mark>(K3)</mark>
	Mapping of COs with POs and PSOs														
COs/F	POs	PO1	PO2	PO3	PO	4 PO5	PO6	P07	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO	1						3	3	3	3	3				
CO	2					3									
CO	3	3	2	1	1										
CO	4	3	2	1	1										
CO	5	3	2	1	1										
1 – Sli	ght, 2	– Mode	erate, 3	<ul> <li>Substant</li> </ul>	ial, BT	- Bloom's	Taxono	my							
						ASSES	SMENT	PATTE	ERN - 1	THEORY	,				
Tes	st / Blo Catego	oom's ory*	R	ememberi (K1) %	ng	Understa (K2)	anding %	Appl (K3)	ying %	Analyz (K4) 9	ing   %	Evaluating (K5) %	g (	Creating (K6) %	Total %
	CAT	1		-		-		-		-		-		-	-
	CAT	2		-		-		-		-		-		-	-
	CAT	3		-		-		-		-		-		-	-
	ESE The examination and award of marks will be done by the Ministry of Defence, Government of India which includes all K1 to K6 knowledge levels. The maximum marks for the End Semester Examination is 500 marks. It will be converted to 100 marks.														

		22MB001 - COST ACCOUNTING FOR EN	GINEER	s							
		(Offered by Department of Management S	Studies)								
Progra Branch	mme& າ	All BE/BTech Engineering and Technology Branches	Sem.	Category	L	Т	Р	Credit			
Prereq	uisites	NIL	5	OE	3	1	0	4			
Pream	ole	To provide an In-depth study of the Cost Accounting principles a classification of costs components to facilitate decision Making.	and techni	ques for iden	tifica	tion, a	analys	is and			
Unit –	l	Introduction to Cost Accounting						9 + 3			
accounting and management accounting – cost centres – cost units – Elements of cost – classification of cost – preparation of cost sheet.											
Unit – II         Cost Ascertainment – Elements of cost         9 + 3											
Materia Labour incentiv Overhe	al Costs: r Costs: /e scheme eads: Coll	Procurement of materials – Inventory management and control – Time Keeping, Time booking and payroll – Labour turnover - es. ection, classification and apportionment and allocation of overhea	scrap, spo – principle ads.	oilage, defect es and meth	ives ods	and w of re	/astag mune	e ration and			
Unit - III     Basic Costing Methods     9 + 3											
Operating Costing - Meaning - Preparation of Operating Cost Sheet - Transport Costing - Power Supply Costing - Hospital Costing.											
Unit –	IV	Advanced Costing Methods						9 + 3			
Feature Proces	es of Job ( s Loss - N	Costing - Batch Costing - Preparation of Cost Sheet Under Job Co ormal and Abnormal Loss.	osting, and	d Batch Costi	ng -	Proce	ess Co	osting -			
Unit – '	V	Cost Accounting Techniques						9 + 3			
Budge classific Standa costing varianc	t and Buc cation of b ard Costin as a man ses – Sales	Igetary Control: Budgetary control as a management Tool – Inst udgets – Fixed and Flexible Budgeting. Ig and Variance Analysis: Budgetary control and standard costin agement Tool – Cost variances – Direct material cost variances – s variance.	allation of ng – Suita - Direct la	Budgetary co ability of stanc bour cost vari	antro lard ( iance	l syste costin es – C	em g – St iverhe	andard ad			
				Lecture:	45,	Tutor	ial: 15	5, Total:60			
TEXT E	BOOKS										
1.	Jawahar Educatio	Lal, SeemaSrivastava, Manisha Singh, " Cost Accounting, Text, F n, New Delhi, 2020.	Problems	and Cases", 6	6th E	dition	, McG	raw Hill			
2. William Lanen, Shannon Anderson and Michael Maher, "Fundamentals of cost Accounting",7th Edition, McGraw Hill Education, New Delhi, 2020.											
REFER	RENCES										
1.	M.N.Aroi	a and PriyankaKatyal, "Cost Accounting", 5th Edition, Vikas publi	shing Hou	use, New Dell	hi, 20	)23.					
2.	Ravi M.K	ishore, " Cost and Management Accounting", 6th Edition, Taxma	nn, New	Delhi, 2021							
3.	M.N.Aroi	a, "Cost and Management Accounting",11th Edition, Vikas Publis	hing, Nev	v Delhi, 2021.							

COUR On co	SE OUTCOMES: mpletion of the course, the students will be able to	BT Mapped (Highest Level)
CO1	understand the conceptual frame work of cost accounting	Understanding (K2)
CO2	understand the basic concepts and process in determination of cost of product and services	Understanding (K2)
CO3	use the basic costing methods in different business situation	Applying (K3)
CO4	demonstrate the advanced costing methods in various decision making situation	Applying (K3)
CO5	prepare various types of budgets and determine variance in different situations.	Applying (K3)

	Mapping of COs with POs and PSOs													
COs/POs	P01	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO1	2 PSO1	PSO2
CO1										2	3	1		
CO2										2	3	1		
CO3										2	3	1		
CO4										2	3	1		
CO5										2	3	1		
1 – Slight, 2	– Mode	rate, 3 -	Substantia	I, BT-	Bloom's	Taxon	nomy							
					ASSES	SMEN		ERN - T	HEOR	(				
Test / Blo Catego	om's ry*	Reme (I	embering K1) %	Und	lerstand (K2) %	ling	Applying (K3) %	g An	alyzing K4) %	l Eval	uating (K	5) %	Creating (K6) %	Total %
CAT	1		30		70									100
CAT2	2		15		35		50							100
CAT	3		15		35		50							100

\*  $\pm 3\%$  may be varied (CAT 1,2 & 3 – 50 marks & ESE – 100 marks)

ESE

	22MBO02 Economic Analysis for Decisio	on Making									
	(Offered by Department of Management S	Studies)									
Programme Branch	All BE/BTech Engineering and Technology Branches	Sem.	Category	L	т	Р	Credit				
Prerequisit	es Basic understanding of differential calculus	6	OE	3	1	0	4				
Preamble	The course aims at introducing a few vital techniques required for informed managerial decisions.	or carrying	out economic	: ana	alysis	for m	aking				
Unit – I	Economic Optimization						9 + 3				
Economic ( Theory of fir incremental	<b>Optimization:</b> m – Business versus Economic profit – Revenue relations – Cost relati concept.	ions – Pro	fit relations –	Mar	ginal	versu	S				
Unit – II	Forecasting						9 + 3				
Forecasting	<b>g:</b> Forecasting applications – Techniques –Naire method – Moving ave d – Growth Trend – Sales, cost and revenue forecasting.	rage – Ex	ponential smc	othi	ng - <sup>-</sup>	Trend	analysis –				
Unit – III     Production and Cost Analysis     9 + 3											
Cost Analy volume – pr Unit – IV Competitive	sis: Economic and Accounting costs – Time in cost analysis – Short ru ofit analysis. Competitive Market Analysis Market Analysis: Characteristics of competitive markets – Profit max market supply curve – Equilibrium in competitive markets - Monopoly	n cost – L kimisation – Monopo	ong run cost - – Marginal ar listic competit	- co nalys ion.	st rela	ations comp	9 + 3 9 + 3 etition –				
Unit – V	Game theory and Competitive Strategy						9 + 3				
Game Theo Dominance	ry Basics - Prisoner's Dilemma - Saddle Point - Two Person Zero Sum Rule - Mixed Strategies.	Game - G	ames without	Sac	dle f	Points	-				
			Lecture: 4	45, T	utor	ial: 1	5, Total:60				
TEXT BOO	<s< th=""><th></th><th></th><th></th><th></th><th></th><th></th></s<>										
1. Mar	k Hirschey, "Managerial Economics", 12 <sup>th</sup> Edition, Cengage Learning, I	New Delhi	, 2022.								
2. Geetika, PiyaliGhosh, Purba Roy Choudhury, "Managerial Economics", 3rd Edition, McGraw Hill Education, New Delhi, 2019.											
REFERENC	ES										
1. Gup	ota. G, "Managerial Economics", 2nd Edition, McGraw Hill Education, N	lew Delhi,	2019.								
2. Ahu	Ahuja. H. L, "Principles of Microeconomics", 22nd Edition, S. Chand Publishing, New Delhi, 2019.										
3. Par Del	neerSelvam R, P. Sivasankaran, P. Senthilkumar., "Managerial Econo ni, 2018.	omics", 1s	t Edition, Cen	gage	e Lea	irning	, New				

COURSE OUTCOMES:       BT Mappe         On completion of the course, the students will be able to       (Highest Level)													apped t Level)		
CO1	Und	erstand	revenue	e, cost and	profit re	elations	and ap	ply techr	niques	to find b	est cours	e of action	า.	Applyir	ng (K3)
CO2	Арр	ly appro	opriate fo	precasting t	echniq	ues for e	estimati	ng sales	, cost a	and reve	nue.			Applyir	ng (K3)
CO3	Und – pr	erstand ofit ana	the rela lysis	tion betwe	en inpu	its and o	output c	of produc	tion sy	/stem ar	d perforr	n cost – v	olume	Applyir	ng (K3)
CO4	Арр	ly mark	et equilib	orium conce	epts in I	monopo	ly and r	nonopoli	stically	/ compe	itive mar	kets.		Applyir	ng (K3)
CO5	Und	erstand	game th	neory and a	pply in	differen	it strate	gic decis	ions					Applyir	ng (K3)
	Nonning of COo with DOo and DSOo														
Mapping of COs with POs and PSOs           COs/POs         PO1         PO3         PO4         PO5         PO6         PO7         PO8         PO9         PO10         PO11         PO12         PS01         PS02															
CO	1					2					1	3			
CO	2					2					1	3			
CO	3					2					1	3			
CO	4					2					1	3			
CO	5					2					1	3			
1 – Slig	ght, 2	– Mode	rate, 3 -	Substantia	al, BT-	Bloom's	Taxono	omy			I				
						ASSES	SMEN	ΓΡΑΤΤΕ	RN - 1	THEORY	,				
Test Ca	/ Blo atego	om's ry*	Rem (I	embering K1) %	Und	erstanc (K2) %	ling	Applying (K3) %		nalyzing (K4) %	Eval	uating (K	5) %	Creating (K6) %	Total %
	CAT1	-		35		35		30							100
	CAT2	2		15		45		40							100
	CAT 3	3		15		35		50							100
	ESE			5		40		55							100

\* ±3% may be varied (CAT 1,2 & 3 – 50 marks & ESE – 100 marks)

		22MBO03 Marketing Analytics	;								
		(Offered by Department of Management	Studies)								
Progra Branch	imme& n	All BE/BTech Engineering and Technology Branches	Sem.	Category	L	т	Ρ	Credit			
Prereq	uisites	Basic understanding of differential calculus	7	OE	3	1	0	4			
Preaml	ble	Marketing analytics enables marketers to measure, manage an effectiveness and optimize return on investment (ROI). This courses use customer value and apply analytic tools to various manufacture customer value and apply analytic tools to various manufacture customer value and apply analytic tools to various manufacture customer value and apply analytic tools to various manufacture customer value and apply analytic tools to various manufacture customer value and apply analytic tools to various manufacture customer value and apply analytic tools to various manufacture customer value and apply analytic tools to various manufacture customer value and apply analytic tools to various manufacture customer value and apply analytic tools to various manufacture customer value and apply analytic tools to various manufacture customer value and apply analytic tools to various manufacture customer value and apply analytic tools to various manufacture customer value and apply analytic tools to various manufacture customer value and apply analytic tools to various manufacture customer value and apply analytic tools to various manufacture customer value and apply apply analytic tools to various manufacture customer value and apply ap	d analyze r Irse expose	narketing per es the student	forma ts wit	ance th the	to ma tools	aximize its s to			
Unit –	1	Market & Marketing Analytics	rketing dec	1310113.				9 + 3			
Introdu Market Market	uction - In t Insight - t Segmen	troduction to marketing analytics, Models & Metrics Market sizing. tation –Segmentation, Targeting & Positioning									
Unit –	II	Business & Competition						9 + 3			
Compe Busine Busine	etitive An ess Strate ess Opera	alysis - Competitor identification, analysis, and actions gy –Scenarios, Decision Model, Metrics ations - Forecasting									
Unit - III     Product and Price     9+3											
Product and Service Analytics - Conjoint analysis and product/service metrics Price Analytics - Pricing techniques and assessment											
Unit –	IV	Distribution & Promotion						9 + 3			
Distrib Promo	tion Anal	alytics – Characteristics, Channel evaluation and selection, Multic ytics - Promotion budget estimation and allocation, Metrics	channel dis	tribution and i	metri	CS.					
Unit –	V	Sales						9 + 3			
Sales /	Analytics	- Metrics for sales, profitability, and support		Lecture: 4	45, T	utori	ial: 15	i, Total:60			
TEXT I	BOOKS										
1.	Stephen	Sorger, "Marketing Analytics: Strategic Models and Metrics", 1st	Edition, Ad	dmiral Press,	UK, 2	2016					
2.	2. Wayne L. Winston, "Marketing Analytics: Data-Driven Techniques with Microsoft Excel", 1st Edition, Wiley, New Delhi, 2018.										
REFER	REFERENCES										
1.	Tommy I	Blanchard, "Data Science for Marketing Analytics", 1st Edition, Pa	ackt Publis	hing, UK, 201	9.						
2.	Mike Gri	gsby, "Marketing Analytics", 2nd Edition, Kogan Page, UK, 2018.	1								
3.	B. David A. Aaker, V. Kumar, Robert P. Leone, George S. Day., "Marketing Research", 1st Edition, Wiley, New Delhi, 2019.										

COURSE OUTCOMES: On completion of the course, the students will be able to											(	BT Mapped (Highest Level)				
CO1	Unde	erstand	the impo	ortance of	Analytic	s in Ma	keting,	size an	d segme	ent the	market		Ur	Understanding (K2)		
CO2	Understand the Business, competition and its related decisions.											Ur	Understanding (K2)			
CO3	Identify important features of a product and suitable pricing methods.											Applying (K3)				
CO4	4 Assess Channel performance and Promotion Metrics.											Applying (K3)				
CO5	Assess sales performance.											Applying (K3)				
Mapping of COs with POs and PSOs																
COs/P	Os/POs PO1 PO2 PO3 PO4 PO5 PO6 PO7 PO8 PO9 PO10 PO11 PO12 PSO1 PSC										PSO2					

Test / Bloom's		Reme	mbering	Und	erstand	ing A	pplying	Ana	alyzing	<b>E</b> val		· ) 0/	Creating	Total 0/
ASSESSMENT PATTERN - THEORY														
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														
CO5										2	3	1		
CO4										2	3	1		
CO3										2	3	1		
CO2										2	3	1		
CO1										2	3	1		

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	35	65					100
CAT2	15	35	50				100
CAT 3	15	15	70				100
ESE	25	25	50				100

\*  $\pm$ 3% may be varied (CAT 1,2 & 3 – 50 marks & ESE – 100 marks)

		22MA	001 - MAT	THEMA	TICAL	L FOU	UNC	DAT	TION	S FC	DR M	ACHIN	ELI	EARNI	NG				
				(Offere	d by D	Depar	artm	nent	t of N	Math	emat	ics)							
Progra Branc	amme & h	AII B.E/.BT	ech Bran	ches								Sem.	C	Catego	ry	L	Т	Ρ	Credi
Preree	quisites	Nil										5		OE		3	1	0	4
Pream	reamble To impart the basic knowledge in linear algebra, decomposition of matrices, continuous optimization, linear regression and support vector machines which provide the foundations for machine learning and deep learning.																		
Unit –	t – I Vector Spaces: 9+3																		
Real \ Basis	ector space and dimensi	es (Definition ion – Row spa	& Problen ace, Colum	ns) – Su nn space	ubspac e and N	aces – Null S	– Li Spa	_inea ace.	ar Co	ombir	natior	ns – Li	near	deper	deno	;e a	and i	ndep	endence
Unit –	11	Linear Tra	nsformati	ons:															9+3
Introdu	uction – Ra	nk and nullity	<ul> <li>. – Dimei</li> <li>. – Dimei</li> </ul>	nsion th	neorem	n – K	Kerr	rnel a	and	rang	je –	Chang	e of	basis	– Co	omp	oositi	on a	nd invers
Unit –		Inner Prod	uct Space	es:	10.														9+3
Norms	s – Inner pro	oducts – Leng	th and Di	stance -	– Ang	gle ar	and (	Orth	hogo	onality	y – O	rthono	rma	Basis	– G	am	n-Sch	midt	Process
Unit _		Matrix Dec	omnositiv	on and V	Vector	or Cal	alcul	ulue.											0+3
Matrix	Decomposi	tion: Cholesky	/ decompo	sition -	Singul	ular V:	Valu		)econ	nnos	ition					-			3+3
Vector functio	Calculus: I ons – Gradie ariate Tavlo	Differentiation ents of matric r Series.	of Univar es – Usefi	riate Fur ul Identi	nctions ities for	ns – P or Cor	Part ompu	rtial I outing	Diffe ng Gr	erenti adiei	ation nts –	and G Highe	iradi r Ore	ents – der De	Grao rivati	lier ves	nts o - Li	f Veo neari	tor value zation an
Unit –	V	Optimizati	on:																9+3
Introdu Kuhn metho	uction – Cla Tucker conc d.	assification of ditions – Lagra	Optimizat ange's mu	ion Prol Itiplier n	blems nethod	s – Co d –- U	Cons Unc	straii cons	ined strain	mult ned o	ivaria ptimi:	ble op zation:	timiz Ste	epest	vith desc	neo ent	qualit met	ty co hod -	nstraints - Newton
TEXT	BOOK													Leciu	10.4	<i>,</i> , ,	utor	iai. i .	, i otai.u
		nton and Chr	ia Porroa	"Elomo	ntonul	Linco	or A	Algok	bro"	11+4	- Edit	ion la	hn I		Sor		Now	Dolb	i 2014 f
1.	Units I,II,II		is nones,	LIEIIIEI		Linea		Aigei	ыа,	, i i u		.ion, jc	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	wiley o	301	15, 1	New	Dein	1, 2014 10
2.	M. P. Deis Press, 201	senroth, A. A. 19 for Units –	Faisal, ar IV, V.	nd C. S.	Ong, '	, "Math	athen	emati	tics fo	or Ma	achin	e Lear	ning	', 1st E	ditio	۱C	amb	ridge	Universi
REFE	RENCES:																		
1.	David C. I New Delhi	Lay, Steven R i, 2016.	t. Lay, Juc	dith McD	Donald,	d, "Lin	ineai	ar Al	lgebr	a an	d its	Applica	ation	s", 5 <sup>th</sup>	Editi	on,	Pea	rson	Educatio
2.	Ethem Alp MIT Press	baydin, "Introd s,USA,2020.	uction to N	Machine	e Learn	ning(A	(Ada	aptiv	ve Co	ompı	utatio	n and I	Macl	nine Le	arnir	ıg s	series	3)", 4	<sup>th</sup> Editio
3.	R. O. Dud	a, E. Hart, an	d D.G. Sto	ork, "Patt	tern cla	lassifi	ificati	ation"	", 2 <sup>nd</sup>	<sup>d</sup> Edit	tion, J	lohn W	iley	& Sons	s, 20 <sup>-</sup>	12.			

COUR On co	SE OUTCOMES: mpletion of the course, the students will be able to	BT Mapped (Highest Level)
CO1	understand the concepts of vector spaces.	Understanding (K2)
CO2	interpret the concepts of linear transformations.	Understanding (K2)
CO3	apply the concept of inner product space and decompose the given matrix by means of orthonormal vectors.	Applying (K3)
CO4	demonstrate the knowledge of factorisation of matrices and vectors in Machine learning.	Understanding (K2)
CO5	identify suitable optimization algorithms for machine learning applications.	Applying (K2)
1		

## Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1												
CO2	3	1												
CO3	3	2												
CO4	3	3	3	1										
CO5	3	2	3	3										

1 - Slight, 2 - Moderate, 3 - Substantial, BT- Bloom's Taxonomy

## **ASSESSMENT PATTERN - THEORY**

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	15	65	20				100
CAT2	15	65	20				100
CAT3	15	50	60				100
ESE	10	40	50				100
* . 00/			400				

\* ±3% may be varied (CAT 1,2 & 3 – 50 marks & ESE – 100 marks)
		22MAO02 - NUMERICAL COMPUTIN	NG									
		(Offered by Department of Mathemat	tics)									
Progra Branch	a <b>mme &amp;</b> h	All B.E/.BTech Branches	Sem.	Category	L	т	Ρ	Credit				
Prereq	uisites	Nil	5	OE	3	1	0	4				
Pream	ble	To impart knowledge in interpolation, numerical differentiation numerical algorithms to identify roots of algebraic and transport solve linear system of equations, ordinary differential equation	on and in cendenta	tegration. Als al equations,	so de findii	eveloj ng ei	p skill gen v	s to apply alues and				
Unit –		Solution to Algebraic and Transcendental Equations and	l Eigen v	alue proble	ms:			9+3				
Solutio Raphso Iterativo <b>Unit –</b>	n to Algebra on method <u>e method fo</u> II	aic and Transcendental Equations: Bisection method - Iteration r Eigen values: Power method – Jacobi's method. Solution of Simultaneous Linear Algebraic equations:	n methoo	d – Method of	fals	e pos	sition -	– Newton- 9+3				
Introduction - Direct methods: Gauss elimination method – Gauss - Jordan method – LU decomposition method – Crout's method –Iterative methods: Gauss Jacobi and Gauss – Seidel methods.												
Unit – III Interpolation: 9+3												
Interpolation with equal intervals: Newton's forward and backward difference formulae – Central difference interpolation formulae: Gauss forward and backward interpolation formulae – Interpolation with unequal intervals: Lagrange's interpolation formula – Newton's divided difference formula.												
Unit –	IV	Numerical Differentiation and Integration:						9+3				
Differer Simpso	ntiation usin ons 1/3 <sup>rd</sup> rule	g Newton's forward, backward and divided difference formula e – Simpsons 3/8 <sup>th</sup> rule – Double integrals using Trapezoidal ar	ae – Nur nd Simps	nerical integr son's rules.	atior	: Tra	pezoi	idal rule –				
Unit –	V	Numerical Solution of First order Ordinary Differential Ec	quations	5:				9+3				
Single Multi st	step metho tep methods	ds: Taylor series method – Euler method – Modified Euler m :: Milne's predictor corrector method – Adam's Bashforth metho	nethod – od.	Fourth orde	r Ru	nge-l	Kutta	method -				
				Lecture:	45, T	utor	ial:15	, Total:60				
TEXT	BOOK:											
1.	Veerarajar 2018.	T, Ramachandran T., "Numerical Methods", 1 <sup>st</sup> Edition, Tata	McGraw	Hill Publishi	ng C	ompa	any, N	lew Delhi,				
REFER	RENCES:											
1.	Kandasam 2016.	y, P., Thilakavathy, K. and Gunavathy, K., "Numerical Method	s", Repri	nt Edition, S.	Cha	nd &	Co, N	lew Delhi,				
2.	<ol> <li>Sankara Rao. K., "Numerical Methods for Scientists and Engineers", 3<sup>rd</sup> Edition, Prentice Hall of India Pvt. Ltd, , New Delhi, 2007.</li> </ol>											
3.	Steven C.	Chapra, Raymond P. Canale., "Numerical Methods for Enginee	ers", 7 <sup>th</sup> I	Edition, McGr	aw-F	Hill E	ducati	ion, 2014.				
4.	Sastry, S.S	S, "Introductory Methods of Numerical Analysis", $5^{th}$ Edition, PH	II Learni	ng Pvt. Ltd, 2	015.							

COUR On co	SE O	UTCOM	IES: he cours	se. the s	tudents	will be a	able to						(H	BT Map lighest L	ped _evel)
CO1	appl	y variou	s numer	ical techi	niques to	solve al	gebraic a	and trans	scende	ental equa	tions.			Applying	(K3)
CO2	solve	e simulta	aneous I	inear equ	uations b	y numeri	cal meth	ods.					ŀ	Applying	(K3)
CO3	com	pute inte	ermediat	e values	of giver	evenly (	or) uneve	enly spa	ced da	ta.			ŀ	Applying	(K3)
CO4	appl	y the co	ncepts o	of numeri	cal diffe	entiation	and integ	gration i	n real t	ime appli	cations.		ŀ	Applying	(K3)
CO5	iden	tify the s	solution o	of first or	dinary d	fferential	equation	is by nui	merica	l methods	i.		ŀ	Applying	(K3)
Manning of COs with POs and PSOs															
		[			N	lapping	of COs	with P	Os ar	nd PSOs					
COs/F	os	PO1	PO2	PO3	PO4	PO5	P06	P07	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
co	1	3	2	1											
CO	2	3	2	2											
CO	3	3	3	2											
CO	4	3	2	1											
CO	5	3	3	3											
1 – Sli	ght, 2	2 – Moo	derate, 3	3 – Sub	stantial	BT- Blo	om's Ta	axonom	у						
					ŀ	SSESS	MENT F	PATTER	RN - T	HEORY					
Test Ca	t / Blo atego	oom's ory*	Rer	nember (K1) %	ring l	Jndersta (K2)	anding %	Appl (K3	ying ) %	Analyz (K4) 9	ing E %	valuatin (K5) %	g Crea (Ke	ating 6) %	Total %
	CAT	1		10		15		75	5						100
	CAT	2		10		15		75	5						100
	CAT	3		10		15		75	5						100
	ESE	Ξ		10		15		75	5						100
* ±3%	may	be vari	ied (CA	T1,2 &	3 – 50	marks &	ESE –	100 ma	arks)						

		22MAO03 - STOCHASTIC PROCESSES AND QU	EUING T	HEORY								
		(Offered by Department of Mathemat	tics)									
Progra Branc	amme & h	All B.E/.BTech Branches	Sem.	Category	L	Т	Ρ	Credit				
Prerec	quisites	Nil	5	OE	3	1	0	4				
Pream	ble	To provide an in-depth knowledge in random variables, ra ability to apply suitable queuing models to real time application	andom p ons.	rocess, corre	elatio	n ar	nd pro	omote the				
Unit –		Random Variables:						9+3				
Discre and Va	te and Cont ariance – Mo	inuous random variables – Probability Mass and Probability oments – Moment generating functions.	density 1	functions – N	lathe	emati	cal e	xpectation				
Unit –	II	Random processes:						9+3				
Generation	al concepts	and definitions - Classification - Stationary process - Marko	ov chains	s – Transitior	n pro	babi	lities	– Poisson				
Unit –	III	Correlation and Spectral densities:						9+3				
Auto ( Proper functio	Correlation - ties (Withou n.	<ul> <li>Cross Correlation – Properties (Without Proof) – Power t Proof) – Wiener- Khintchine relation – Relationship between</li> </ul>	spectral n cross p	density – C bower spectru	ross im a	spe nd c	ectral ross o	density – correlation				
Unit –	IV	Queuing Theory:						9+3				
Chara model (M/M/0 model	cteristics of ) (M/M/1) : C): (∞/FIFO) IV (Finite ca	a queueing system – Kendall's notation – Queuing model I ( $I (\infty/FIFO)$ – Little's formulae – Queuing model II (Infinite ca – Queuing model III (Finite capacity single server Poisson apacity multiple server Poisson model) (M/M/C) : (N/ FIFO).	Infinite ca apacity m queue m	apacity single nultiple serve nodel) (M/M/1	: s€ r Po ): (N	erver issor I/FIF	Poiss n que O) –	son queue ue model Queueing				
Unit –	V	Non-Markovian Queues and Queue Networks:						9+3				
Introdu queuin	uction to Noting networks	n-Markovian queues – M/G/1 queue – Pollaczek-Khintchine	formula -	- Series que	ues	– Op	en a	nd Closed				
				Lecture:4	15, T	utori	ial:15	, Total:60				
TEXT	BOOK:											
1. Veerarajan, T, "Probability and Statistics, Random Processes and Queuing Theory", 1 <sup>st</sup> edition, McGraw-Hill Education, Chennai, 2019.												
REFERENCES:												
1. Athanasios Papoulis, S. Unnikrishna Pillai., "Probability, Random Variables and Stochastic Processes", 4 <sup>th</sup> edition, McGraw Hill, New Delhi, 2017.												
2.	Allen A.O.	., "Probability, Statistics and Queuing Theory", 2nd Edition, Aca	ademic P	ress, New De	elhi,	199	0.					
3.	Roy D. Ya and Comp	ates and David J. Goodman, "Probability and Stochastic Proc outer Engineers", 3 <sup>rd</sup> edition, John Wiley & Sons, 2014.	cesses -	A friendly Int	rodu	ction	for	Electrical				
4.	John F. S edition. Jo	Shortle, James M. Thompson, Donald Gross and Carl M. Ha	arris, "Fu	Indamentals	of G	ueui	ng Tł	neory", 5 <sup>th</sup>				

COUR On co	SE O mplet	UTCOM ion of t	IES: he cour	se, the s	tudents	s will be a	able to						(H	BT Map lighest L	ped .evel)
CO1	app	ly rando	om varial	oles suita	bly in p	ractical pr	oblems.						A	Applying	(K3)
CO2	app	ly the co	oncept o	f random	proces	s in comm	nunicatio	n proble	ms.				A	Applying	(K3)
CO3	und func	erstand	the co	ncepts a	nd prop	perties of	Spectra	al Densi	ity Fun	ction an	d Cross	Correlatio	<sup>n</sup> Und	lerstandi	ng (K2)
CO4	use	the app	oropriate	queuing	model f	or a given	n practica	al applica	ation.				ŀ	Applying	(K3)
CO5	iden	tify the	real time	queue ir	n compu	iter netwo	orks and	take dec	cision a	ccordingl	у.		A	Applying	(K3)
	Manning of COs with POs and PSOs														
Mapping of COs with POs and PSOs															
COs/F	POs	PO1	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO	)1 3 1														
CO	2	3	2												
со	3	3	2												
со	4	3	3	3										2	
CO	5	3	3	3										3	
1 – SI	ight, 2	2 – Moo	derate,	3 – Subs	stantial	, BT- Blo	om's Ta	axonom	у						
						SSESS	MENT F	PATTEI	RN - T	HEORY					
Tes C	t / Blo atego	oom's ory*	Rer	nember (K1) %	ing l	Jndersta (K2)	anding %	Appl (K3	ying ) %	Analyz (K4) 9	ing E %	valuating (K5) %	g Crea (K6	ating 6) %	Total %
	CAT1         10         20         70         100														
	CAT2 10 30 60 100														
	CAT	3		10		20		70	)						100
	ESE	Ξ		10		20		70	)						100

\* ±3% may be varied (CAT 1,2 & 3 – 50 marks & ESE – 100 marks)

			22MAO04 - STATIS	TICS FOR ENGINE	ERS								
			(Offered by Depart	tment of Mathemat	tics)								
Programm Branch	e & All	B.E/.BTech Brar	ches		Sem.	Category	L	т	Р	Credit			
Prerequisi	tes Nil				5	OE	3	1	0	4			
Preamble	To app app	impart the basic k oly correlation, sui plications.	nowledge in presentati able non- parametric t	ion of data, descript tests and control cha	tive statis arts to co	stical measure ontrol the varia	es ar ation	nd pro s in r	ovide real tii	skills to me			
Unit – I	Ör	ganization and F	resentation of Data:							9+3			
Introduction quantitative data – Diag distribution	n to Statis and qual grammatic s – Ogive	stics – Collection litative data – Typ and Graphical Re curves – Stem an	of data – Classification es of Measurements: presentation: Histogra d leaf chart.	on and tabulation c nominal, ordinal, di m - Frequency curv	of data – iscrete a ve - Frequ	- Types of da nd continuous uency polygor	ata: s da n - C	prima ta – umul	ary, s Prese ative	econdary, entation of frequency			
Unit – II	De	escriptive Statist	cs:							9+3			
Measures values: Qu – Coefficie	of location artiles – D nt of variat	or central tenden eciles and percen ion – Measures o	cy: Arithmetic mean – tiles – Measures of dis skewness – Kurtosis.	Median – Mode – ( persion: Mean devi	Geometr ation – C	ic mean – Ha Quartile deviat	armo ion -	nic m - Sta	nean ndarc	<ul> <li>Partition</li> <li>deviation</li> </ul>			
Unit – III	Coefficient of variation – Measures of skewness – Kurtosis.       Unit – III       Correlation and Regression:       9+3												
Correlation and Regression: Scatter Diagram – Karl Pearson's Correlation Coefficient – Rank Correlation - Regression Coefficients – Fitting of Regression Lines.         Multiple Correlation and Regression: Multiple and partial correlation – Method of least squares – Plane of regression – Properties of residuals – Coefficient of multiple correlation – Coefficient of partial correlation – Multiple correlation with total and partial correlations – Regression and partial correlations in terms of lower order coefficient.         Unit – IV       Non-parametric tests:													
Introduction Whitney U	n – Sign t test – Krus	est: One sample skal-Wallis test – (	sign test – Sign test Dne sample run test –	for paired samples Tests of randomnes	s – Signe ss.	ed rank test -	- Ra	ınk S	Sum t	est: Mann			
Unit – V	Sta	atistical Quality C	ontrol:							9+3			
Introduction attributes:	n to Statist np-chart –	tical quality contro p-chart – c-chart.	I – Control charts – Co	ontrol chart for varia	ables: X-	chart – R-cha	art –	s-ch	art –	Charts for			
						Lecture:4	45, T	utori	ial:15	, Total:60			
TEXT BOO	K:												
1. S.I	P.Gupta, "	Statistical Method	s", 44 <sup>th</sup> Revised Editior	n, Sultan Chand & S	Sons, Ne	w Delhi, 2011	for	Unite	s I,II, `	V			
2. S.0 20	C.Gupta, ∖ 22. for Uni	V.K.Kapoor, "Fund its III, IV.	lamentals of Mathema	atical Statistics", 12	2 <sup>th</sup> Edition	n, Sultan Cha	and	& So	ons, N	lew Delhi,			
REFEREN	CES:												
1. Ja 20	y L. Devo 16.	re., "Probability a	nd Statistics for Engin	neering and the Sci	iences",	9 <sup>th</sup> Edition, C	eng	age	Learn	ing, USA,			
2. G.	C.Beri, "Bı	usiness Statistics"	3 <sup>rd</sup> Edition, Tata McG	raw Hill Education F	Private Li	mited, New D	elhi,	201	1.				
3. Jo 20	nnson. R.A 18.	A., Miller. I and Fr	eund. J., "Probability a	nd Statistics for Eng	gineers",	9 <sup>th</sup> Edition, P	ears	on E	ducat	tion, India,			
4. An	thony Hay	rter, "Probability a	d Statistics for Engine	ers and Scientists",	4 <sup>th</sup> Editio	on, Cengage	Lear	ning,	USA	, 2012.			
5. J.	K. Sharma	a, "Business Statis	tics", 5 <sup>th</sup> Edition, Vikas	Publishing House F	P∨t Ltd, N	loida, 2020.							

COUR On co	SE O mplet	UTCOM	ES: he cour	se, the s	tudents	s will be a	ble to							E (Hi	BT Map ghest L	ped _evel)
CO1	der	nonstrat	te the cla	assificatio	on of dat	a and pre	esent the	data in	various	forms.				Unde	erstandi	ng (K2)
CO2	cor	npute ar	nd interp	ret descr	iptive st	atistical m	neasures	using n	umerica	al and gra	aphical	techniques	s.	А	pplying	(K3)
CO3	app exp	oly statis	stical me	ethods lik	e corre	elation, r	egressio	on analy	/sis in	analys	ing an	d interpret	ing	A	pplying	(K3)
CO4	use	e approp	riate no	n-parame	etric test	to analyz	e experii	mental c	lata.					А	pplying	(K3)
CO5	ide	ntify suit	able cor	ntrol char	ts for mo	onitoring	orocesse	S						A	pplying	(K3)
Mapping of COs with POs and PSOs																
COs/F	POs	PO1	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO1	0 PO11	PC	012	PSO1	PSO2
CO	1	3	2													
CO	2	3	2													
CO	3	3	3	2												
CO	4	3	3	1												
CO	5	3	3	3												
1 – SI	ight, 2	2 – Moo	derate,	3 – Subs	stantial,	, BT- Blo	om's Ta	axonom	У			I				
					A	SSESS	MENT F	PATTER	RN - TH	HEORY						
Tes C	t / Blo atego	oom's ory*	Rer	nember (K1) %	ing L	Jndersta (K2)	nding %	Appl (K3	ying ) %	Analyz (K4) S	ing %	Evaluatir (K5) %	ng	Crea (K6)	ting ) %	Total %
	CAT	1		10		40		50	)							100

CAT2

CAT3

ESE

\*  $\pm$ 3% may be varied (CAT 1,2 & 3 – 50 marks & ESE – 100 marks)

### 22PHO01 - THIN FILM TECHNOLOGY (Offered by Department of Physics)

Progra Branci	amme & h	All BE/BTech Branches	Sem.	Category	L	т	Ρ	Credit					
Prereq	uisites	Nil	5	OE	3	1	0	4					
				1									
Pream	ble	This course aims to impart the essential knowledge on deposin various engineering fields, and also provides motivation to	sition, cha wards inne	racterization a ovations.	nd a	oplica	tion o	of thin films					
Unit –	I	Theories and models of thin film growth:						9+3					
Introdu atomist during	iction – Theor tic models – § growth.	ies of thin film nucleation: Impingement, Adsorption and Therr Structural consequences of thin film nucleation – The four sta	nal accon ges of filn	nmodation – T n Growth – Th	he ca ne inc	apillaı corpoi	rity m ratior	odel – The of defects					
Unit -	II	Vacuum technology:						9+3					
Principle and working of vacuum pumps: Roots vacuum pump, Rotary pump, Diffusion pump, Turbo molecular pump, Cry pump, Ion pump, Ti-sublimation pump – Measurement of Pressure: Bayet-Albert gauge, Pirani and Penning gauge – Cold c and hot cathode ionization gauges – Pressure controlling system (qualitative).													
Unit – III Deposition of thin films - Physical methods:													
Thermal evaporation – Electron beam evaporation – Pulsed laser deposition – Ion plating – DC sputtering – RF sputtering – Magnetron sputtering – Reactive sputtering – Molecular beam epitaxy - Demonstration of deposition of thin films by RF sputtering.													
Unit –	Jnit – IVDeposition of thin films – Chemical methods:9+3												
Chemic Electro	cal vapor dep less depositio	osition – Sol-gel method – Chemical bath deposition – Hyd n – Spray Pyrolysis - Spin coating.	ro therma	I methods – E	Electr	oplati	ng d	eposition –					
Unit –	V	Characterization and Applications of thin films:						9+3					
Charac ray Phe Thin fill	cterization: X-i otoemission S m gas sensors	ray diffraction, Energy dispersive X-ray analysis, Atomic probe Spectroscopy, UV-vis spectroscopy and Four probe resistivity s, Thin films for information storage and Optical coatings.	e microsco / – Applica	opy, Scanning ations (qualita	Tunr tive):	neling Thin	Micr film	oscope, X- solar cells,					
				Lecture:	45, T	utoria	al: 15	5, Total: 60					
TEXT	BOOK:												
1.	Maissel L.I. a	nd Glang R, Hand book of Thin Film Technology, Reprint, McG	Graw Hill I	nc., New York,	197	), (Ur	nit I —	IV)					
2.	<ol> <li>Sam Zhang, Lin Li and Ashok Kumar, Materials Characterization Techniques, 1<sup>st</sup> edition, CRC Press, Boca Raton, 2008 (Unit V)</li> </ol>												
REFE	RENCES:												
1.	Ohring M, Ma	terial Science of Thin Films, 2nd Edition, Academic Press, New	v Jersey,	2001									
2.	Goswami A, 1	hin Film Fundamentals, Reprint, New Age International (P) Ltd	d, New De	elhi, 2003									
3.	Chopra K. L,	Thin Film Phenomena, Illustrated, McGraw Hill Inc., New York,	1969										

ped	ВТ Марр											IES:	OUTCON	COURSE O
_evel)	Highest Lo	(						ole to	ill be al	dents w	e, the stu	he cours	etion of t	On comple
(K3)	Applying (			n process	n growth	thin film	end the	ompreh	dels to c	and mo	ate theory	appropria	utilize the	CO1 (
(K3)	Applying (	se	to make us ethods.	uum and select me	ate vacu uum by	s to cre t of vac	method uremen	n select e meas	o explair xplain th	n pump to uge to e	of vacuum acuum ga	principle of v	apply the of the prir	CO2
(K3)	Applying (	of	of working o	orinciple o	ng the p	ods usii	al meth	t physic	by selec	in films l	ition of th 3.	the depos e methods	describe espective	CO3 r
(K3)	Applying (	of	of working o	orinciple c	ng the p	ods usir	al meth	chemic	y select	n films b	ion of thir 3.	e deposit methods	explain th	CO4 e
(K3)	Applying (	nd	nin films an	rties of th	e proper	end the	ompreh n films.	ies to c is of thi	techniqu plicatior	erization levice ap	t characte various c	e of select Istrate the	nake use also to illu	CO5 n a
					d PSOs	POs and	s with I	g of CO	Mapping	I				
PSO2	PSO1	PO12	PO11	PO10	PO9	PO8	P07	PO6	PO5	PO4	PO3	PO2	P01	COs/POs
		2		2	2						2	2	3	CO1
		2		2	2						2	2	3	CO2
		2		2	2						2	2	3	CO3
		2		2	2						2	2	3	CO4
		2		2	2						2	2	3	CO5
_	I	I			I		ıy	axonon	loom's T	al, BT- B	Substantia	erate, 3 – S	2 – Mode	1 – Slight, 2
							-							
						RN - TH	PATTE	MENT	499F99					

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %						
CAT1	25	35	40				100						
CAT2	25	35	40				100						
CAT3	20	40	40				100						
ESE	ESE 20 40 40 100												
* ±3% may be varied (	±3% may be varied (CAT 1, 2, 3 – 50 marks & ESE – 100 marks)												

#### 22PHO02 - HIGH ENERGY STORAGE DEVICES (Offered by Department of Physics)

Programme& Branch	All BE/BTech Branches	Sem.	Category	L	т	Ρ	Credit						
Prerequisites	Nil	5	OE	3	1	0	4						
Preamble	This course aims to impart the essential knowledge on the funda technologies and materials for energy storage solutions, togeth engineering field.	amental pi er with an	inciples and a overview of o	applic devel	ation opme	areas nt tre	s of proven ands in this						
Unit – I	Introduction to Energy Storage:						9+3						
An overview of en electrical energy storage – Genera off grid energy sto	nergy storage systems (qualitative): Thermal energy storage, mea storage, electrochemical energy storage, electrostatic energy sto al criteria of energy storage systems – Conventional batteries: fur orage systems and requirements.	chanical e rage, mag idamental	nergy storage netic energy s s and applicat	, chei storaç ions -	mical ge an - Gric	ener d opt l con	gy storage, ical energy nected and						
Unit – II	Thermal storage and Mechanical Storage:						9+3						
Thermal storage: Thermal properties of materials, principle of operations, efficiency factors, large scale and medium operations – Merits and demerits of thermal storage system – Recent development in thermal storage systems. Mechanical S Types of mechanical storage systems, principle of operations, emerging advances and technologies in mechanical storage s – Flywheel.													
Unit – III	- III Magnetic storage, Electro-optic, Optical and Chemical Storage:												
Magnetic storage: Principle of operation, emerging challenges and a review on devices and technology. Electro-optic and storage: Emerging devices and upcoming technologies (qualitative). Chemical storage: Power to gas – Hydrogen and Me Power to liquid – Bio fuels – Aluminum-Boron, silicon, and zinc.													
Unit – IV	Electrochemical Storage:						9+3						
Materials, Princip operation, battery –Li-polymer battery battery.	ble of operation, positive electrode materials, negative electrode r y components, design of electrodes, cell and battery fabrications - eries – Applications – Future developments: Sodium-battery, n	materials, - Building nagnesium	electrolytes. L block cells – E n battery, alui	i-ion Batter minur	batte y mo n bat	ries: dules tery	Principle of and packs and silicon						
Unit – V	Fuel Cells, Hydrogen storage and Super capacitors:						9+3						
Fuel Cells: Introd fuel cells and so tanks, cryogenic basic principle of	uction to fuel cells, PEM (polymer electrolyte membrane), Hydrog lid oxide fuel cells. Hydrogen storage systems: Solid state hydro hydrogen storage tanks and liquid phase hydrogen storage tanks operation, performance and technologies of super capacitors.	en PEM fu ogen stora s. Super c	uel cell, direct age tanks, gas apacitors: Fea	meth s pha atures	anol f ise hy s of s	uel c /drog uper	ell, alkaline en storage capacitors,						
			Lecture:	45, T	utori	al: 15	5, Total: 60						
TEXT BOOK:													
1. Robert A. Huggins, Energy Storage, Springer, 2010, (Unit I – V)													
2. Ehsani, Y (Unit I - V	7. Gao, S. Gay, A. Emadi, Modern Electric, Hybrid Electric and Fu	el Cell Vel	nicles, CRC P	ress,	New	York,	2005						
REFERENCES:	REFERENCES:												
1. Yuping W Press, Ui	Vu, Lithium-Ion Batteries: Fundamentals and Applications (Electronic definition of the control o	ochemical	Energy Stora	age ai	nd Co	nver	sion), CRC						
2. Trevor M	Yuping Wu, Lithium-Ion Batteries: Fundamentals and Applications (Electrochemical Energy Storage and Conversion), CRC Press, United Kingdom, 2015												
	. Letcher, Storing Energy: with Special Reference to Renewable E	Energy So	urces, 2 <sup>nd</sup> edit	ion, E	Isevi	er, 20	)22						

COUR On co	SE OUTCOMES: mpletion of the course, the students will be able to	BT Mapped (Highest Level)
CO1	utilize the appropriate concepts and models to comprehend the basics of energy storage systems.	Applying (K3)
CO2	apply the principle of thermal and mechanical storage systems to explain the working and the recent advancements in thermal and mechanical storage systems.	Applying (K3)
CO3	ultilize the principle of operation of magnetic storage systems, electro-optic, optical and chemical storage systems to illustrate the respective process under gone in these techniques.	Applying (K3)
CO4	explain the principle of operation of electrochemical storage device and materials used and to elucidate the construction and working of various types of high energy storage batteries.	Applying (K3)
CO5	make use of various techniques to construct different types of fuel cells and to explain the advanced techniques involved in hydrogen storage systems and also to explain the principle and working of super capacitors.	Applying (K3)

	Mapping of COs with POs and PSOs														
COs/POs	P01	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	
CO1	3	2	2						2	2		2			
CO2	3	2	2						2	2		2			
CO3	3	2	2						2	2		2			
CO4	3	2	2						2	2		2			
CO5	3	2	2						2	2		2			
		_									•				

1 - Slight, 2 - Moderate, 3 - Substantial, BT- Bloom's Taxonomy

#### ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	25	35	40				100
CAT2	25	35	40				100
CAT3	20	40	40				100
ESE	20	40	40				100
* ±3% may be varied	(CAT 1,2,3 – 50 ma	urks & ESE – 100 n	narks)				

# 22PH003 - STRUCTURAL AND OPTICAL CHARACTERIZATION OF MATERIALS (Offered by Department of Physics)

Programn Branch	ne&	All BE/BTech Branches	Sem.	Category	L	т	Ρ	Credit					
Prerequis	ites	Nil	5	OE	3	1	0	4					
Preamble		This course aims to impart the essential knowledge on the cl Raman spectroscopy, UV-visible spectroscopy, Electron mic their application in various engineering fields, and also provid	haracteriz croscopy a les motiva	ation of materi and Scanning ition towards ir	als u tunne nnova	sing ) eling itions	K-ray micro	diffraction, scopy and					
Unit – I		Introduction to Characterization Techniques and X-Ray I	Diffraction	ו:				9+3					
Importance Theory of procedure	e of mater X-ray diff for structu	ials characterization – Classification of characterization techni raction – Powder and Single crystal X-ray diffraction: Instru rre determination (qualitative), crystallite size determination (So	ques – Cr umentatior cherrer eq	ystalline mate n (qualitative), uation), strain	rials XRD calcu	<ul> <li>Red</li> <li>path</li> <li>lation</li> </ul>	ciproo tern, n – Al	cal lattice – systematic oplications.					
Unit – II		Electron Microscopy:						9+3					
Need of characteris transmission microscop	electron r stic X-rays on electron e –Wavele	nicroscopy – Electron specimen interaction: Emission of s, transmitted electrons, specimen interaction volume – R n microscope: Schematic diagram and working – Different type ength dispersive X-ray analysis – Three parameter equation for	seconda esolution es of filam r quantitat	ry electrons, – Scanning ents– Field e ive compositio	back electi missi n ana	ron r on so alysis	ered nicro: cannii	electrons, scope and ng electron					
Unit – III	nit – III Scanning Tunneling Microscopy:												
Introduction to quantum mechanical tunneling – Basic principles of scanning tunneling microscopy – Two modes of scar constant height mode and constant voltage mode – Instrumentation and working – Applications.													
Unit – IV		Raman Spectroscopy:						9+3					
Introductio determinat	on – Pure tion – Instr	rotational Raman spectra – Vibrational Raman spectra – Poumentation and working – Near-Infra-Red Raman Spectroscop	olarization by – Applie	of light and cations.	Rama	an ef	fect -	- Structure					
Unit – V		Ultra Violet & Visible Spectroscopy:						9+3					
Regions of electronic	of UV-Visib transition -	le radiation – Colour and light absorption – Chromophore c - Frank-Condon principle – Instrumentation and working – App	oncept – blications.	Beer's and La	ambe	rťs la	aws -	- Theory of					
				Lecture:	45, T	utoria	al: 15	, Total: 60					
TEXT BOO	OK:												
1. C	Cullity B. D.	and Stock S. R, Elements of X-ray diffraction, 3rd Edition, Pea	arson Edu	cation, India, 2	2003	(Unit	I)						
2. Banwell C. N, McCash E. M, Choudhury H. K, Fundamentals of Molecular Spectroscopy, 5 <sup>th</sup> Edition, Tata McGraw-Hill Publ., New Delhi, 2013 (Unit II-V)													
REFEREN	ICES:												
1. H	. Holt D. B. and Joy D. C, SEM micro characterization of semiconductors, 1 <sup>st</sup> Edition, Academic Press, New Delhi, 1989												
2. W	Villard H. H Publishing (	I., Merritt L. L., John A Dean, and Settle Jr. F. A, Instrumental r Company, United States, 1988	methods c	of Analysis 7th	Editio	n, Wa	adsw	orth					
3. E	Iton N. Ka	ufman, Characterization of Materials (Volume1 & 2), 2 <sup>nd</sup> , Wiley	-Interscie	nce, New Jers	ey, 20	)12							

COURS	E OU	тсом	NES:											BT Map	bed	
On com	npletic	on of t	the cours	e, the stu	dents w	vill be al	ole to							(Highest L	evel)	
CO1	apply parar	/ the meters	concept of s of mater	of X-ray c ials.	liffractior	n to det	ermine	the cry	stal str	ucture a	and relate	ed structu	ral	Applying	(K3)	
CO2	deter mate	rmine erials u	the micr ising the c	o-structur	al parar matter v	neters vaves ar	of mate	erials a	nd to roscopy	perform	surface	analysis	of	Applying	(K3)	
CO3 utilize the concept and phenomenon of quantum mechanical tunneling to interpret the surface image recorded at atomic level using scanning tunneling microscopy.													ice	Applying	(K3)	
CO4 make use of the concept of Raman effect and Raman spectroscopy to determine the crystal structure and related structural parameters of materials.													tal	Applying	(K3)	
CO5	apply	/ the t	heory of L	JV-Vis spe	ectroscop	by to cor	npreher	nd the w	orking	of UV-V	is spectro	photomet	er.	Applying (K3)		
													Ľ			
					I	Mapping	g of CO	s with I	POs an	d PSOs						
COs/PC	Ds F	PO1	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	P011	PO12	PSO1	PSO2	
CO1		3	2	2						2	2		2			
CO2		3	2	2						2	2		2			

**ASSESSMENT PATTERN - THEORY** 

Applying

(K3) %

40

40

40

40

Understanding

(K2) %

40

35

30

40

2

2

2

Analyzing

(K4) %

2

2

2

Evaluating

(K5) %

2

2

2

Creating

(K6) %

Total %

100

100

100

100

CO3

CO4

CO5

3

3

3

Test / Bloom's

Category\*

CAT1

CAT2

CAT3

ESE

2

2

2

2

2

2

1 - Slight, 2 - Moderate, 3 - Substantial, BT- Bloom's Taxonomy

Remembering

(K1) %

20

25

30

20

\* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

### 22CYO01 - INSTRUMENTAL METHODS OF ANALYSIS (Offered by Department of Chemistry)

Programme & Branch	All BE / BTech Branches	Sem.	Category	L	т	Ρ	Credit							
Prerequisites	Nil	5	OE	3	1	0	4							
	· · · · · · · · · · · · · · · · · · ·			1										
Preamble	Instrumental methods of analysis aim to prepare the students methods in order to identify the molecules and reaction med towards the industries.	to have chanism	all-encompas for the proce	ssing ess t	knov to en	wledg hance	e of spectral e application							
Unit – I	Absorption and Emission Spectroscopy						9+3							
Basic concepts of a signal to noise ratio results – basic pr Spectroscopy.	Absorption and Emission Spectroscopy – representation of spectro- - techniques for signal to noise enhancement – resolving power nciples, instrumentation and applications of Atomic Absorptic	ctra – ba – Fourie on, Atom	sic elements er transform s nic Fluoresce	of p pect nce	ractic roscc and	al spe py – o Atom	ectroscopy – evaluation of lic Emission							
Unit – II	IR, Raman and NMR Spectroscopy						9+3							
Infrared Spectrosco analysis. Raman Spectrosco Nuclear Magnetic r using NMR spectra	analysis. Raman Spectroscopy – Classical and Quantum theory instrumentation, Structural analysis and quantitative analysis. Nuclear Magnetic resonance Spectroscopy – basic principles – pulsed Fourier transform NMR spectrometer – Structural eluci- using NMR spectra and quantitative analysis. Unit – III Surface Studies													
Unit – III	- III Surface Studies													
Surface Study – X-Ray Emission Spectroscopy (XES), X- Ray Photo Electron Spectroscopy (XPS) - Auger Electron Spectroscopy (AES) - Transmission Electron Microscopy (TEM) - Scanning Electron Microscopy (SEM) - Surface Tunneling Microscopy (STEM) - Atomic Force Microscopy (AFM).														
Unit – IV	Mass Spectroscopy						9+3							
Mass spectroscopy spectra with molect Microprobe Mass A	<ul> <li>– Ionization methods in mass spectroscopy – mass analyzer – id ular structure - Instrumentation design and application of Fourier nalyzer (IMMA).</li> </ul>	on collec Transfo	tion systems rm Mass Spe	- cor ctros	relati copy	on of (FT-I	molecular VIS) and Ion							
Unit - V	Thermal Analysis						9+3							
Thermal Analysis: p Differential Scannir	principles and instrumentations and applications of Thermograving Calorimetry (DSC), evolved gas detection, Thermo Mechanica	netry (TO I Analysi	BA), Differenti s and Thermo	al Th omet	nerma ric Ti	al Ana tratior	ilysis (DTA), า.							
			Lecture	: 45,	Tuto	rial: 1	15, Total: 60							
TEXT BOOK:														
1. Chatwal. G 2019.	1. Chatwal. G. R., Anand, Sham K., "Instrumental Methods of Chemical Analysis" 5th Edition, Himalaya Publishing House, 2019.													
<b>REFERENCES</b> :	REFERENCES:													
1. B.K. Sharn	na, Instrumental Method of Chemical Analysis, Krishna Prakasha	n Media	(P) Ltd. 2019											
2. Willard,H.H 2004.	I, Merritt,L.L, Dean,J.A, and Settle, F.A, "Instrumental methods o	f analysi	s" CBS Publis	shers	8 & D	istribu	itors, 7 Ed,							
3. Kaur. H, "Ir	nstrumental Methods of Chemical Analysis", XII Edition, Pragati p	orakasha	n, Meerat, 20	18.										

COUR On cor	SE OL npleti	JTCON ion of t	IES: the cours	se, the s	udents	will be	able to							BT Map (Highest	ped Level)		
CO1	illust tech	trate the	e basics (	of spectro	oscopy to	o unders	stand the	e instrur	mentatio	on of va	rious spe	ectral	U	nderstand	ing (K2)		
CO2	appl	y the IF	R, Ramar	and NM	R for qu	antitativ	e analys	is of the	e sampl	e.				Applying	(K3)		
CO3	O3 apply the various techniques for the better understanding of surface morphology.													Applying	(K3)		
CO4	CO4 explain the principle, instrumentation of mass spectroscopy for the analysis of organic sample.												U	Understanding (K2)			
CO5	illust	trate the	e thermal	analysis	for the i	dentifica	ation of t	hermal	stability	of the	compoun	ds.	U	Understanding (K2)			
						Manni	ng of C	Os with	POs a	nd PS(	)s						
COs/P	Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	P08	PO9	PO10	PO11	PO12	PSO1	PSO2		
CO1	CO1 3 1																
CO2	>	3	2	1	1												

		ASSESSMEN	T PATTERN	– THEORY			
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	25	35	40				100
CAT2	25	35	40				100
CAT3	25	35	40				100
ESE	25	35	40				100

CO3

CO4

CO5

# 22CYO02 - CHEMISTRY CONCEPTS FOR COMPETITIVE EXAMINATIONS (Offered by Department of Chemistry)

Programme & Branch	All BE / BTech Branches	Sem.	Category	L	т	Ρ	Credit
Prerequisites	Nil	5	OE	3	1	0	4
Preamble	This course aims to refresh the knowledge of chemistry requisited students with a capacity to solve the problems in chemistry whi including TNFUSRC-FORESTER (paper-II: General science-c chemistry), GATE (thermodynamics concept for chemical & me	ired for ile partic hemistry echanica	competitive e ipating variou (), UPSC-IAS I engineering)	xam s co (pre ).	inatio mpeti lims:	ns an tive e Gene	d equip the xaminations ral science-
Unit – I	Periodic Classification of Elements						9+3
Mendeleev's period Periodic properties nano metals and op	Jic table-Law and classification of elements- Modern periodic law – important aspects of s, p & d block elements -Reactivity series kides.	w-Moder s and Us	n periodic tal ses - Alloys-U	ble a ses	nd its of All	s chai oys- F	acteristics - Properties of
Unit – II	Chemical Equations and Bonding						9+3
Chemical Equatio Chemical Bondin covalent compound nomenclature and	<ul> <li>ns: Types of ions and radicals- oxidation and reduction-redox reages</li> <li>g: Octet rule -types of chemical bond -formation of ionic and order differences between ionic and covalent compounds-Coording somerism - application in analytical chemistry.</li> </ul>	actions - covalent nate cov	balancing ion bond- comm alent bond- (	ic ec ion µ Coor	juatio prope dinati	ns. rties ( on co	of ionic and ompounds –
Unit – III	Acids, Bases, Salts and Metallurgy						9+3
Acid- base theory in everyday life-salt Metallurgy: introd aluminum, copper a	<ul> <li>Bronsted- Lowry theory- conjugate acid-base- Lewis concept- s-classification of salts-uses of salts.</li> <li>uction-terminologies in metallurgy-differences between minerals and iron.</li> </ul>	HSAB- a	applications- p es-occurrenc	oHs e of	cale- meta	Impoi als- m	tance of pH netallurgy of
Unit – IV	Carbon and its Compounds						9+3
Introduction-component nature of carbon a functional groups-	unds of carbon-modern definition of organic chemistry- bonding nd its compounds-chemical properties of carbon compounds-ho classification of organic compounds based on functional group-et	in carbo omologo hanol-eti	on and its co us series-hyd nanoic acid.	mpoi Iroca	unds- rbons	allotro and	ppy-physical their types-
Unit – V	Thermodynamics						9+3
Introduction- some thermodynamics: r reversible isotherm ideal gases- secor change for system changes-Maxwell r	important terms in thermodynamics-thermodynamic system, nathematical expression and interpretation- applications of firs al expansion/compression of an ideal gas-adiabatic expansion of nd laws of thermodynamics: entropy- entropy change for isolat only (ideal gas)- entropy change for mixing of ideal gases-en elations.	proces st law o an idea ted syste stropy of	s, properties f thermodyna l gas-isobaric em (system a physical cha	and and and and inges	d ene s-mol isoch surror s- en	ergy- ar he noric p unding tropy	first law of at capacity- processes in gs)- entropy of chemical
			Lecture:	45,	Tuto	rial: 1	5, Total: 60
TEXT BOOK:							
1. Steven S. Units-I, II,	Zumdahl, Susan A. Zumdahl and Donald J. DeCoste , "Chemistry III, IV.	/", 10 <sup>th</sup> E	dition, Cenga	ge L	earni	ng, 20	)18., for
2. Wiley edito	rial board. "Wiley Engineering Chemistry". 2 <sup>nd</sup> Edition, Wiley India	a Pvt. Lt	d, New Delhi,	Rep	rint 2	019, f	or Units- I,
REFERENCES:							
1. B.R. Puri,	.R. Sharma, Principles of Inorganic Chemistry, 33 <sup>rd</sup> Edition, Vish	al Publis	shing Co., 202	20.			
2. Paula Brui	se, "Organic Chemistry", 8 <sup>th</sup> Edition, Pearson Education, 2020.						

COUR: On cor	SE OL npleti	JTCON	IES: the cour	se, the s	tudent	s will be	able to							BT Map (Highest	ped Level)
CO1	appl and	y the b reactiv	asic con	icept of p of s, p &	eriodic d bloc	: classific k elemen	ation of ts.	elemer	nts to e	explain th	ne perio	dic propertie	es	Applying	(K3)
CO2	utiliz equa	the cation ar	concepts nd differe	of chem ntiate ion	ical eq ic and	uation an covalent	id bondi compou	ng to s nds.	olve th	e proble	ms in ba	alancing ion	ic	Applying	(K3)
CO3	appl pH ii	y the c n every	oncept o day life,	of acid, ba classifica	ase, sa tion of	lts and m salts and	netallurg metallu	y to ex rgy of A	plain H I, Cu 8	SAB co Fe.	ncepts, I	mportance	of	Applying	(K3)
CO4	mak carb	e use o on com	of the compounds.	ncept of	carbor	and its	compou	nds to	explain	bonding	g and cla	assification	of	Applying	(K3)
CO5	utiliz law o	the it the it the rectangle in the second se	mportant nodynarr	terms and terms an	nd con exampl	cepts of t es.	hermod	ynamic	s to ex	plain the	e first lav	and secor	ld	Applying	(K3)
	Mapping of COs with POs and PSOs														
COs/Pos         PO1         PO2         PO3         PO4         PO5         PO6         PO7         PO8         PO9         PO10         PO11         PO12         PS01         PS02															
CO1		3	2	1											
CO2	2	3	2	1											
COS	3	3	2	1											
CO4	1	3	2	1											
CO5	5	3	2	1											
1 – Slig	ght, 2 -	– Mode	erate, 3 -	Substan	tial, BT	- Bloom's	Taxono	omy							
		_				ASSE	SSMEN	T PATT	ERN -	THEOR	RY				
Tes C	t / Blo atego	oom's ory*	Re	memberi (K1) %	ng	Understa (K2)	anding %	Apply (K3)	ying %	Analyz (K4) 9	ing %	Evaluating (K5) %	C (	reating K6) %	Total %
	CAT	1		25		35		40	)						100
	CAT2	2		25		35		40	)						100
	CAT3 25 35 40 100														
	ESE			25		35		40	)						100
* ±3% ı	may b	e varie	d (CAT 1	, 2 & 3 –	50 ma	rks & ESI	Ξ-100	marks)							

# 22CYO03 – ORGANIC CHEMISTRY FOR INDUSTRY (Offered by Department of Chemistry)

Programme & Branch	All BE / BTech Branches	Sem.	Category	L	т	Ρ	Credit						
Prerequisites	Nil	5	OE	3	1	0	4						
		I.											
Preamble	Organic Chemistry for Industry aims to equip the studen chemistry in order to meet the industrial needs.	ts to ha	ve wide-rang	e k	nowle	edge	on organic						
Unit – I	Basic aspects of Organic Chemistry						9+3						
Organic intermed synthetic applicat Saytzeff's rule).	ates: carbocations, carbanions, free radicals, carbenes and nitions- Nucleophilic uni- and bimolecular reactions (SN1 and SN	trenes, t 2)- Elimi	heir method on ation reaction	of fo Ins	ormati (E1 8	ion, s & E2;	tability and Hoffman &						
Unit – II	Molecular Rearrangements						9+3						
Reactions involvi Migration of carbo rearrangement, H	g electron deficient, carbon, nitrogen, oxygen centers, emphasen: Wagner-Meerwein, Pinacol-pinacolone, benzyl-benzilic acid re ofmann, Curtius, Lossen rearrangements- Migration of oxygen: Be	sis on sy arranger ayer-Villi	ynthetic utility nent – Migrati ger oxidation.	of on d	the roof nitro	earrai ogen:	ngements - Beckmann						
Unit – III	Synthetic Reagents & Applications						9+3						
Lithium aluminiu bromosuccinamid oxidation –p-tolue crown ethers-Trin catalysts.	m hydride- sodium boronydride- selenium-di-oxide- osn e (NBS)- lead tetraacetate - dicyclohexylcarbodiimide (DCC) nesulphonyl chloride – trifluoroacetic acid- lithium diisopropylam ethyl silyl iodide - dichlorodicyanobenzoquinone (DDQ) – Gilmar	num te – pyridi ide (LDA n reagen	etroxide- phe nium chloroc .) – 1,3- dithia t– phase tran	nyi hror ne i sfer	isot nate (react catal	iniocy (PCC ive ui ysts-	anate- N- :) – Swern mpolung) - Wilkinson's						
catalysts. Unit – IV Unit Operations 9+3													
Extraction: Liqu filtration- pressure evaporators-facto crystallization-nuc	d equilibria-extraction with reflux-extraction with agitation-cour and vacuum filtration-centrifugal filtration. <b>Distillation:</b> Azeotrop s affecting evaporation. <b>Crystallization:</b> Crystallization from aq eation.	inter cur pic and st jueous-n	rent extractio team distillatio on- aqueous	on. on. <b>E</b> solu	Filtra vapo tions	tion: pratio facto	Theory of n: Types of rs affecting						
Unit – V	Unit Processes						9+3						
Nitration: Nitration nitration-mixed ac study on industria and Streptomycin	g agents-aromatic nitration-kinetics and mechanism of aroma id for nitration. Halogenation: Kinetics of halogenations-types halogenation process. Fermentation: Aerobic and anaerobic for Production of Vitamins: B2 and B12.	atic nitra of halo ermentat	tion- process genations-cat ion. Productic	eq alyti on o	uipme c hale f Anti	ent fo ogena biotic:	or technical ations-Case s: Penicillin						
			Lecture: 4	<b>15</b> , 1	utor	ial: 1	5, Total: 60						
TEXT BOOK:													
1. P.S.Kalsi," Organic Reactions and their Mechanisms", 5 <sup>th</sup> Edition, New Age International publishers, 2020, for Unit-I, II, III, V.													
2. Arun Bahl, B.S.Bahl, "Advanced Organic Chemistry", 6 <sup>th</sup> Edition, S Chand, 2022, for Unit-IV, V.													
REFERENCES:													
1. V.K.Ahluw	alia, Rakesh Parashar, "Organic Reaction Mechanisms" Fourth E	dition, 20	011										
2. Jonathan	Clayden, Nick Greeves, Stuart Warren, "Organic Chemistry", 2 <sup>nd</sup> E	Edition, C	Oxford Univers	sity I	Press	, 2014	4.						
3. Paula Yur	anis Bruice, "Organic Chemistry",8 <sup>th</sup> Edition, Pearson, 2020.												

COUF On co	RSE O	UTCOM	IES: he cou	rse, the s	tudent	s will be	able to							BT Map (Highest	oped Level)
CO1	illust react	rate the tions.	basic	concept	of org	anic inte	rmediate	es to e	xplain	the SN	1, SN2,	E1 and I	<sup>E2</sup> U	nderstand	ling (K2)
CO2	utiliz carbo	e the co on, nitro	oncepts gen, ox	of molect	ular rea ters, en	rrangem nphasis o	ent to e	xplain re etic utili	eactior ty of th	is involv e rearrai	ing elect ngement	ron deficie s.	nt,	Applying	g (K3)
CO3	seleo synth	ot the s nesis.	suitable	syntheti	c rege	nts for	various	functio	nal gr	oup cor	nversions	s in orgar	nic	Applying	g (K3)
CO4	make purifi	e use o cation c	f the co of organ	oncept of	extract unds.	ion, filtra	ition, dis	stillation	, evap	oration,	crystalliz	ation for tl	ne	Applying	g (K3)
CO5	apply proce	y the co ess.	oncept	of nitratio	on, hal	ogenatior	ns and	ferment	tation	to expla	in the ii	ndustrial u	nit	Applying	g (K3)
	Mapping of COs with POs and PSOs														
Mapping of COs with POs and PSOs           COs/POs         PO1         PO1         PO1         PSO1         PSO2															
COS	COS/POS         PO1         PO2         PO3         PO4         PO5         PO6         PO7         PO8         PO9         PO10         PO11         PO12         PS01         PS0           CO1         2         1													P302	
	)1	3	1												
CC	)2	3	2	1	1										
CC	)3	3	2	1	1										
CC	)4	3	2	1	1										
CC	)5	3	2	1	1										
1 – Sl	ight, 2	– Mode	rate, 3 -	- Substar	itial, BT	- Bloom's	s Taxon	omy							
						ASSES	SSMEN	ΓΡΑΤΤ	ERN –	THEOR	Y				
Те	st / Ble Catege	oom's ory*	Re	emember (K1) %	ing	Understa (K2)	anding %	Apply (K3)	ving %	Analyz (K4) 9	ing %	Evaluating (K5) %	C  (	reating K6) %	Total %
	CAT	1		25		35		40	)						100
	CAT	2		25		35		40	)						100
	CAT	3		25		35		40	)						100
	ESE	Ξ		25		35		40	)						100
* ±3%	may b	oe varied	d (CAT	1,2&3-	50 ma	rks & ES	E – 100	marks)			1		1		1

		22MAO05 - GRAPH THEORY AND ITS APPL		NS										
		(Offered by Department of Mathemat	tics)											
Progra Branc	amme & h	All B.E/.BTech Branches	Sem.	Category	L	Т	Ρ	Credit						
Prerec	quisites	Nil	6	OE	3	1	0	4						
Pream	ble	To develop rigorous logical thinking and analytical skills by gra real time engineering problems in networks, computer archite artificial intelligence, software engineering, expert systems, soft	aph theo cture, co tware/ha	retic concepts ompiling tech rdware correct	s wh nique	ich h es, m s pro	elps f nodel oblem	or solving checking,						
Unit –		Graphs:						9+3						
Introdu Hamilt algorith	uction – De onian grap nm.	efinition – Types of graphs – Degree of vertex – Walk, path an oh – Euler graph – Digraph - Shortest paths – Shortest path	nd cycle algorithi	– Isomorphis ms: Dijkstra's	m – s alg	Con orithi	necte m – \	d graph – Narshall's						
Unit –	<b>II</b>	Trees:						9+3						
Introdu Spann tree alg	roduction – Properties of trees – Pendant vertices in a tree – Distances and centers in a tree – Rooted and binary trees – anning tree – Construction of spanning tree: BFS algorithm – DFS algorithm - Minimum Spanning tree – Minimal spanning e algorithms: Prim's algorithm – Kruskal's algorithm. <b>hit – III</b> Graph Coloring: 9+3													
Unit –	nit – III Graph Coloring: 9+3													
Vertex	ertex coloring – Chromatic number – Chromatic partitioning – Independent sets – Chromatic polynomial – Matching –													
Coveri	ng – Four	color problem (statement only) – Simple applications.												
Unit –	IV	Matrix Representation and Applications:		A 11		_		9+3						
Chines	Represen se Postma	tation: Incidence matrix – Circuit matrix - Cut-set matrix – Path n Problem – Fleury's Algorithm – Travelling salesman problem.	Matrix -	- Adjacency r	natri	x – ⊦	ropei	ties - The						
Unit –	V	Network Flows and Applications:						9+3						
Flows Ford-F Biparti	and cuts ulkerson <i>i</i> te matchin	in networks - Max-flow Min-cut Theorem – Transport networks Algorithm – Edmonds-Karp Algorithm – Maximal Flow Applicati g.	s –Resid ions: Mu	ual capacity Iltiple sources	and s and	Resi d sin	dual ks –	network – Maximum						
				Lecture:4	15, T	utori	al:15	, Total:60						
TEXT	BOOK:													
1.	Narsingh New Yor	Deo, "Graph Theory with Applications to Engineering and Comp k, 2016 for Units I, II, III.	outer Sci	ence", 1 <sup>st</sup> Ed	ition,	Dov	er Pu	blications,						
2.	S. Saha Ray, "Graph Theory with Algorithms and Its Applications in Applied Science and Technology", 1 <sup>st</sup> Edition, Springer, London, 2013 for Units IV,V.													
REFE	RENCES:													
1.	1. Douglas B West, "Introduction to Graph Theory", 2 <sup>nd</sup> Edition, Pearson Education, New Delhi, 2002.													
2.	Jonathar	n L. Gross and Jay Yellen, "Graph Theory and its Applications", 2	end Editio	n, CRC Press	s, Ne	w Yc	ork, 20	006.						
3.	J.A.Bond York,198	ly and U.S.R. Murty ,Graph Theory and Applications,5 <sup>th</sup> Editio ;2.	n, Elsev	ier Science F	Publis	shing	Co.,	Inc., New						

COUR On co	SE O mplet	UTCOM ion of t	ES: he cour	se, the s	tuden	ts will be a	able to						(H	BT Map lighest	ped _evel)
CO1	appl	y basic	graph th	eoretic c	oncept	s in finding	shortest	path.					ŀ	Applying	(K3)
CO2	intre	pret the	concep	ts of tres	s and i	ts types.							ŀ	Applying	(K3)
CO3	com	pute the	Chrom	atic partit	ion, Cł	nromatic po	lynomia	and Ma	itching	of a give	n graph.		ŀ	Applying	(K3)
CO4	appl	y the co	ncepts o	of matrix	repres	entation of	graph st	ructures					ŀ	Applying	(K3)
CO5	iden	tify the r	naximal	flow in n	etwork	by means	of suitab	le algor	ithms.				ŀ	Applying	(K3)
	Mapping of COs with POs and PSOs														
COs/F	POs	PO1	PO2	PO3	PO4	4 PO5	PO6	P07	PO8	B PO9	PO10	PO11	PO12	PSO1	PSO2
CO	CO1 3 2 1														
CO	2	3	1												
CO	3	3	1												
CO	4	3	2	2											
CO	5	3	2	3											
1 – SI	ight, 2	2 – Moo	derate,	3 – Sub	stantia	al, BT- Blo	om's Ta	axonom	у			1	1	4	1
						ASSESS	MENT F	PATTE	RN - T	HEORY					
Tes C	t / Blo atego	oom's ory*	Re	nembei (K1) %	ring	Understa (K2)	anding %	Appl (K3	ying ) %	Analyz (K4) <sup>o</sup>	ing E %	valuatin (K5) %	g Crea (Ke	ating 6) %	Total %
	CAT	1		10		30		60	)						100
	CAT	2		10		20		70	)						100
	CAT3 10 20 70									100					

\*  $\pm$ 3% may be varied (CAT 1,2 & 3 – 50 marks & ESE – 100 marks)

ESE

		22MAX01 - DATA ANALYTICS USING R PROG	RAMMIN	IG				
		(Offered by Department of Mathematic	:s)					
Prog Bran	ramme & ch	All B.E/.BTech Branches	Sem.	Category	L	т	Ρ	Credit
Prere	quisites	Nil	6	OE	3	0	2	4
Deser		To import the basis to conclude in D and develop shills to each the					- 4	4 - 4' - 4' 1
Prear	ndie	no impart the basic knowledge in R and develop skills to apply the measures, data handling, probability, testing of hypothesis and develop skills to apply the measures and develop skills to apply the measures and the measures are the measures and the measures are the measures and the measures are the measures a	esign of e	eage of R pro experiments.	gran	nmin	g to s	statistical
Unit -	- 1	Introduction to R:						9
Overv Runn	/iew of R pi ing and ma	rogramming – Need for R – Installing R – Environment setup with nipulating packages – Basic objects: Vectors – Matrix – Array – Lis	R Studio sts – Fac	o – Packages tors – Data fi	s: Ins rame	tallin s.	g pa	ckages –
Unit -	- 11	R Programming Structures and Functions:						9
Basic	expression	ns: Arithmetic expressions – Control Statements: if and if-else s	tatement	s switch	state	men	t – L	oops: for
– Mat	h functions	<ul> <li>– Function: Creating a function – calling a function – belaut value – Statistical functions – Apply-family functions – Getting started with</li> </ul>	ith string	s – Formattin	g da	- ∟oų ta ar	nd tim	e.
Unit -	- 111	Descriptive Statistics:						9
Sumr	nary comm r Modeling	and – Summarizing samples – cumulative statistics – summary si · Simple linear regression – Multiple regression – Curvilinear reg	tatistics f pression	or data fram – Plotting lir	es – lear	sum mod	mary els a	tables –
fitting			grooolori	i lotting iii	ioui	mou		
Unit -	- IV	Working with data:	ha filoa	built in date	o o to	Vie		9
Scatt	er plots – lir	ne plots – bar charts – pie charts – Cleveland dot charts – Histogram	m and de	ensity plots –	Box-	whis	ker p	lots.
Unit ·	- V	Probability Distributions, Testing of hypothesis and ANOVA:						9
Proba	ability Distri	butions: Binomial Distribution – Poisson Distribution – Normal Distribution – Normal Distributions: and ANOVA: Student's t-test – Non-Parametric tests: \	ribution. Wilcoxon	II-test – P	aireo	1 t s	nd I	l-tests -
Corre	lation and o	covariance – Tests for association – Analysis of variance: One-way		– Two-way	ANO	VA.		
List o	of Exercise	s / Experiments:						
1.	Implemen	tation of operations of data objects such as vector, list and matrix.						
2.	Implemen	tation and use of array, factors and data frames in R.						
3.	Programs	using decision making statements and looping structures.					<u></u>	
4.	Programs	to demonstrate programming concepts using functions (Using buil	t-in and	user-defined	func	tions	)	
5.	Performin	g various basic statistical measures for the given data.						
6.	Calculate	the regression coefficient and obtain the lines of regression for the	given da	ata.				
7.	Creating a	and reading various types of data files.						
8.	Create dif	ferent charts for visualization of given set of data.						
9.	Computat	ion of probability using Binomial, Poisson and Normal distributions	•					
10.	Perform th	he t-test for testing significance of mean.						
11.	Perform v	arious non-parametric tests for the given sample data.						
12.	Perform C	One way and two way ANOVA.						
				Lecture:45,	Prac	ctica	l:30,	Total:75
TEXT	BOOK:							
1.	Kun Ren,	"Learning R Programming", 1 <sup>st</sup> Edition, Packt Publishing Ltd, UK, 2 donor, "Boginning R The Statistical Programming Language" 1 <sup>st</sup> Ec	2016 for	Units I, II.	one	Inc		2012 for
2.		/, V.	JILION, JO		0115,	inc, i	<b>J</b> 3A,	2012 101
REFE	RENCES:							
1.	Seema Ao	charya, "Data Analytics using R", 1 <sup>st</sup> Edition, McGraw Hill Education	n, Chenn	ai, 2018.				
2.	Norman M	latloff, "The Art of R Programming", 1 <sup>st</sup> Edition, No Starch Press, S	an Franc	cisco, 2011.				
3.	Paul Teet	or, "R Cookbook", 1 <sup>st</sup> Edition, O'Reilly Media, USA, 2011.						
4.	Laborator	y Manual						

COUR	OURSE OUTCOMES:BT Mappedn completion of the course, the students will be able to(Highest Level)														
	mplet	orotond	he cour:	se, the s	tudents	will be a	able to						Unc	derstandi	ng (K2)
COT	und	erstand	the basi		uamenta	IIS OF R.							Ma	anipulatio	$\frac{(\hat{S}2)}{(\hat{S}2)}$
CO2	appl	ly the co	oncepts o	of decisio	on, loopii	ng structu	ires and	function	s in rea	al time p	roblems.		Ma	anipulatio	(K3) on (S2)
CO3	appl	ly R pro	grammin	ig to des	criptive s	statistics.							Ma	Applying anipulatio	(K3) on (S2)
CO4	appl	ly the lib	oraries fo	r data m	anipulati	on and d	ata visua	lization	in R.				/ Ma	Applying	(K3)
CO5	use	R studio	o to iden	tify the p	robability	/ and test	t statistic	al hypot	hesis.				Ma	Applying	(K3) (S2)
													ivic	anpalate	(02)
					N	lapping	of COs	with P	Os ar	nd PSOs	5				
COs/F	POs	P01	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
со	CO1 3 1 1														
СО	CO2 3 1 1 2														
со	3	3	2	2	2	2									
со	4	3	3	2	3	2									
со	5	3	2	2	3	2									
1 – Sli	ight, 2	2 – Moo	derate, 3	3 – Sub	stantial,	BT- Blo	om's Ta	axonom	у						
					A	SSESS	MENT F	PATTEI	RN - T	HEORY					
Tes C	t / Blo atego	oom's ory*	Rer	nember (K1) %	ing L	Indersta (K2)	anding %	Appl (K3	ying ) %	Analyz (K4) <sup>o</sup>	ing E %	valuatin (K5) %	g Crea (K6	ating 6) %	Total %
	CAT	1		10		30		60	)						100
	CAT	2		10		20		70	)						100
	CAT	3		10		20		70	)						100
	ESE	Ξ		10		20		70	)						100
* ±3%	±3% may be varied (CAT 1,2 & 3 – 50 marks & ESE – 100 marks)														

		22MAO06 - OPERATIONS RESEAR	СН								
		(Offered by Department of Mathemat	tics)								
Program Branch	ime &	All B.E/.BTech Branches	Sem.	Category	L	т	Ρ	Credit			
Prerequi	sites	Nil	6	OE	3	1	0	4			
Preamble	)	To provide the skills for solving the real time engineering p transportation models and also impart knowledge in finding or resources, project management techniques and game theore	problems optimal s etic conce	s involving lir solutions to pr epts.	near roble	obje ms ii	ctive nvolvi	functions, ng limited			
Unit – I		Linear Programming:						9+3			
Introducti Solution of	ion to Oper of LPP: Ba	rations research – Applications of OR – Linear Programming - sic concepts – Graphical Solution – Simplex method – Artificia	<ul> <li>Format</li> <li>al technic</li> </ul>	ion of Linear ques: Big M n	Prog	ramr od.	ning l	Problem –			
Unit – II		Transportation and Assignment Problems:						9+3			
Transpor solution: Assignme	tation Prol North-Wes ent Probler	blem: Introduction – Mathematical formulation – Solution of st Corner Rule – Vogel's Approximation Method – Optimal Solutions: Introduction – Mathematical Formulation – Hungarian Algorithms: Introduction – Hungarian – Hungari	transpo ution: Mo prithm.	rtation proble ODI method.	em:	Initial	basi	c feasible			
Unit – III		Game Theory:						9+3			
Introducti Strategies Arithmetic	Introduction – Basic Terminology – Two-Person zero sum games – Pure strategies (Games with saddle point) – Mixed Strategies (Games without saddle points) – Rule of Dominance – Solution of Mixed Strategy games: Algebraic method – Arithmetic method – Graphical method.										
Unit – IV		Sequencing models:				_		9+3			
Sequenci through th	ing probler hree mach	ns: Introduction – Johnson's algorithm – Processing of n jobs ines – Processing of 'n' jobs through 'm' machines - Processir	through ng of two	two machine jobs through	s – 'm'	Proce	essing nines.	g of n jobs			
Unit – V		Network and Project Management:						9+3			
Introducti network -	ion – Basic - Critical P	c terminology – Rules of Network construction – Fulkerson's R ath Method (CPM) – Programme Evaluation and Review Tech	Rule for r nnique (F	numbering of PERT).	ever	nts –	Cons	truction of			
				Lecture:4	15, T	utori	al:15	, Total:60			
TEXT BC	DOK:										
1. S	Sharma J.K	, "Operations Research – Theory and Applications", 6 <sup>th</sup> Edition	n, Trinity	Press, India,	Nev	v Del	hi, 20	17.			
REFERE	NCES:										
1. T	aha, Hamo	dy A., "Operation Research: An introduction", 9 <sup>th</sup> edition, Pears	son Edu	cation, 2010.							
2. H	liller, Frede //cGraw Hil	erick. S. and Lieberman, Gerald. J., "An introduction to Operat I (SIE) 8 <sup>th</sup> edition, 2005.	ions rese	earch- conce	ots a	nd ca	ases",	Tata			
3. R	Ravindran, 2005.	A., Phillips, D.J., and Solberg, J.J., "Operations Research- Pri	nciples a	and Practice",	Joh	n Wil	ey &	Sons,			
4. K P	anti Swaru Publications	up, P.K. Gupta, Man Mohan, "Operations Research", 15 <sup>th</sup> revis s, New Delhi, 2017.	sed Editio	on, S. Chand	& S(	ons E	duca	tion			
5. C	Gupta P.K. Delhi, 2014	and Hira D.S., "Operations Research: An Introduction", 7 <sup>th</sup> Re	evised Ec	lition, S.Char	id ar	id Co	. Ltd.	, New			

COURS On con	SE OU	ITCOM on of t	ES: he cours	se, the s	tudents	will be a	ble to						(H	BT Mapı ighest L	ped Level)	
CO1	form	ulate a	nd solve	linear pr	ogrammi	ng probl	ems.						A	pplying	(K3)	
CO2	apply	rtransp	ortation	and assi	gnment a	algorithm	is in engi	ineering	problem	ns.			A	pplying	(K3)	
CO3 use game theory concepts in practical situations.									A	pplying	(K3)					
CO4 identify the minimum processing times for sequencing problems									A	pplying	(K3)					
CO5	apply	y the co	oncepts o	of CPM a	and PER	Г in sche	duling th	ne projec	t netwoi	ˈks.			Applying (K3)			
	Mapping of COs with POs and PSOs															
COs/P	Os	PO1	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	
C:O1	1	3	2	R												

CO1	3	2	3							
CO2	3	2	1							
CO3	3	2	1							
CO4	3	2	1							
CO5	3	2	3							
1 Slight		larata (		stantial	om'e Te	vonom	v			

1 - Slight, 2 - Moderate, 3 - Substantial, BT- Bloom's Taxonomy

		ASSESSMENT P	ATTERN - 1	HEORY			
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	10	20	70				100
CAT2	10	20	70				100
CAT3	10	20	70				100
ESE	10	20	70				100
* ±3% may be varied	I (CAT 1,2 & 3 – 5	50 marks & ESE –	100 marks)				

		22MAO07 - NUMBER THEORY AND CRYPT	OGRAP	HY							
	(Offered by Department of Mathematics)										
Progra Branc	amme & h	All B.E/.BTech Branches	Sem.	Category	L	т	Ρ	Credit			
Prerec	quisites	Nil	6	OE	3	1	0	4			
_											
Pream	ble	To provide the skills for applying various number theoretic cryptography and network security and impart knowledge of t	c algorit basic cry	hms, congrue ptographic te	ence chni	s, pr ques	imalit <u>:</u>	y tests in			
Unit –	I	Divisibility Theory:						9+3			
Divisio – Func	n algorithm Jamental the	<ul> <li>Base-b representations – Number patterns – Prime and com orem of Arithmetic – LCM.</li> </ul>	iposite n	umbers – GC	D –	Eucli	dean	Algorithm			
Unit –	II	Theory of Congruences:						9+3			
Basic of Chines	concepts – F se remainde	Properties of congruences – Linear congruences – Solution of I r theorem.	inear co	ngruences –	Ferm	naťs∣	Little t	heorem –			
Unit –	Unit – III         Number Theoretic Functions:         9+3										
Introdu Proper	Introduction – Functions $\tau$ and $\sigma$ – Mobius function – Greatest integer function – Euler's Phi function – Euler's theorem – Properties of Euler's function – Applications to Cryptography.										
Unit –	IV	Primality testing and Factorization:						9+3			
Primali Trial di	ity testing: F ivision – Poll	ermat's pseudo primality test – Solvay-Strassen test – Fibona ard's Rho method – Quadratic sieve method.	acci test	<ul> <li>Lucas tes</li> </ul>	st – I	nteg	er fac	torization:			
Unit –	٧	Classical Cryptographic Techniques:						9+3			
Introdu	uction – Sub	stitution techniques - Transposition techniques - Encryption	and dec	ryption – Syl	nme	tric a	ind as	symmetric			
key cry	/ptography -	- Steganography.									
				Lecture:4	45, T	utori	al:15	, Total:60			
TEXT	TEXT BOOK:										
1.	Thomas Ko Units I ,II, I	oshy, "Elementary Number Theory with Applications", 2 <sup>nd</sup> Edit II.	ion, Aca	demic Press,	Else	evier,	USA	, 2007 for			
2.	William Sta Delhi, 2019	allings, "Cryptography and Network Security: Principles and P 9 for Units IV,V.	ractice",	7 <sup>th</sup> Edition, I	Pear	son E	Educa	tion, New			
REFE	RENCES:										
1.	Ivan Niven John Wiley	, Herbert S. Zukerman, Hugh L. Montgomery, "An Introduction & Sons, New Delhi, 2008.	to the TI	neory of Num	bers	", Re	print E	Edition,			
2.	<ol> <li>Bernard Menezes, "Cryptography and Network Security", Cengage Learning India, 1<sup>st</sup> Edition, New Delhi, 2010.</li> </ol>										

COUR: On cor	SE O nplet	UTCOM	ES: he cours	se, the s	tudents	s will be a	able to						(۲	BT Map lighest l	ped _evel)
CO1	und	erstand	the cond	cepts of c	divisibilit	y and car	nonical de	ecompos	sitions.				Und	derstandi	ng (K2)
CO2	obta	ain the k	nowledg	e in theo	ry of co	ngruence	s and sol	lution of	linear c	congruen	ces.		Unc	derstandi	ng (K2)
CO3	use	differen	t numbe	r theoret	ic functi	on suitabl	y in crypt	tography	/.				1	Applying	(K3)
CO4	арр	ly Prima	lity test a	and facto	risation	algorithm	ns to netv	vork sec	urity pro	oblems.			1	Applying	(K3)
CO5	app issi	ly the ues.	e suita	able c	ryptogra	aphic t	echnique	es to	hand	dle rea	al time	e securi	ty /	Applying	(K3)
					N	lapping	of COs	with P	Os an	d PSOs					
COs/P	POs	PO1	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO.	CO1 3 2														
CO	CO2 3 1 .														
CO	3	3	1												
CO4	4	3	2	1		2									
CO	5	3	2	1		2									
1 – Sli	ght, 2	2 – Moo	derate, 3	3 – Sub	stantial	, BT- Blo	om's Ta	axonom	у						
					ļ	SSESS	MENT F	PATTE	RN - TI	HEORY					
Test Ca	Test / Bloom's Category*Remembering (K1) %Understanding (K2) %Applying (K3) %Analyzing (K4) %Evaluating (K5) %Creating (K6) %Total %														
	CAT	1		10		30		60	)						100
	CAT	2		10		20		70	)						100
	CAT	3		10		20		70	)						100
	ESE 10 20 70 100														

\* ±3% may be varied (CAT 1,2 & 3 – 50 marks & ESE – 100 marks)

## 22PH004 - SYNTHESIS, CHARACTERIZATION AND BIOLOGICAL APPLICATIONS OF NANOMATERIALS (Offered by Department of Physics)

Progr Branc	amme & ch	All BE/BTech Branches	Sem.	Category	L	т	Ρ	Credit				
Prere	quisites	Nil	6	OE	3	1	0	4				
Prean	nble	This course aims to impart the knowledge on the fundame analysis of nanomaterials, carbon tubes and biological applet	entals of nations of	nomaterials, s nanomaterials	ynthe	esis o	f nan	omaterials,				
Unit -	- 1	Introduction to nanomaterials						9+3				
Nanos confin Ceran	science and na ement effect - nic nanoparticl	anotechnology – Scientific revolution – Nanoscale – Nanos - Classification of nanomaterials based on dimension – Pr es – Semiconductor nanoparticles – Polymer nanomaterials.	sized effect operties of	s – Surface-te nanomaterial	o-volu s – ľ	ume r Metal	atio nanc	<ul> <li>Quantum</li> <li>particles –</li> </ul>				
Unit -	- 11	Synthesis of nanomaterials						9+3				
Physic Depos nanor	cal, chemical a sition method - naterials.	and mechanical methods of preparation – Top down approa - Colloidal precipitation method – Sol-Gel method – Chemica	ches and l I precipitat	pottom up app ion method – (	oroac Greei	hes – n synt	Phy Phy	sical Vapor s method of				
Unit -	- 111	Characterization of nanomaterials						9+3				
X-ray analys BET (	X-ray diffraction analysis – Grain size calculation – Lattice parameters - Cell volume – Photoluminescence analysis – Emission peak analysis – UV visible spectroscopy analysis – Bandgap estimation – HRTEM & AFM analysis (qualitative) – particle size analysis – BET (qualitative).											
Unit -	- IV	Carbon nanotubes						9+3				
Allotro Struct	opes of carbor ure of Carbon	n – Diamond – Graphite – Graphene – Fullerenes – Carbo nanotubes – Preparation: Laser ablation method – CVD – Ap	n nanotube plications.	es – Propertie	s – S	SWC	νT –	MWCNT -				
Unit -	- V	Biological applications						9+3				
Antiba diffusi	acterial activity on method – A	– Mechanism – Antifungal activity – Microorganism – Gram ntioxidant activity – DPPH method – Anticancer activity – Cyl	n positive b totoxity – N	acteria – Grar ITT method –⊺	n neą Foxici	gative ty of i	bact	teria – Disc particles.				
	Lecture: 45, Tutorial: 15, Total: 60											
TEXT	BOOK:											
1.	Charles P Po	ole Jr., and Frank J. Ownes ,. "Introduction to Nanotechnolog	ıy", John W	iley Sons, Inc.	, 200	3.						
REFE	RENCES:											
1.	C. Kittel., "Int	roduction to Solid State Physics", Wiley Eastern Ltd., (2005).										
2.	Tamilarasan	K. and Prabu K., "Materials Science", 1st Edition, McGraw Hil	II Educatior	n Pvt. Ltd., Nev	<i>w</i> Del	hi, 20	18.					

COURSE On comp	OUTCO	MES: the cours	se, the stu	dents w	/ill be al	ble to						(	BT Map Highest I	ped _evel)
CO1	describe quantum	the prope confinem	erties of nar ient and als	nomater so able t	ials usin to classif	ig conc fy nano	epts suc material	h as si s.	urface to	volume r	atio and		Applying	(K3)
CO2	explain th	he synthe	sis of nano	material	ls using	select	physical	and ch	emical n	nethods.			Applying	(K3)
CO3	explain th	he charac	terization o	f nanom	naterials	using 2	XRD, U∖	′-vis, H	IRTEM 8	AFM an	d BET.		Applying	(K3)
CO4	Illustrate	the prepa	aration of C	NT and	their ap	plicatio	ns.						Applying	(K3)
CO5	explore t activity, a	he biologi antioxidan	cal applica t activity ar	tions of nd antica	nanoma ancer ac	terials tivity.	such as	antiba	cterial ac	tivity, ant	ifungal		Applying	(K3)
				Ма	apping	of CO	)s with	POs a	nd PSC	Ds	-			
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2						2	2		2		
CO2	3	2	2						2	2		2		
CO3	3	2	2						2	2		2		
CO4	3	2	2						2	2		2		
CO5	3	2	2						2	2		2		
1 – Slight,	2 – Mod	erate, 3 –	Substantia	l, BT- B	loom's 1	Faxono	my							
					ASSES	SMENT	ΓΡΑΤΤΕ	RN - 1	HEORY					
Test / I Cate	Bloom's gory*	Rer	nembering (K1) %	y Uno	derstan (K2) %	ding	Applyir (K3) %	A A	nalyzing (K4) %	g Eva (ł	luating (5) %	Crea (K6)	ting ) %	Total %
CA	AT1		20		50		30							100
CA	AT2		20		50		30							100
CA	АТЗ		20		50		30							100
E	SE		20		50		30							100
* ±3% ma	y be vari	ed (CAT	1,2,3 – 50 i	marks &	& ESE –	100 m	arks)	·				·	k	

#### 22PHO05 - TECHNIQUES OF CRYSTAL GROWTH (Offered by Department of Physics)

Progra Branc	amme& h	All BE/BTech Branches	Sem.	Category	L	т	Ρ	Credit		
Prerec	quisites	Nil	6	OE	3	1	0	4		
Pream	ble	This course aims to impart the knowledge on crystals, physics of c	crystal gro	owth and crys	tal gr	owth	meth	ods.		
Unit –	I	Introduction to Crystals						9+3		
Classif planes	ication of s	olids – Crystalline and amorphous – Single and polycrystalline mat lices – Indices of crystal direction – Symmetry – Symmetry element	terials – S s in cubic	Space lattice - crystal – Phy	- Bra ′sical	vais I prope	attice erties	e – Lattice		
Unit –	II	Theories of Crystal Growth						9+3		
Phase solid so heterog Atmos	rule – Phas olution (eut geneous n pheric nucle	se diagrams – Binary phase diagrams – Alloy and compounds – Bin ectic) – Invariant reactions – Eutectic, peritectic and peritectoid (qua ucleation – Classical theory – Energy of formation of nucleus eation.	nary syste alitative) - – Kinetie	em with comp – Nucleation of c theory of r	lete s conce nuclea	olid s pt – I ation	oluti Iomo (qua	on and no ogeneous, llitative) –		
Unit –		Melt growth						9+3		
Bulk c encaps	rystal grow	nth methods – Melt growth methods – Bridgman (vertical and language) of the semiconductors – Vermeil growth technique for growth tec	horizonta owing gen	<ol> <li>and Czoch</li> <li>crystals – Zo</li> </ol>	iralsk one n	i met nelting	hods g.	– Liquid		
Unit –	Unit – IV Solution growth 9+3									
Low te biologi	ow temperature solution growth – High temperature solution growth – Electro crystallization – Crystal growth in gel – Growth of iological crystals – Hydrothermal technique.									
Unit –	٧	Vapour growth						9+3		
Physic chlorid	al vapour ti e, hydride,	ransport – chemical vapour transport. Epitaxial growth techniques - metalorganic – Molecular beam epitaxy.	– Liquid p	hase epitaxy	– Va	pour	phas	e epitaxy:		
				Lecture: 4	5, Tu	torial	: 15,	Total: 60		
TEXT	ΧΤ ΒΟΟΚ:									
1.	Introductio	on to Crystallography Philips, Read Books (9 June 2011), India.								
REFE	RENCES:									
1.	B. D. Culli	ty Addison, Elements of X-ray diffraction, Wesley Publishers, 1977.								
2.	Santhana	Raghavan and Dr. P. Ramasamy, Crystal growth processes and me	ethods, K	RU publicatio	ns, 1	999.				
3.	Leonid V.	Azaroff, Introduction to Solids, Tata McGraw Hill Publishing Compa	ny.							
4.	C. Kittel W	iley, Introduction to Solid State Physics, Eastern University Edition.	1							

COUR On co	RSE OUTCOMES: Impletion of the course, the students will be able to	BT Mapped (Highest Level)
CO1	describe the physical properties of crystals using the concepts of crystalline materials, amorphous material, space lattice, unit cell, Miller indices and crystal symmetry.	Applying (K3)
CO2	explain nucleation in crystal growth using the concepts of phase diagrams and formation energy.	Applying (K3)
CO3	demonstrate the growth of bulk crystals using melt growth techniques.	Applying (K3)
CO4	demonstrate the growth of crystals using solution growth techniques.	Applying (K3)
CO5	comprehend the growth of epitaxy crystal using vapour growth techniques.	Applying (K3)

	Mapping of COs with POs and PSOs														
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	
CO1	3	2	2						2	2		2			
CO2	3	2	2						2	2		2			
CO3	3	2	2						2	2		2			
CO4	3	2	2						2	2		2			
CO5	3	2	2						2	2		2			
					· -					•					

1 - Slight, 2 - Moderate, 3 - Substantial, BT- Bloom's Taxonomy

	ASSESSMENT PATTERN – THEORY														
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %								
CAT1	20	50	30				100								
CAT2	20	50	30				100								
CAT3	20	50	30				100								
ESE	20	50	30				100								
* ***															

\* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

# 22CYO04 - CORROSION SCIENCE AND ENGINEERING

(Offered by Department of Chemistry)

Programme & Branch	All BE / BTech Branches	Sem.	Category	L	т	Ρ	Credit								
Prerequisites	Nil	6	OE	3	1	0	4								
Preamble	Preamble Corrosion science and engineering aims to equip the students to have a wide-range of knowledge on corrosion and prevention methods in order to meet the industrial needs.														
Unit – I	Corrosion and its Units						9+3								
Introduction- electro chemical mechanism Vs chemical mechanism - emf series and Galvanic series – galvanic corrosion – area effect in anodic and cathodic metal coatings – prediction using emf series and galvanic series - Pilling Bedworth's ratio and it consequences (Problems) – units of corrosion rate: mdd (milligrams per square decimeter per day), mmpy (millie miles per year) and mpy (mils per year) –- importance of corrosion prevention in various industries: direct and indirect effects of determining corrosion rates - weight loss method, weight gain method and chemical analysis of solution.															
Unit – II Thermodynamics of Corrosion 9+3															
Electrode potentials, Electrical double layer, Gouy-Chapman model, Stern model, Bockris – Devanathan-Müller model - free energy and oxidation potential - criterion of corrosion (Problems) - basis of Pourbaix Diagrams - Pourbaix diagrams of water, magnesium, aluminium and Iron - limitations and applications.															
Unit – III	Kinetics of Corrosion														
Electrochemical polarization – Evan's diagram – activation polarization – concentration polarization - mixed potential theory(Wagner and Traud) – application of mixed potential theory – effect of metal in acid solution – cathodic protection of iron in acid solution – effect of cathodic reaction – effect of cathodic area – passivity – Flade potential – theories of passivity - adsorption theory – oxide film theory – film sequence theory.         Unit – IV       Types of Corrosion       9+3         Introduction - (i) Crevice - differential aeration corrosion (ii) pitting – mechanism and factors (iii) intergranular- chromium depletion															
stray current corro	sion - causes and its control.	alique- C	avitation dan	lage	– ne	ung d	lamage (v)								
Unit - V	Prevention of Corrosion						9+3								
Inhibitors – types of inhibitors, chemisorption of inhibitors, effect of concentration, effect of molecular structure, vapour phase inhibitors – prevention of corrosion at the design stage and in service conditions – control of catastrophic oxidation and hydrogen disease – Langelier saturation index and its uses - corrosion prevention by surface coatings – phosphating and its uses - principles and procedures of cathodic protection: sacrificial anodes and external cathodic current impression- painting, vitreous enamels, plastic lining.															
			Lecture:	45,	Tuto	rial: 1	5, Total: 60								
TEXT BOOK:															
1. E. McCaf	erty, Introduction to Corrosion Science, 2 <sup>nd</sup> Edition, Springer, 201	7.													
REFERENCES:															
1. R. Winsto Wiley put	n, Corrosion and Corrosion Control: An Introduction to Corrosion lisher, 2008.	Science	and Engineer	ing,	Revis	ed 4 <sup>th</sup>	Edition,								
2. Fontanna	"Corrosion Engineering", (Materials Science and Metallurgy serie	es), McGi	raw Hill intern	atior	nal Ec	I., 200	)5.								

COUR: On cor	SE Ol npleti	JTCON	IES: the cour	rse, the s	tudent	s will be	able to							BT Map (Highest	ped Level)
CO1	CO1 illustrate the mechanism, expression of rate of corrosion and importance of corrosion studies to Understanding Understanding														ing (K2)
CO2	CO2 demonstrate the thermodynamics and kinetics of different models of corrosion with respect to the environment. Applying (K3)														(K3)
CO3	utiliz	e the tl	heories o	of corrosi	on to int	erpret wi	ith the re	eal time	applica	ations.				Applying	(K3)
CO4	CO4organize the various types of corrosion to understand the corrosion problems.Applying (K3)														(K3)
CO5	CO5 summarize the corrosion prevention methods to avoid corrosion related issues. Understanding (K2)														ing (K2)
	Mapping of COs with POs and PSOs														
COs/P	COs/Pos         PO1         PO2         PO3         PO4         PO5         PO6         PO7         PO8         PO9         PO10         PO11         PO12         PS01         PS02														PSO2
CO1	1	3	1												
CO2	2	3	2	1	1	Τ	Γ	Γ	Γ						
COS	3	3	2	1	1										
CO4	1	3	2	1	1										
COS	5	3	1		Γ	Τ		Γ	<u> </u>						
1 – Sliç	ght, 2 ·	– Mode	erate, 3 -	- Substar	itial, BT	- Bloom's	s Taxon	omy							
		_				ASSE	SSMEN	T PATT	ERN -	- THEOF	RY				
Tes C	t / Blo atego	oom's ory*	Re	memberi (K1) %	ing	Jndersta (K2)	anding %	Apply (K3)	ying ) %	Analyz (K4) 9	ing %	Evaluating (K5) %		reating K6) %	Total %
	CAT	1		25		35		40	)						100
	CAT	2		25		35		40	)						100
	CAT	3		25		35		40	)						100
	ESE			25		35		40	)						100
* ±3% !	may b	e varie	d (CAT ·	1,2&3-	50 ma	rks & ESI	E – 100	marks)							

# 22CYO05 - CHEMISTRY OF COSMETICS IN DAILY LIFE

#### (Offered by Department of Chemistry)

Programme & Branch	All BE / BTech Branches	Sem.	Category	L	т	Ρ	Credit							
Prerequisites	Nil         6         OE         3         1         0													
		I												
Preamble	This course aims to provide knowledge on chemistry of cosmetic	s for en	gineering stud	dents	-									
Unit - I	Formulation of Cosmetic Product						9+3							
Introduction - basic sciences of cleansing – surfactant and adsorption, surfactant micelles, surfactants and cleansing, surfactants and foam (foam formation, stability, drainage, rupture and collapse and defoaming) - basics of dispersions - electrical charges associated with surfaces and barriers – basics of emulsion (stability, Ostwald ripening, prevention of creaming and sedimentation).														
Unit - II	- II Structuring Materials and Regulation for Cosmetics													
Introduction - water/hydrophilic base materials, oleaginous/hydrophobic base materials and amphiphilic substances - adding functions and effects - materials that add or improve functional value, emotional value and materials for quality control – cosmetic and personal care product safety – potential contaminants in cosmetics – regulations related to cosmetics – cosmetic regulation in india - future challenges in cosmetics material development.														
Unit - III	Polymers in Cosmetic Products						9+3							
Polymers in Cosmetics - polymer solubility and compatibility, polymer conformation - polymers that modify surfaces - film-forming polymers in cosmetics and personal care products - hair-conditioning polymers - polymers for the treatment of skin - polymers as controlled release matrices - dendritic polymers - polymeric antimicrobials and bacteriostats.														
Unit - IV	Natural Products and Fragrance in Cosmetics						9+3							
Introduction – nati allergens - aroma sensitivities.	chemicals - fragrance creation and duplication - fragrance app	d releas	e - allergens 5 malodor	in c – fra	osme agran	tics – ce al	e testing for lergies and							
Unit - V	Preparation of Cosmetics						9+3							
Cosmetics in day t nail lacquer, cream	o day life – characteristics, types, formulation, preparation and eva ns, toothpaste and hair dye.	luation r	nethods of lip	stick	, sha	mpoo	, powder,							
			Lecture:	45, 1	lutor	ial: 1	5, Total: 60							
TEXT BOOK:														
1. Kazutami Theoretica	Sakamoto, Robert Y. Lochhead, Howard I. Maibach, Yuji Yamashit al Principles and Applications, Elsevier, 2017 , for Units- I, II, III, IV,	ta, Cosm V.	netic Science	and	Tech	nolog	y:							
2. Gaurav Ku	umar Sharma, Jayesh Gadiya, Meenakshi Dhanawat A text book o	f cosmet	tic formulatior	n, 20 <sup>-</sup>	18, fo	r Unit	-V.							
REFERENCES:														
1. R.K. Nem	a, K.S. Rathore , B.K. Dubey, Textbook of Cosmetics, CBS Publish	ners and	Distributors,	201	7.									
2. Bruno Bur Mechanisi	lando, Elisa Bottini-Massa, LuisellaVerotta, Laura Cornara, Herbal ns of Action, CRC Press, 2010.	Principle	es in Cosmeti	cs: F	rope	rties a	and							

COUR On cor	COURSE OUTCOMES:BT MappedOn completion of the course, the students will be able to(Highest Level)														ped Level)	
CO1	outli	ine the	formul	ation	of cosm	etics p	products.							U	nderstand	ling (K2)
CO2	iden	ntify the	struct	uring	material	s and	regulatior	n involve	ed in cos	smetic	s develop	oment.			Applying	(K3)
CO3	inte	rpret th	e polyr	ners	and its re	ole in	cosmetics	6.						U	nderstand	ling (K2)
CO4	develop knowledge about natural products and Fragrance in Cosmetics. Applying (K3)														(K3)	
CO5	205 apply the knowledge of cosmetics to explain the characteristics, formulation, preparation and Applying (K3)														(K3)	
Mapping of COs with POs and PSOs																
COs/P	COs/Pos         PO1         PO2         PO3         PO4         PO5         PO6         PO7         PO8         PO9         PO10         PO11         PO12         PS01         PS02														PSO2	
CO1	3 1															
CO2	2	3	2		1											
CO3	3	3	1													
CO4	ŀ	3	2		1											
CO5	5	3	2		1											
1 – Slig	ght, 2	– Mode	erate, 3	3 – S	Substantia	al, BT-	Bloom's	Taxonor	ny				1			
							ASSES	SMENT	PATTE	RN –	THEOR	1				1
Te	st / B Categ	loom's gory*	;	Rei	memberi (K1) %	ng	Understa (K2)	anding %	Apply (K3)	ying %	Analyzi (K4) %	ing %	Evaluating (K5) %	Cı (	eating K6) %	Total %
	CA	T1			25		35		40	)						100
	CA	T2			25		35		40	)						100
	CA	Т3			25		35		40	)						100
	ES	ΒE			25		35		40	)						100
* ±3% ı	may t	be varie	d (CA	T 1, 2	2 & 3 – 5	0 mar	ks & ESE	– 100 m	narks)							

#### 22CYO06 – NANOCOMPOSITE MATERIALS (Offered by Department of Chemistry)

Progra Branch	mme&	All BE / BTech Branches	Sem.	Category	L	т	Ρ	Credit							
Prereq	uisites	Nil         6         OE         3         1         0													
Pream	Preamble This course aims to equip the students to have knowledge on processing, characterization, pr features and applications of nanocomposites.														
Unit –	l	Introduction of nanocomposites						9+3							
Introduction – nanocomposites – nanocomposites past and present – nomenclature – composite materials: introduction to solids - atomic and molecular solids – role of statistics in materials – primary, secondary and tertiary structure – transitions.															
Unit - I	it - IIProperties and features of nanocomposites9+														
Properties: physics of modulus – continuum measurements – yield – fracture – rubbery elasticity and viscoelasticity – composites and nanocomposites – surface mechanical properties –diffusion and permeability – features of nanocomposites: basics of polymer nanocomposites - nano reinforcements – matrix materials – hazards of particles.															
Unit - I	11	Processing of nanocomposites													
Viscosity: types of flow, experimental viscosity, non-newtonian flow -low-viscosity processing: solvent processing, particle behavior, in situ polymerization, post-forming, hazards of solvent processing - melt, high shear and direct processing: melting and softening, melt processes with small shears or low-shear rates flow, meltprocesses with large deformations or high-shear rates, thermo-kinetic processes.															
Unit - I	V	Characterization of nanocomposites						9+3							
Introdu nanoco propert	ction to cha mposites – ies.	racterization – experiment design – sample preparation – ir texture – electromagnetic energy –visualization – physicoch	naging - nemical	-structural cł analysis – cl	harac hara	cteriza cteriz	ation ation	<ul> <li>scales in of physical</li> </ul>							
Unit - \	1	Applications of nanocomposites						9+3							
Nanoco protein nanoco	omposites – nanocompo omposite mat	optical, structural applications – nanoparticulate systems with esites – applications-polypropylene nanocomposites – applicaterials – application for corrosion protection.	organic i tion as e	matrices – ap exterior auton	oplica natic	ations com	s – bio ponei	odegradable nts – hybrid							
				Lecture:	45,	Tuto	rial: 1	5, Total: 60							
TEXT E	300K:														
1.	Thomas E. Publication	Twardowski, "Introduction to Nanocomposite Materials – Prop s, April 2007, for Units-I, II, III, IV.	oerties, F	Processing, C	hara	cteriz	zation	", DesTech							
2.	Klaus Fried for Units-I,	lrich, Stoyko Fakivov, Zhony Shang, "Polymer Composites from II, V.	n Nano –	to Macro – s	cale	', Spr	inger	USA, 2005,							
REFER	ENCES:														
1.	Pulickel M.	A, Linda S. S, Paul V.B, "Nanocomposite Science and Technol	ogy", Wi	ley-VCH, 200	6.										
2.	Vikas Mitta	I, Characterization techniques for polymer nanocomposites, Wil	ey-VCH,	2012.											

COUR On co	SE O mple	UTCON tion of	MES: the cou	Irse, the s	studen	ts will be	e able to	)						BT Map (Highest	oped Level)			
CO1	ide	entify the	e knowl	edge of na	anocom	posites a	and to e	xplain it	s struc	ture.				Applying	g (K3)			
CO2	ар	ply the	knowle	dge on va	ious pr	operties	and feat	ures of	nanoco	omposite	es.			Applying (K3)				
CO3	O3 choose the various concepts involving in the processing of nanocomposites.														g (K3)			
CO4	CO4 apply the acquired knowledge on characterization of nanocomposites.														g (K3)			
CO5 organize the applications of nanocomposites in various fields.														Applying	g (K3)			
	Manning of COs with POs and PSOs																	
00-/5	Mapping of COs with POs and PSOs														<b>DQQQ</b>			
COS/Pos P01 P02 P03				P04	P05	P06	P07	P08	P09	PO10	P011	P012	PS01	PS02				
CO1	1	3	2	1	1													
CO2	2	3	2	1	1													
COS	3	3	2	1	1													
CO4	4	3	2	1	1													
COS	5	3	2	1	1													
1 – Slię	ght, 2	– Mode	erate, 3	- Substa	ntial, B	Γ- Bloom	's Taxor	nomy				1			L.			
						ASSE	SSMEN	T PATI	ERN -	THEOF	RY							
Tes C	t / Bl	oom's ory*	R	emember (K1) %	ing	Understa (K2)	anding %	Apply (K3)	ying ) %	Analyzing (K4) %		Evaluating (K5) %	) C (	reating K6) %	Total %			
	CAT	1		25		35	i	40	D						100			
	CAT	2		25		35		40	)					100				
	CAT	3		25		35		40	)						100			
	ESE	Ξ		25		35	1	4(	)						100			

\*  $\pm 3\%$  may be varied (CAT 1, 2 & 3 – 50 marks & ESE – 100 marks)
22MA008 - NON-LINEAR OPTIMIZATION												
(Offered by Department of Mathematics)												
Progra Branc	amme & h	All B.E/.BTech Branches	Sem.	Category	L	Т	Ρ	Credit				
Prerec	quisites	Nil	7	OE	3	0	0	3				
Pream	ble	The course focuses on the basic concepts, various to optimization.	echnique	es and appl	icatio	ons	of er	igineering				
Unit –	I	Classical Optimization Techniques:						9				
Introdu with e conditi	uction to Op quality const ions.	timization – Statement of an Optimization problem – Mathema raints – Lagrange multipliers method – Multi variable optimization	atical for ation with	mulation – M n inequality c	ulti v onst	variat raint	ole op – Kuł	timization nn Tucker				
Unit – II         Non-Linear Programming: One-Dimensional Minimization Method:         9           Introduction – Unimodal function – Elimination Methods: Unrestricted search – Exhaustive search – Dichotomous search – Interval halving method – Fibonacci method – Golden section method – Direct root methods: Newton method – Secant method.         9												
Unit – III         Non-Linear Programming: Unconstrained Optimization Techniques:         9												
Introdu Jeeve'	uction to Uno s method –	constrained optimization – Direct Search Methods: Grid searc Powell's method.	h metho	d – Univariat	e me	ethod	– Ho	okes and				
Unit –	IV	Unconstrained Optimization Techniques (Indirect Metho	ds):					9				
Gradie Marqu	ent of a Fund ardt method	tion – Indirect Search Methods: Steepest descent method – F	-letcher-l	Reeves meth	od –	New	ton's	method –				
Unit –	V	Non-Linear Programming: Constrained Optimization Tec	hniques	:				9				
Introdu progra metho	uction – Ch Imming – In d.	aracteristics of a Constrained Problem – Direct Methods: direct methods: Transformation techniques – Exterior penalt	Random y functio	search metl n method –	nod Inte	– Se rior p	equen enalt <u>y</u>	tial linear y function				
								Total:45				
TEXT	BOOK:											
1.	S.S.Rao, E	ngineering Optimization Theory and Practice, 5th Edition, Joh	n Wiley	& Sons Ltd, L	JSA,	2020	).					
REFERENCES:												
1.	David Luer	nberger and Yinyu Ye, Linear and Nonlinear Programming, 4 <sup>th</sup>	edition,	Springer-Ver	ag, i	2015						
2.	A.Ravindra India Pvt. I	n, K.M.Ragsdell, G.V.Reklaitis, Engineering Optimization: M.td., 2006.	lethods	and applicati	ons,	2 <sup>nd</sup>	Editio	n, Wiley				
3.	3. Yang, Xin-She. Optimization Techniques and Applications with Examples. 1 <sup>st</sup> Edition, John Wiley & Sons, United Kingdom, 2018.											

COUR On co	COURSE OUTCOMES:BT MappedOn completion of the course, the students will be able to(Highest Level)														
CO1	solv	e proble	ems with	equality	and ine	quality co	nstraints	5.					4	Applying	(K3)
CO2	solv	e nonlir	near prog	gramming	g probler	ns of fund	ctions of	single va	ariable.				ŀ	Applying	(K3)
CO3	use	metho	ds of und	constrain	ed optim	ization to	solve n	on linear	proble	ms			ŀ	Applying	(K3)
CO4	solv	e nonlir	near optir	mization	problem	s in the p	resence	of inequ	ality an	id equalit	y constra	ints.	ŀ	Applying	(K3)
CO5	app	ly sever	al mode	rn metho	ds of op	timization	for solv	ing engiı	neering	problem	s		A	Applying	(K3)
	Mapping of COs with POs and PSOs														
COs/F	os	PO1	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	P011	PO12	PSO1	PSO2
CO	1	3	3	2											
CO	2	3	2												
CO	3	3	3	1											
CO	4	3	3	3											
CO	5	3	2	3											
1 – Slig	ght, 2	– Mode	rate, 3 –	Substan	tial, BT-	Bloom's	Taxonor	ny							
						ASSES	SMENT	PATTER	N - TH	EORY					
Tes C	t / Blo atego	oom's ory*	Rei	member (K1) %	ing	Understa (K2)	anding %	Appl (K3	ying ) %	Analyzi (K4) %	ing E %	Evaluating (K5) %	g Crea (Ke	ating 6) %	Total %
	CAT	1		10		10		80	)						100
	CAT	2		10		10		80	)						100
	CAT	3		10		10		80	)						100
	ESE 10 10 80 100														
* ±3%	may b	e varied	d (CAT 1	,2 & 3 –	50 marl	ks & ESE	– 100 m	narks)							

22MA009 - OPTIMIZATION FOR ENGINEERS													
(Offered by Department of Mathematics)													
Programme & Branch	All B.E/.BTech Branches	Sem.	Category	L	т	Ρ	Credit						
Prerequisites	Nil	7	OE	3	0	0	3						
				1		1							
Preamble	To provide the skills for solving the real time engineering pro functions and also impart knowledge in finding optimal solut making and analyzing queuing models.	blems in tions to p	volving linear roblems invo	and Iving	non∙ mul	linea ti-leve	r objective el decision						
Unit – I	Linear Programming:						9						
Introduction to Operations research – Applications of OR – Linear Programming – Formation of Linear Programming Problem – Solution of LPP: Basic concepts – Graphical Solution – Simplex method – Artificial techniques: Big M method.													
Unit – II Integer Programming: 9													
Introduction – Types of Integer Programming Problems – Solution of Integer programming problems – Gomory's all integer cutting plane method - Gomory's Mixed-Integer Cutting Plane Method – Branch and Bound method.													
Unit – III	Unit - IIIDynamic programming:9												
Introduction – C of Discrete Dyna	naracteristics – Formulation of Dynamic programming problems mic programming problem – Solution of LPP by Dynamic progra	s –Dynam Imming.	nic programm	ing /	Algor	ithm	<ul> <li>Solution</li> </ul>						
Unit – IV Queueing Theory: 9													
Characteristics of model) (M/M/1) (M/M/C): (∞/FIF model IV (Finite	of a queueing system – Kendall's notation – Queuing model I ( : (∞/FIFO) – Little's formulae – Queuing model II (Infinite ca D) – Queuing model III (Finite capacity single server Poisson capacity multiple server Poisson model) (M/M/C) : (N/ FIFO)	Infinite ca apacity m queue m	apacity single nultiple serve nodel) (M/M/1	r Po ): (N	rver issor I/FIF	Poise n que O) –	son queue eue model Queueing						
Unit – V	Non-Linear Programming:						9						
Introduction – M constraints – La conditions.	athematical formulation of Non-linear programing problems – agrange multipliers method – Non-linear programing probler	Non-line m with i	ar programin nequality cor	ng pr Instra	oble int -	m wit - Kuł	h equality nn Tucker						
							Total:45						
TEXT BOOK:													
1. Sharma	J.K, "Operations Research – Theory and Applications", 6 <sup>th</sup> Editio	on, Trinity	Press, India	, Nev	v De	lhi, 20	017.						
REFERENCES:													
1. Taha, Ha	amdy A., "Operation Research: An introduction", 9 <sup>th</sup> edition, Pear	son Edu	cation, 2010.										
<ol> <li>Hiller, Frederick. S. and Lieberman, Gerald. J., "An introduction to Operations research- concepts and cases", Tata McGraw Hill (SIE) 8<sup>th</sup> edition, 2005.</li> </ol>													
3. Ravindra 2005.	n, A., Phillips, D.J., and Solberg, J.J., "Operations Research-	Principle	s and Practio	ce", 、	John	Wile	y & Sons,						
4. Kanti Sv Publicati	varup, P.K. Gupta, Man Mohan, "Operations Research", 15 <sup>th</sup> ons, New Delhi, 2017.	revised I	Edition, S. C	hand	& 3	Sons	Education						
5. Gupta F Delhi, 20	Gupta P.K. and Hira D.S., "Operations Research: An Introduction", 7 <sup>th</sup> Revised Edition, S.Chand and Co. Ltd., New Delhi, 2014.												

COUR On co	SE O mplet	UTCOM	IES: he cour:	se, the s	tudents	will be a	able to						(H	BT Map lighest l	ped _evel)
CO1	form	nulate a	nd solve	linear pi	ogramm	ing probl	ems.						A	Applying	(K3)
CO2	solv	ve Intege	er Progra	amming	problem	s that exi	st in real	time ap	plicatior	ns.			ŀ	Applying	(K3)
CO3	der give	nonstrat en netw	te the th ork.	eoretica	l working	gs of dyn	amic pro	ogramm	ing met	hod to f	ind short	est path fo	or A	Applying	(K3)
CO4	use	the app	oropriate	queuing	model f	or a giver	n practica	al applica	ation.				ŀ	Applying	(K3)
CO5	app con	oly the estraints	concept and obj	of non ectives.	-linear	orogramn	ning for	solving	the pr	roblems	involving	non-line	ar "	Applying	(K3)
	Mapping of COs with POs and PSOs														
COs/F	POs	P01	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
СО	1	3	2	3											
CO	2	3	2	1											
CO	3	3	2	1											
CO	4	3	2	1											
CO	5	3	2	3											
1 – Slig	ght, 2	– Mode	rate, 3 –	Substar	ntial, BT-	Bloom's	Taxonon	ny							
						ASSES	SMENT I	PATTER	RN - TH	EORY					
Tes C	atego	oom's ory*	Re	member (K1) %	ing	Understa (K2)	anding %	Appl (K3	ying ) %	Analyz (K4) S	ing E %	Evaluating (K5) %	J Crea (Ke	ating 6) %	Total %
	CAT	1		10		20	20 70					100			
	CAT	2		10		20		70	)						100
	CAT	3		10		20		70	)						100
	ESE	Ξ		10		20		70	)						100
* ±3%	* ±3% may be varied (CAT 1,2 & 3 – 50 marks & ESE – 100 marks)														

# 22CYO07 - WASTE AND HAZARDOUS WASTE MANAGEMENT (Offered by Department of Chemistry)

Programme & Branch	All BE / BTech Branches	Sem.	Category	L	т	Ρ	Credit						
Prerequisites	Nil	7	OE	3	0	0	3						
		I											
Preamble	Waste and Hazardous waste management aims to equip the waste management.	students	s to have a w	ide-r	ange	of kn	owledge on						
Unit – I	Solid Waste Management						9						
Solid wastes: defi	nition, sources, types, composition of solid waste- Solid was	ste mana	agement syst	em:	colle	ction,	separation,						
processing and trar	sformation of solid waste - combustion, aerobic composting, v	vermicon	nposting, pyro	olysis	s, lan	dfill-cl	assification,						
types, methods and	control of leachate in landfills - recycling of material found in	n munici	pal solid was	ste- r	ecycl	ing of	paper and						
cardboard, recycling	of plastics, recycling of glass.						•						
	Hazardous waste management	antine a			<b>af b</b>		9						
<b>fazardous wastes:</b> definition, nature and sources of hazardous waste, classification and characteristics of hazardous waste-													
chemical class of ha	azardous waste, generation, segregation, treatment and dispose	al. waste	tion bydroly			nzalic	n, recycling						
extraction and lead	ning ion exchange photolytic reaction- thermal treatment meth	on/reduc	ineration – hi	onder	irada	tion of	f hazardous						
waste: aerobic, ana	erobic, reductive dehalogenations - land treatment and compositi	ina.	incration bi	ouce	nuuu		mazaraoas						
Unit – III	E- Waste & Biomedical Waste Management						9						
E-Waste Managem	ent: definition, sources, classification, collection, segregation, tre	eatment	and disposal.										
Biomedical Waste	Management : Introduction-definition –components of biomedi	ical wast	e-waste gene	ratio	n –w	aste i	dentification						
and waste control-	waste storage-labeling and color coding-handling and transpor	rtation-wa	aste treatmer	nt an	d dis	posal	- autoclave,						
hydroclave, microw	ave treatments- chemical disinfection - sanitary and secure land	dfill.				-							
Unit – IV	Unit – IVPollution From Major Industries And Management9												
Introduction- sourc pharmaceuticals, su	es and characteristics - waste treatment flow sheets for s Igar, petroleum refinery, fertilizer and dairy industries.	selected	industries s	uch	as t	extiles	s, tanneries,						
Unit – V	Solid Waste Management and Legislation						9						
Solid waste manage plastic waste mana movement) rules - c	ement plan - solid waste (management and handling) rules - bior gement rules - e-waste management rules - hazardous and co construction and demolition waste management rules.	medical v other w	vaste (manag vastes (manag	jeme geme	nt an ent a	d han nd tra	dling) rules- nsboundary						
							Total: 45						
TEXT BOOK:													
1. George Tch manageme	nobanoglous, Hillary Theisen, Samuel a Vigil, Integrated solid wa nt issues) McGraw hill Education (India) Pvt. Ltd., 2015, for Unit-	aste man -I, II, V.	agement (En	ginee	ering	princij	ole and						
2. SC Bhatia, Unit-II, III, I	2. SC Bhatia, Handbook of Industrial pollution and control (Volume-1), CBS Publisher and Distributers, New Delhi, 2002, for Unit-II, III, IV, V.												
REFERENCES:													
1. Manual on (CPHEEO)	Municipal Solid Waste management, Central public Health and E , Govt. of India, May 2000.	Environm	ental Engine	ering	Orga	nizati	on						
2. Michael D.	LaGrega, Phillip L. Buckingham, Jeffrey C. Evans, Hazardous w	aste mai	nagement, MI	EDT	EC, 2	015.							
3. Majeti Nara Internationa	simha Vara Prasad, Meththika Vithanage, Anwesha Borthakur, ' al Best Practices and Case Studies" 1 <sup>st</sup> Edition, Butterworth-Hein	"Handbo nemann,	ok of Electron 2019.	ic W	aste	Mana	gement:						

COURSE OUTCOMES: On completion of the course, the students will be able to										BT Mapped (Highest Level)						
CO1	apply	y the te	echnical p	points that	at are ree	quired to	set up	a solid v	vaste m	anagen	nent syste	em.		Applying	(K3)	
CO2	expla	ain the	various	disposal	and trea	tment m	ethods of	of hazar	dous w	astes.			U	nderstand	ing (K2)	
CO3	orga	nize th	e approp	riate met	hod for	managir	ng e-was	ste and	biomedi	ical was	te.			Applying	(K3)	
CO4	ident treat	tify the ment.	hazards	from var	ious ind	ustries a	nd apply	y the wa	iste mai	nageme	nt technio	ques for its	6	Applying	(K3)	
CO5	O5 relate the legal legislation to solid waste management.											U	Understanding (K2)			
Manning of COs with POs and PSOs																
COs/P	os	PO1	PO2	PO3	PO4	PO5	PO6	P07	P08	PO9	PO10	P011	PO12	PSO1	PSO2	
CO1		3	2	1	1			3								
CO2	2	2	1					3								
COS	3	3	2	1	1			3								
CO4	CO4         3         2         1         1         3 <th< td=""></th<>															
CO5	CO5         2         1         3   <															
1 – Slig	ght, 2 -	– Mode	erate, 3 –	Substan	tial, BT-	Bloom's	s Taxono	omy								

	ASSESSMENT PATTERN – THEORY										
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %				
CAT1	25	35	40				100				
CAT2	25	35	40				100				
CAT3	25	35	40				100				
ESE	25	35	40				100				
* ±3% may be varied (CAT 1, 2 & 3 – 50 marks & ESE – 100 marks)											

# 22CYO08 - CHEMISTRY IN EVERY DAY LIFE (Offered by Department of Chemistry)

Progra Branch	imme& 1	All BE / BTech Branches	Sem.	Category	L	т	Ρ	Credit				
Prereq	uisites	Nil	7	OE	3	0	0	3				
Preaml	ble	This course aims to prepare the students to have the know creams, milk powder, soil, fertilizer, pesticides, insecticides, chemistry in our everyday activities.	vledge o fungicid	n oils, fats, s les and herbi	suga cide	r, ad s in o	ultera order	nts in food, to know its				
Unit –		Oils, Fats and Sugar						9				
Distinc solvent sucrose	tion between e extraction - e from beet r	oils and fats – properties – classification – edible oils – vege refining of crude vegetable oils – processing of animal fats - pot.	etable oil - manufa	s –animal oil acture of can	s – I e su	manu gar -	factur mar	e of oils by nufacture of				
Unit – II Adulterants in food 9												
Food Adulteration and prevention – common food adulterants – food additives – food colorants– preservatives – flavourants – food poisoning – analysis of adulterants in edible oils, coffee powder, chilli powder, turmeric powder, meat , fish, ghee and milk – harmful effects of food adulterants												
Unit – III Creams and Milk powder												
Creams: Composition-chemistry of creaming process- Factors influencing cream separation (Mention the factors only) - Estin of fat in cream - Milk powder: Need for making powder-drying process- spraying, drum drying, jet drying and foam drying-prir involved in each.												
Unit –	IV	Soil and Fertilizers						9				
Soil an Fertilize fertilize obtain	alysis: Com ers: primary rs and its co estimated yie	bosition of soil - Organic and Inorganic constituents-Soil acidi nutrients –role of Nitrogen, potassium and phosphorous on mposition - Secondary nutrients – micronutrients and their func- eld.	ity - buff n plant g ctions in	ering capacit growth –Com plants -optin	y of plex nal a	soils ferti dditic	-Limi lizers n of F	ing of soil - and mixed Fertilizers to				
Unit –	V	Pesticides, Insecticides, Fungicides and Herbicides						9				
Pesticio Inorgar pesticio organio dicholo	des – Classi nic pesticides des: Endrin c (dithiocarba rophenoxyac	fication – general methods of application and toxicity, Safety – borates - Organic pesticides – D.D.T. and BHC-Plant deriva and Aldrin (Chemical name - Structure- functions and uses) amate) fungicides - Industrial fungicides: Creosote fractions - setic acid and 2,4,5-tricholorophenoxyaceticacid (structure and f	y measu atives: py -Fungicio Herbicio function)	res when usi vrethrin and N des: Inorgani les: Selective	ng p licoti c (B e and	estic ne - ordea 1 non	ides-l Synth aux m -seleo	nsecticides: etic organic nixture) and ctive - 2, 4-				
								Total: 45				
TEXT E	BOOK:											
1.	Sharma B I	K, Industrial Chemistry, Goel publishing house, New Delhi, 201	1, for Un	its- I, II, IV								
2. Alex V Ramani, Food Chemistry, MJP Publishers, Chennai, 2009, for Units -II, III, V.												
REFER	REFERENCES:											
1.	Dilip Kuma	Das, Introductory Soil Science, 1st Edition, Kalyani Publishers	, Reprint	2002.								
2.	K. Bagavat	ni Sundari– "Applied Chemistry", MJP Publishers, Chennai, 200	06.									
3.	Ashutosh K	ar, Medicinal Chemistry, Wiley Eastern limited, New Delhi, 199	3.									

COUR On co	SE OUTCOMES: mpletion of the course, the students will be able to	BT Mapped (Highest Level)
CO1	outline the importance of oils, fats and sugar.	Understanding (K2)
CO2	identify the harmful effects of adulterants in food.	Applying (K3)
CO3	develop the knowledge on creams and milk powder.	Applying (K3)
CO4	interpret the nature and composition of soil and fertilizers.	Understanding (K2)
CO5	illustrate the difference of pesticides, insecticides, fungicides and herbicides.	Understanding (K2)

	Mapping of COs with POs and PSOs													
COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1												
CO2	3	2	1	1										
CO3	3	2	1	1										
CO4	3	1												
CO5	3	1												
1 – Slight, 2	1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy													

	oligin, z	modorato, o	Cabolantial, DT	Bloom o raxonomy	
					-

ASSESSMENT PATTERN – THEORY											
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %				
CAT1	25	35	40				100				
CAT2	25	35	40				100				
CAT3	25	35	40				100				
ESE	25	35	40				100				
* ±3% may be varied (CAT 1, 2 & 3 – 50 marks & ESE – 100 marks)											

#### 22CYO09 - CHEMISTRY OF NUTRITION FOR WOMEN HEALTH (Offered by Department of Chemistry)

Program Branch	nme &	All BE / BTech Branches	Sem.	Category	L	т	Ρ	Credit						
Prerequi	isites	Nil	8	OE	3	0	0	3						
Preamble	e	This course aims to provide knowledge for engineering stud the role of nutrition for women health.	ents on	components	of h	ealth	, fitne	ss and also						
Unit - I		Nutrition						9						
Energy- deficienc soluble v minerals	<ul> <li>Functions, sources and concept of energy balance - recommended dietary allowances, dietary sources - e iciency and/ or excess consumption on health of the following nutrients: carbohydrates and dietary fiber – lipids – protuble vitamins: A, D,E and K - water soluble vitamins: Thiamin, riboflavin, niacin, pyridoxine, folate, vitamin B12 and vitaments: calcium, iron, zinc and iodine.</li> <li>it - II</li> </ul>													
Unit - II	Women Health Women Health menopause – hypothyroid, PCOD-diabetes - policies and programs for													
Disease	ernal and child nutrition and health - menopause – hypothyroid - PCOD-diabetes - policies and programs for p ernal and child nutrition and health - concept of small family - methods of family planning - merits and demerits.													
Unit - III	- III Nutrition for Nursing Mother and Infants													
Physiolog nursing r infants a	siology and psychology of lactation, hormonal control, composition of colostrums and breast milk, nutritional requirem sing mother, advantages of breast feeding, food and nutritional requirements for infants, weaning and supplementary nts and immunization.													
Unit - IV		Nutrition for Physical Fitness						9						
Significat disorders for mana	nce of phy s, bone hea agement of	sical fitness and nutrition in the prevention and management of alth and cancer - nutrition and exercise regimes for pre and post obesity - critical review of various dietary regimes for weight and	of weigh stnatal fit d fat redu	t control, obe ness - nutrit uction - preve	sity, ional entior	diab and of w	etes r exerc /eight	nellitus, CV ise regimes cycling.						
Unit - V		Role of Women in National Development						9						
Women ratio, agi status.	in family a ing, widow	nd community: Demographic changes menarche, marriage, fe hood. Women in society: Women's role, their resources, and	ertility, m I contrib	orbidity, mor ution to famil	tality y, a	r, life nd ef	expe fect c	ctancy, sex of nutritional						
								Total: 45						
ТЕХТ ВС	DOK:													
1. 5	Srilakshmi,	B., Nutrition Science, New Age International (P) Ltd., New Delh	ni, 2017,	for Units- I, I	V, V.									
2.	Arpita Vern Units - II, II	na, Women's Health and Nutrition: Role of State and Voluntary ( I, IV.	Organiza	itions, Rawat	Pub	lishei	rs, 20	17, for						
REFERE	REFERENCES:													
1.	Shubhangi	ni A Joshi , Nutrition and Dietetics, TataMacGraw Hill, 2010.												
2. I	Rujuta Diw	ekar, Women and The Weight Loss Tamasha, Westland ltd, 20	10.											
3.	Swaminath Co. Ltd., Ba	an, M., Advanced Textbook on Food and Nutrition, Vol. 1, Seco angalore, 2012.	ond Editio	on, Bangalore	e Prir	iting a	and P	ublishing						
1														

COUR On co	SE OUTCOMES: mpletion of the course, the students will be able to	BT Mapped (Highest Level)
CO1	make use of the knowledge of dietary sources in day to day life.	Applying (K3)
CO2	explain the disease pattern and policies towards women health.	Understanding (K2)
CO3	develop knowledge about nutrition during lactation and for infants.	Applying (K3)
CO4	utilize the knowledge of physical fitness and nutrition towards good health.	Applying (K3)
CO5	interpret the various role of women in society.	Understanding (K2)

	Mapping of COs with POs and PSOs														
COs/Pos	COs/Pos         PO1         PO2         PO3         PO4         PO5         PO6         PO7         PO8         PO9         PO10         PO11         PO12         PS01         PS02														
CO1	CO1         3         2         1   <														
CO2	3	1													
CO3	3	2	1												
CO4	3	2	1												
CO5	CO5 3 1														
1 – Slight, 2	1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

	ASSESSMENT PATTERN – THEORY													
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %							
CAT1	25	35	40				100							
CAT2	25	35	40				100							
CAT3	25	35	40				100							
ESE	25	35	40				100							
* ±3% may be varied (	CAT 1, 2 & 3 – 50 r	marks & ESE – 100	marks)											

### Honours degree with specialization in Smart Manufacturing

S.No	Course Title	Credits
1.	22MEH01 - Digital Manufacturing	4
2.	22MEH02 - Factory Automation	3
3.	22MEJ01 - 3D Modeling and Prototyping	4
4.	22MEH03- Smart Manufacturing Transformation	3
5.	22MEH04 - Industrial IOT	4
	TOTAL	18

22MEH01 – DIGITAL MANUFACTURING															
Progra Branci	imme & n	B.E. & Mechanical Engineering Se	m.	Category	L	т	Р	Credit							
Prereq	uisites	Manufacturing Technology 5/6	6/7	HN	3	1	0	4							
Pream	ble	This course provides the importance of information, sensors manufacturing. It additionally describes the digital twin technology	s, act and its	uators, cor implementa	ntrol atio	lers n in s	used hop fl	in digital oor.							
Unit –	I	Introduction to Digital Manufacturing:						9+3							
Introdu Archite Manufa	Architecture of Digital Manufacturing System - Modelling theory and Method of Digital Manufacturing Science - Computing Manufacturing in Digital Manufacturing Science - Methodology – Manufacturing - Theoretical units.       9+3														
Unit –	Unit – II         Manufacturing Informatics:         9+3           Manufacturing Informatics in Digital Manufacturing - Principal Properties - Measurement and Synthesis - Integration Sharing and         Sharing and														
Manufa	acturing Inform	natics in Digital Manufacturing - Principal Properties - Measuremen	t and	Synthesis -	Inte	egrati	on, S	haring and							
Intellige Learnir	Security. Intelligent Manufacturing in Digital Manufacturing Science - Sensing End Fusion - Knowledge Engineering - Autonomy, Self- Learning.														
Unit –	Learning.Unit - IIIBionic Manufacturing and Management Technology:9+3														
Scienc Develo Manag Produc Enviror	e of Bionic pment of Bio- ement Techn tion Pattern ment Techno	Manufacturing in Digital Manufacturing Science-Overview, Bionic Manufacturing. ology in Digital Manufacturing Science - Management of Technology - MOT mode. Key technology of Digital Manufacturing Science ology.	Macl - Tec - P	hinery - Bio chnological s roduct Life	olog Stra Cyc	ical tegie cles	Manu s Mar · Res	facturing - nagement - ource and							
Unit –	IV	Digital Twin:						9+3							
Digital Digital	Onit – IV       Digital Twin:       9+3         Digital Twin and Related Concepts - Value of Digital Twin - Application of Digital Twin and its Challenges - Three-Dimensional Digital Twin – Requirements - Three level Digital Twins - Rules for Digital Twin Modelling.       9+3														
Unit –	V	Equipment Energy Consumption Management (EECM) in Digit	al Twi	in Shop Flo	or:			9+3							
Implerr Fusion Health	nentation of E in Digital Twi Management	ECM in Digital Twin Shop floor - Potential Advantages of EECM in n Shop Floor Models Fusion - Data Fusion – Services - Digital Twin (PHM) Method, Case study.	Digital for Co	l Twin Shop omplex Equi	Flo pme	or – ( ent –	Cyber Progr	- Physical nostics and							
				Lecture:	45,	Tuto	rial:1	5, Total:60							
TEXT I	BOOKS:														
1.	Zude Zhou, 2012 for uni	Shane Xie, Dejun Chen, "Fundamentals of Digital Manufacturing ts I, II, III	Sciend	ce", 1 <sup>st</sup> Editi	on,	Sprii	nger,	New York,							
2	Fei Tao, Me units IV, V	ng Zhang A.Y.C.Nee, "Digital Twin Driven Smart Manufacturing" 1 <sup>st</sup>	Editio	n, Academic	; pre	ess, L	ondo.	n, 2019 for							
REFEF	RENCES:														
1. 2.	Kaushik Ku CRC Press, Surjya Kan	mar, Divya ZindaniJ. Paulo Davi.," Digital Manufacturing and Asse London, 2019 ta Pal, Debasish Mishra, Arpan Pal, Samik Dutta, Debashish Ch	mbly akrav	Systems in arty, "Digita	Ind al T	ustry <sup>-</sup> win	4.0", – Fu	4 <sup>th</sup> Edition, Indamental							
	Concepts to	Applications in Advanced Manufacturing , 1ª Edition, Springer, New	YOR	, 2021											
COUR On cor	SE OUTCOM	ES: he course, the students will be able to				E (Hi	ST Ma ghes	pped t Level)							
CO1	Illustrate the	digital manufacturing concepts in manufacturing applications				Unde	erstan	ding (K2)							
CO2	conceptualiz	ze manufacturing informatics for digital manufacturing				Unde	erstan	ding (K2)							
CO3	extend Bion	ic manufacturing and manufacturing technology to the real word prol	lems			A	oplyin	g (K3)							
CO4	discriminate	digital twin and its application				Unde	erstan	ding (K2)							
CO5	select suital	ble equipment energy consumption management method in digital tw	in sho	op-floor		A	oplyin	g (K3)							

Mapping of COs with POs and PSOs														
COs/POs	P01	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3			3		2			2				1	
CO2	3			3		2			2				2	
CO3	3			3		2			2				3	
CO4	3			3		2			2				1	
CO5	3			3		2			2				3	

1 - Slight, 2 - Moderate, 3 - Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY													
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %						
CAT1	30	70					100						
CAT2	20	50	30				100						
CAT3	20	50	30				100						
ESE	20	50	30				100						
* ±3% may be varied (C	CAT 1,2,3 – 50 mark	s & ESE – 100 mar	rks)										

22MEH02 – FACTORY AUTOMATION															
_					[	1									
Programme Branch	e &	B.E. & Mechanical Engineering	Sem.	Category	L	т	Р	Credit							
Prerequisit	es	Nil	5/6/7	HN	3	0	0	3							
Preamble		This course provides the significant role of automation in inspection and testing. It also impart the knowledge on se automation production.	producti everal p	on lines, ma principles of	teria con	al ha ditior	ndlin mo	g systems, nitoring for							
Unit – I		Automation in Production System:						9							
Introduction - Levels of Assembly -	Introduction, Principles and Strategies of Automation - Basic Elements of an Automated System - Advanced Automation Function - Levels of Automations. Automated Flow lines - Methods of Work part Transport - Transfer Mechanism - Design for Automate Assembly - Types of Automated Assembly Systems and Buffer Storage.														
Unit – II Advanced Material Handling Technologies: 9															
Automated handling and storage systems in manufacturing - Rail Guided Vehicles (RGVs), Automated Guided Vehicles (AGVs) Applications of RGVs and AGVs. Automated Storage and Retrieval Systems (AS/RS), Considerations for planning an AS /RS system, Robots and their applications in handling and storage.															
Unit – III		Automated Inspection and Testing:						9							
Automated Non-Contac Future trend	Inspection t inspection ts.	on Principles and Methods - Sensor technologies for Automate tion methods. Machine Vision: Resolution, Lighting, Connectiv	ed Inspe vity ana	ction - Conta lysis - Three	ict i dir	nspe nens	ction ional	methods – vision and							
Unit – IV		Robotic inspection and Identification Techniques:						9							
Introduction testing and systems.	- Types Inspectio	s of robots - Fundamentals of robot control and programming on - Servo robots - Case study. Identification techniques - Micro	<ul> <li>Intelli</li> <li>senso</li> </ul>	gent robots - rs, Nano sens	- Ro sors	botic , Bar	visio code	on, Robotic e and RFID							
Unit – V		Condition Monitoring:						9							
Principles - condition mo	Sensors	s for monitoring force - Vibration and noise - Selection of sens - Direct tool wear assessment, Indirect tool wear assessment - T	sors and Fool con	I monitoring t dition monitor	ech ing	nique syste	es. M em.	achine tool							
								Total:45							
TEXT BOO	KS:														
1. Mike for l	ell P Gro Units I &	over," Automation, Production Systems and Computer Integrated	d Manuf	acturing",4 <sup>th</sup> E	ditio	on, P	earso	on, 2019							
2 Star 201	nley L. I 9 for Un	Robinson & Richard Kendall Miller, "Automated Inspection and its III & IV	l Quality	/ Assurance",	1 <sup>st</sup>	Editi	on, (	CRC press,							
3 Ami	iya R. M	ohanty," Machinery Condition Monitoring Principles and Practices	s", 1 <sup>st</sup> Eo	dition, CRC P	ress	, 201	5 for	Unit V							
REFERENC	CE:														
1. Sing	gh and J	ohn Wiley," System Approach to Computer Integrated Design an	d Manu	facturing" 1 <sup>st</sup> I	Editi	on, V	Viley,	1995							
COURSE O On complet	UTCOM tion of t	ES: he course, the students will be able to				E (Hi	BT Ma ghes	apped it Level)							
CO1 des	CO1 describe the principles, types and level of automation Understanding (K2)														
CO2 com	npare va	rious material handling systems in automated industry				Unde	erstai	nding (K2)							
CO3 con	ıtrast var	ious types of inspection techniques				A	pplyii	ng (K3)							
CO4 disc	cuss the	robotic based inspection and identification techniques used in inc	dustry			Unde	erstai	nding (K2)							
CO5 app	D5     appraise the role of condition monitoring in factory automation     Applying (K3)														

	Mapping of COs with POs and PSOs														
COs/POs	P01	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	
CO1	3	1			3							2	3	3	
CO2	3	1			3							2	3	3	
CO3	CO3         3         1         3         2         3         3														
CO4	CO4         3         1         3         2         3         3														
CO5	CO5         3         1         3         2         3         3														
1 – Slight, 2	– Mode	erate, 3 –	Substanti	al, BT-	Bloom's	Taxono	my								
					ASSES	SMENT	PATTE	RN – T	HEOR	(					
Test / BI Categ	oom's ory*	Re	memberi (K1) %	ng	Understa (K2)	anding %	Apply (K3)	ving %	Analyz (K4) 9	ing l %	Evaluating (K5) %	g C	reating (K6) %	Total %	
CAT	1		40		60	)								100	
CAT	2		20		50		30	)						100	
CAT	3		20		50		30	)						100	
ESI	Ε		20		50	)	30	)						100	
* ±3% may l	oe varie	d (CAT 1	,2,3 – 50	marks	& ESE –	100 ma	rks)	·							

### 22MEJ01 - 3D MODELING AND PROTOTYPING

Progra Branci	nme & h	BE . & Mechanical Engineering	Sem.	Category	L	т	Ρ	Credit
Prereq	uisites	Machine Drawing Laboratory	5/6/7	HN	3	0	2	4
		· · · · · · · · · · · · · · · · · · ·			1		1	
Pream	ble	This course emphasizes the strategic modeling consideration guidelines for material design considerations, part consolidat modules available in CAD packages are also dealt in this cour printing files are covered. Practical classes are also included to	ns requin tion and rse. The o have ha	red for 3D pr computation theory, optio ands on expe	inting al to ns a rienc	g. It ols. nd f œ.	also The 3 The for	details the 3D printing mats of 3D
Unit –		Introduction to 3D Design for Prototyping:						9
Introdu Design Optimiz	ction - Using to Avoid An zation of Latti	prototype to Add Value to Products - General Guidelines for E isotropy - Economics of AM - Design to Minimize Print Time - D ice Structures.	Designin Design to	g Additive Ma Minimize Po	anufa st-pr	ictu oce	ring (A ssing	AM) Parts - - Topology
Unit –		Design for Plastic Prototyping:						9
Genera Suppor Print O Conner	al design gui rt Material - F prientation - S ctions – Vario	delines - Designing for Material Extrusion: Material Extrusion A Fill Style - Other Considerations – Various Feature Types. Design Support Material – Overhangs – Isotropy - Hollowing Parts and R bus Feature Types.	Accuracy ning for ` Resin Re	v and Tolerar Vat Photopoly moval – Deta	ices /mer iils -	- L izat Hor	ayer 1 ion: F izonta	Thickness - Resolution - Il Bridges –
Unit –		Design for Metal Prototyping:						9
Design Topolo up a M	ing for Metal gy Optimizat etal AM Print	Powder Bed Fusion - Metal Powder Production - Powder Mor ion - Lattice Structures - Overhangs and Support Material - Res Job - Design for Laser Powder Bed Fusion and Electron Beam N	phology sidual St Velting.	- Metal AM ress - Stress	Mate Con	rial cen	Chara tratior	acteristics - ns - Setting
Unit –	IV	Computational Tools and Part Consolidation:						9
Compu Optimis Guideli /Desigr	itational Tool sation - Parar nes for Part n For Assemb	s: Aims of Using Design Analysis - Special Considerations for metric or Size Optimisation. Consolidation: Design for Function - Material Considerations - bly(DFA) - Assembly Considerations.	Analysis Conven	s – Meshing tional Design	- Bo For	und Ma	ary C Inufac	onditions – ture (DFM)
Unit –	V	Software related to Rapid Prototyping:						9
Introdu Prototy and Ide	ction - The pe File Type eamaker soft	Stereolithography (STL) File - Problems with STL Files - ST as – Other file formats – Prototyping modules in CAD packages ware and its features.	L File M s (Solidw	lanipulation - orks and Cre	Bey eo) -	/ond Intr	d the oducti	STL File - on to Cura
		ENTS / EXERCISES						
1.	Modeling a	nd 3D printing of a tea cup.						
2.	Modeling a	nd 3D printing of a mechanical component.						
3.	Modeling a	nd 3D printing of a functional mechanical assembly.				_		
4.	Modeling a	nd 3D printing of an innovate component/structure.						
5.	Creating sk	in surface for simple scanned components for 3D printing.						
6.	Perform co	mplex surface for 3D printing design.						
7.	Modeling a	nd 3D printing for style components.						
8.	Analysis of	3D printed components through mechanical testing.						
	-	· · · · · · ·		Lecture:4	5, P	ract	ical:3	0, Total:75
ΤΕΧΤ Ι	BOOKS:							
1.	Olaf Diegel Nature, Sin	, Axel Nordin, Damien Motte, "A Practical Guide to Design for Ad- gapore, 2019 for Units –I, II, III and IV.	ditive Ma	anufacturing"	1 <sup>st</sup> E	ditic	on, Sp	ringer
2.	lan Gibson, Manufactur	David W. Rosen and Brent Stucker, "Additive Manufacturing Tec ing", 2 <sup>nd</sup> Edition, Springer, USA, 2015 for Unit – V.	chnologi	es: Rapid Pro	totyp	oing	to Dir	ect Digital

REFER	RENCI	ES/ MA	NUAL /	SOFTWA	RE:													
1.	Sam 2015	uel N. E i.	Bernier, I	BertierLuy	t, Tatian	a Reinh	ard, "Ma	ake: De	sign for	3D Prir	nting", 1 <sup>st</sup>	Edition, N	laker Meo	dia Inc, Ca	nada,			
2.	Andr Editi	eas Ge on, Har	bhardt, ' ser Pub	Understar lisher, Gei	nding Ad rmany, 2	ditive M 2011.	anufact	uring: F	Rapid Pr	ototypir	ng, Rapid	l Tooling, I	Rapid Ma	nufacturin	g", 1 <sup>st</sup>			
3.	Crec	7.0, S	olidWork	s 2018, C	ATIA V5	R12, Uli	imaker	Cura 4.:	3.									
COUR On co	SE OL npleti	JTCOM on of t	ES: he cours	se, the stu	udents	will be a	ble to						(	BT Mapp Highest L	oed evel)			
CO1	reco	gnize th	ne variou	s principle	es in des	ign for a	dditive	manufa	cturing				Und	lerstanding	g (K2)			
CO2	choc	se suita	able desi	gn for pol	ymer AN	Λ							Арр	Applying (K3)				
CO3	seled	ct the co	orrect de	sign for m	etal AM								Арр					
CO4	desc	ribe the	e comput	ational too	ols for cl	necking <i>i</i>	AM des	igns an	d guidel	ines for	part con	solidation	Und	lerstanding	g (K2)			
CO5	deve	lop pro	per CAD	model an	nd STL fi	le for pe	rformin	g 3D pri	nting				Арр	lying (K3)				
CO6	perfo	orm 3D	modeling	g and 3D p	orinting	of a mec	hanical	compo	nent				App Mar	lying (K3), hipulation (	S2)			
CO7	perfo	orm 3D	modeling	g and 3D p	orinting	of a func	tional m	nechani	cal com	ponent			Арр	lying (K3),				
CO8	anal	yze a 3	D printed	l object as	s per des	sign guid	elines						App Pree	lying (K3), cision (S3)				
						Mapping	g of CO	s with	POs an	d PSOs	3							
COs/F	Os	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2			

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	3	3										1	2
CO2	1	3	3										1	2
CO3	1	3	3										1	2
CO4	1	3	3		2								1	3
CO5	1	3	3		3								3	2
CO6		3	2	1	3								3	2
CO7		3	2	1	3								3	2
CO8		3	2	1	3								3	2
1 – Slight, 2	– Mode	erate, 3 –	Substant	al, BT- I	Bloom's	Taxono	my							

ASSESSMENT PATTERN – THEORY													
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %						
CAT1	20	40	40	-	-	-	100						
CAT2	20	40	40	-	-	-	100						
CAT3	20	30	50	-	-	-	100						
ESE	20	40	40	-	-	-	100						
* 20/ may be varied (	CAT 1 2 2 EO mort		dia)										

\* ±3% may be varied (CAT 1,2,3 - 50 marks & ESE - 100 marks)

22MEH03 – SMART MANUFACTURING TRANSFORMATION															
Progra	mme &	B F & Mechanical Engineering	Sem	Category	1	т	Р	Credit							
Branch	) Visitos	Manufacturing Technology	-	•	•	3									
riereq	uisites		J	U	U	5									
Pream	ble	This course details the application concepts of smart manufacturing in various manufacturing sectors outlines the importance of smart additive manufacturing for a sustainable future.													
Unit –	I	Introduction to Manufacturing 4.X:						9							
Introduction to Manufacturing 4.x for Smart Digital Manufacturing: From Industry 4.0 to Manufacturing 4.x - The Framev Manufacturing 4.x - The Manufacturing 4.x Roadmap - Finding the Tipping Points.															
Unit –	II	Manufacturing 4.x for Specific Approaches:													
Manufacturing 4.x for Repetitive Operations - Manufacturing 4.x for Process Industries - Manufacturing 4.x for Con Manufacturing - Manufacturing 4.x for Small and Medium Businesses, Cloud Adoption.															
Unit –	111	Big Data Analytics in Semiconductor Manufacturing:						9							
Semiconductor Manufacturing - The Big Data Revolution and Associated Challenges - Analytics Approaches in Semicondu Manufacturing - Next Generation Fault Detection and Classification - Predictive Maintenance - Big Data Architectures - Emerge of Artificial Intelligence and Other Big Data-Friendly Analytics - Realizing the Complete Smart Manufacturing, Vision.															
Unit –	IV	Cyber Physical System Integrated Smart Manufacturing Wor	rkshop	s:				9							
Construction of Cyber-Physical System–Integrated Smart Manufacturing Workshops- Framework of Smart Manufacturing Workshops - Maturity Model for Smart Manufacturing Workshop - A case study in Automotive Industry - Maturity Assessment – Case study Inferences.															
Unit –	V	Sustainable and Smart Additive Manufacturing:						9							
Introduction to Sustainable and Smart Additive Manufacturing (SSAM) - Additive Manufacturing and its Qualification - Sustainability and Additive Manufacturing - Big Data Analytics Framework for SSAM - Key Technologies for Big Data analytics SSAM - Benefits of SSAM - Managerial Implications - Case study scenario.															
TEXT E	BOOK:														
1.	René Wolf a Across Indu	nd Raffaello Lepratti, "Smart Digital Manufacturing: A Guide for D stries" 1 <sup>st</sup> Edition, Wiley-VCH, Germany, 2020.	Digital T	ransformatio	n wi	h Re	al Cas	se Studies							
REFER	ENCES:														
1.	Masoud So	roush, McKetta Michael Baldea, Thomas Edgar, "Smart Manufa ited Kingdom, 2020	acturing	Concepts a	nd	Metho	ods" 1	I <sup>st</sup> Edition,							
2.	Feitao, Men 2019.	g Zhang, A.Y.C. Nee, "Digital Twin Smart Manufacturing", 1 <sup>st</sup> E	Edition,	Academic P	ress	, Uni	ted K	ingdom,							
COURS On cor	SE OUTCOM	ES: ne course, the students will be able to				B (Hig	T Ma ghest	pped Level)							
CO1	discuss the	concepts of Manufacturing 4.x				Unde	rstan	ding (K2)							
CO2	select desire	ed approach during implementation of Manufacturing 4.x				Unde	erstan	ding (K2)							
CO3	implement tl	ne application of big data analytics in manufacturing sector				Ap	oplyin	g (K3)							
CO4	apply the co	ncepts of cyber-physical system-integrated smart manufacturing	worksh	ops		Ap	oplyin	g (K3)							
CO5	infer the imp	ortance of smart additive manufacturing				Unde	rstan	ding (K2)							

					Mappin	g of CO	s with	POs ar	nd PSOs	5				
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1			1								2	3
CO2	2	1			1								2	3
CO3	3	2	1		1								2	3
CO4	3	2	1		1								2	3
CO5	2	1			1								2	3
1 – Slight, 2	– Mode	erate, 3 –	Substanti	al, BT-	Bloom's	Taxono	my							
					ASSES	SMENT	PATTE	ERN - T	HEORY	,				
Test / Bl Categ	oom's ory*	Re	memberi (K1) %	ng l	Jndersta (K2)	anding %	Apply (K3)	ying %	Analyz (K4) 9	ing %	Evaluating (K5) %	) C	reating (K6) %	Total %
CAT	1		40		60		-		-		-		-	100
CAT	2		30		45		25		-		-		-	100
CAT	3		30		45		25	5	-		-		-	100
ESI	E		20		50		30	)	-		-		-	100
* +3% may b	be varie	d (CAT 1	.2.3 – 50	marks 8	& ESE -	100 ma	rks)			·		·		÷

	22MEH04 – INDUSTRIAL IOT													
				1										
Programme & Branch	B.E. & Mechanical Engineering	Sem.	Category	L	Т	Ρ	Credit							
Prerequisites	Nil	5/6/7	HN	3	1	0	4							
Preamble	Imble         The course will provide a thorough understanding of the components used in Industrial Internet of Things (IIOT) and information communication systems utilized in manufacturing plants.													
Unit – I	IIOT and Cloud Computing:						9+3							
Introduction, Physical Design of IOT - Logical Design of IOT - IOT Enabling Technologies - Domain Specific IOTs, IOT Design Methodology - IOT Physical Devices: Raspberry Pi, pcDuino, Beaglebone Black, Cubieboard. Introduction to Cloud Computing: Cloud Models, Cloud based Services and Applications, Cloud Service and Platforms.														
Unit – II	Machine to Machine Communication and Technologies:						9+3							
Introduction to M2M, Description of M2M Market, Segments/Applications – Automotive, Smart Telemetry, Surveillance and Security - M2M Industrial Automation - M2M Terminals and Modules. Communication Protocols: IEEE 802.15.4, ZigBee, Z Wave, Bluetooth, Bluetooth Low Energy (BLE), Near Field Communication (NFC), Radio Frequency Identification (RFID) Industry Standards Communication Technology: LoRAWAN, Open Platform Communication (OPC) Unified Architecture, Message Queuing Telemetry Transport (MQTT). Connecting into Existing Modbus and Profibus Technology - Wireless Network Communication.         Unit – III       IIoT Components:       9+3         Mechatronics Applications and Trends - Sensors and Transducers - Signal Conditioning - Mechanical Components - Software       Software														
Development - Pneu	matic and Hydraulic Actuators – Microcontrollers - Basic Closed	I-Loop Co	ontrol.				0.2							
Unit – IV	Information Systems in Manufacturing:						9+3							
Manufacturing Organizations and Management - Networked Enterprises - Globalization Challenges and Opportunities - Dimensions of Information Systems - Approaches to Study Information System - Technical and Behavioural Approach - Information Technology Infrastructure.														
Unit – V	Applications of IIOT:						9+3							
Smart Metering - e- Real Life examples of	Health Body Area Networks - City Automation - Energy Applicator of IIOT in Manufacturing Sector.	ations - I	Home Autom	atior	1 - R	etail -	Industry -							
			Lecture:	45, -	Tutor	ial:15	, Total:60							
TEXTS BOOKS:														
1. A. Bahga a Limited, Hyd	nd V. Madisetti, "Cloud Computing, A hands-on approach", Jerabad, 2014 for Unit I.	1 <sup>st</sup> Editio	on, Universiti	es F	Press	(Indi	a) Private							
2. D. Boswa 1 <sup>st</sup> Edition, V	arthick, O. Elloumi, and O. Hersent, "M2M Co Viley, 2012 for Unit II.	ommunic	ations: A	Sy	stem	s A	Approach",							
3. A. Bahga a Limited, Hyd	nd V. Madisetti, "Internet of Things: A hands-on approach", derabad, 2016 for Units I, II and V.	1 <sup>st</sup> Editi	on, Universit	ies I	Press	(Indi	a) Private							
4. J. Edward C for Unit III.	Carryer, Matthew Ohline, Thomas Kenny, "Introduction to Mecha	atronic D	esign", 1 <sup>st</sup> Ec	lition	, Pre	ntice	Hall, 2010							
REFERENCES:														
1. A. Suresh, I Use Cases"	Malarvizhi Nandagopal, Pethuru Raj, E. A. Neeba, Jenn-Wei Lin, 1 <sup>st</sup> Edition, Auerbach Publications, 2020.	n, "Indus	trial IoT Appl	icati	on Ai	chited	ctures and							

COUR: On cor	SE O mplet	UTCON	IES: the cou	rse, the st	uden	ts will be a	able to							BT Mapp (Highest L	oed .evel)		
CO1	describe an IOT system with cloud infrastructure												U	Understanding (K2)			
CO2	explain the M2M Communication protocols in a prototype													Understanding (K2)			
CO3	present the basic concepts of the sensors used in electromechanical systems Understanding													ng (K2)			
CO4	dem	onstrat	e the sy	stem inforr	natior	n in manuf	acturing	units					U	Understanding (K2)			
CO5	perf	orm the	case st	udy on Ind	lustria	I IOT appl	ications							Applying	(K3)		
Mapping of COs with POs and PSOs																	
COs/F	POs	PO1	PO2	PO3	PO	4 PO5	PO6	P07	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2		
CO	1	2	1	1		3					1			3	3		
CO	2	2	1	1		3					1			3	3		
CO	3	2	1	1		3					1			3	3		
CO	4	2	1	1		3					1			3	3		
CO	5	3	2	2		3					1			3	3		
1 – Slię	ght, 2	– Mode	erate, 3	- Substant	ial, B	T- Bloom's	Taxono	my				P					
						ASSES	SMENT	PATTE	ERN - 1	THEORY	,						
Tes C	t / Blo atego	oom's ory*	R	ememberi (K1) %	ng	Understa (K2)	anding %	Applying (K3) %		Analyzing E (K4) %		Evaluating (K5) %		Creating (K6) %	Total %		
	CAT	1		35		65									100		
	CAT	2		35		65									100		
	CAT	3		20		50		30	)						100		
	ESE	Ξ		30		55		15	5						100		
* 00/			I COAT	1 0 0 50								-	-		-		

\*  $\pm$ 3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)