KONGU ENGINEERING COLLEGE

(Autonomous Institution Affiliated to Anna University, Chennai)

PERUNDURAI ERODE – 638 060

TAMILNADU INDIA

Estd : 1984

REGULATIONS, CURRICULUM & SYLLABI – 2022

(CHOICE BASED CREDIT SYSTEM AND
OUTCOME BASED EDUCATION)

(For the students admitted during 2022 - 2023 and onwards)

BACHELOR OF ENGINEERING DEGREE
IN
ELECTRONICS AND INSTRUMENTATION ENGINEERING

DEPARTMENT OF ELECTRONICS AND INSTRUMENTATION ENGINEERING

Assuring the Best

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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 ELECTRONICS AND INSTRUMENTATION ENGINEERING	
VISION	
To become a technically competent centre in the domain of Electronics and Instrumentation Engineering to take care of the national and international needs.	
MISSION	
Department of Electronics and Instrumentation Engineering is committed to:	
MS1:	To develop innovative, competent, efficient, disciplined and quality Electronics and Instrumentation Engineers.
MS2:	To produce engineers who can participate in technical advancement and social upliftment of the country.
MS3:	To excel in academic and research activities by facilitating the students to explore the state- of – the –art techniques to meet the industrial needs

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

Graduates of Electronics and Instrumentation Engineering will

PEO1:	Excel in professional career and higher education using their fundamental knowledge in mathematical and engineering principles
PEO2:	Analyse, design, develop and maintain the instrumentation systems of an industry and also offer solutions that are technically feasible, economically viable and socially relevant.
PEO3:	Exhibit Professional and Ethical code of conduct, communication skills, team work and lifelong learning to resolve societal issues

MAPPING OF MISSION STATEMENTS (MS) WITH PEOs

MS\PEO	PEO1	PEO2	PEO3
MS1	3	3	2
MS2	3	3	2
MS3	2	2	2

1 – Slight, 2 – Moderate, 3 – Substantial

PROGRAM OUTCOMES (POs)	
Graduates of Automobile Engineering will**:**	
PO1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	**Design/development of solutions:** 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	**Conduct investigations of complex problems:** 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	**Modern tool usage:** 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	**The engineer and society:** 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	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	**Communication:** 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	**Project management and finance:** 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	**Life-long learning:** 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)

Graduates of Electronics and Instrumentation Engineering will**:**

PSO1	**Development and Automation:** Develop an industrial instrumentation system and provide automation by using modern automation tools.
PSO2	**Entrepreneurship:** Become an entrepreneur by inculcating the skills of project management and finance with the knowledge of instrumentation technology.

MAPPING OF PEOs WITH POs AND PSOs

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

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
BE	Civil Engineering
	Mechanical Engineering
	Electronics and Communication Engineering
	Computer Science and Engineering
	Electrical and Electronics Engineering
	Electronics and Instrumentation Engineering
	Mechatronics Engineering
	Automobile Engineering
	Computer Science and Design
BTech	Chemical Engineering
	Information Technology
	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.

(OR)

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.

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

S.No	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

*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	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 decided based on the credit weightage assigned	---
7.	All other Courses		

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.	Type	Max. Marks	Remarks
1.	Test - I	20	Average of best 2 tests (20 marks)
	Test - II	20	
	Test - III	20	
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 - Voce (Max. 30 Marks)		
Rv. Com	Super visor	Review Committee (excluding supervisor)	Supervisor	Review Committee (excluding supervisor)	Super visor	Ext. Exr.	Supervisor	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.

<table>
<tr><th colspan="9">Continuous Assessment
(Max. 100 Marks)</th></tr>
<tr><th colspan="2" rowspan="2">Zeroth Review</th><th colspan="2" rowspan="2">Review I
(Max.. 20 Marks)</th><th colspan="2" rowspan="2">Review II
ax.. 30 Marks)</th><th colspan="3">Review III
(Max. 50 Marks)</th></tr>
<tr><th>Report Evaluation (Max. 20 Marks)</th><th colspan="2">Viva - Voce
(Max. 30 Marks)</th></tr>
<tr><th>Review Committee</th><th>Supervisor</th><th>Review Committee (excluding supervisor)</th><th>Supervisor</th><th>Review Committee (excluding supervisor)</th><th>Supervisor</th><th>Review Committee</th><th>Supervisor</th><th>Review Committee</th></tr>
<tr><td>0</td><td>0</td><td>10</td><td>10</td><td>15</td><td>15</td><td>20</td><td>10</td><td>20</td></tr>
</table>

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 3rd semester vacation and during 4th semester. Phase II training shall be conducted for minimum of 80 hours in 4th semester vacation and during 5th 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 / Twe 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 course.

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
Based on the relative grading	O (Outstanding)	10
	A+ (Excellent)	9
	A (Very Good)	8
	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:

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

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

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

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										
Category	**Semester**								**Total number of credits**	**Curriculum Content (% of total number of credits of the program)**
	I	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**		
HS	**4**	**4**	**2**			**2**	**3**		**15**	**8.93**
BS	**8**	**8**	**4**						**20**	**11.91**
ES	**8**	**8**	**4**	**4**					**24**	**14.29**
PC	**3**	**4**	**16**	**12**	**15**	**8**			**58**	**34.52**
PE					**3**	**3**	**9**	**3**	**18**	**10.71**
OE					**4**	**4**	**3**	**3**	**14**	**8.33**
EC				**2**	**2**	**6**	**5**	**4**	**19**	**11.31**
MC									**0**	**0**
Semester wise Total	**23**	**24**	**26**	**18**	**24**	**23**	**20**	**11**	**168**	**100.00**

Category	Abbreviation
Lecture hours per week	**L**
Tutorial hours per week	**T**
Practical, Project work, Internship, Professional Skill Training, Industrial Training hours per week	**P**
Credits	**C**

CATEGORISATION OF COURSES							
HUMANITIES AND SOCIAL SCIENCE INCLUDING MANAGEMENT (HS)							
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Sem**
1.	22EGT11	Communication Skills - I	3	0	0	3	I
2.	22VEC11	Yoga and Values for Holistic Development	1	0	1	1	I
3.	22EGT21	Communication Skills - II	3	0	0	3	II
4.	22TAM01	Heritage of Tamils	1	0	0	1	II
5.	22TAM02	Tamils and Technology	1	0	0	1	III
6.	22EGL31	Communication Skills Development Laboratory	0	0	2	1	III
7.	22GET31	Universal Human Values	2	0	0	2	VI
8.	22GCT71	Engineering Economics and Management	3	0	0	3	VII
Total Credits to be earned						**15**	

BASIC SCIENCE (BS)							
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Sem**
1.	22MAC11	Matrices and Ordinary Differential Equations	3	1	2	4	I
2.	22PHT16	Physics for Electronics and Instrumentation Engineering	3	0	0	3	I
3.	22PHL16	Physics Laboratory for Electronics And Instrumentation Engineering	0	0	2	1	I
4.	22MAC21	Multivariable Calculus and Complex Analysis	3	1	2	4	II
5.	22CYT25	Chemistry for Electronics and Instrumentation Engineering	3	0	0	3	II
6.	22CYL11	Chemistry Laboratory for Electrical Systems	0	0	2	1	II
7.	22MAT42	Transforms and Partial Differential Equations	3	1	0	4	IV
		Total Credits to be earned				**20**	

ENGINEERING SCIENCE (ES)							
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Sem**
1.	22CSC11	Problem Solving and Programming in C	3	0	2	4	I
2.	22MET11	Engineering Drawing	3	0	0	3	I
3.	22MEL11	Engineering Practices Laboratory	0	0	2	1	I
4.	22CSC22	Data Structures using C	3	0	2	4	II
5.	22EIT22	Electrical Machines	3	0	0	3	II
6.	22EIL21	Devices and Machines Laboratory	0	0	2	1	II
7.	22ITC31	Java Programming	3	0	2	4	III
8.	22ITC41	Programming in Python	3	0	2	4	IV
		Total Credits to be earned				**24**	

EMPLOYABILITY ENHANCEMENT COURSES (EC)							
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Sem**
1.	22GEL41	Professional Skills Training - I	--	--	--	2	IV
2.	22GEL51	Professional Skills Training II	--	--	--	2	V
3.	22EIP61	Project Work I	0	0	8	4	VI
4.	22GEP61	Comprehensive Test and Viva	--	--	--	2	VI
5.	22EIP71	Project Work II Phase - I	0	0	10	5	VII
6.	22EIP81	Project Work II Phase - II	0	0	8	4	VIII
		Total Credits to be earned				**19**	

MANDATORY COURSES (MC)							
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Sem**
1.	22MNT11	Student Induction Program	--	--	--	0	I
2.	22MNT31	Environmental Science	2	0	0	0	III
Total Credits to be earned						**00**	

PROFESSIONAL CORE (PC)								
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Sem**	**Domain/ Stream**
1.	22EIT11	Electron Devices and Circuits	3	0	0	3	I	EL
2.	22EIC21	Electric Circuit Analysis	3	0	2	4	II	EL
3.	22EIT31	Transducers Engineering	3	0	0	3	III	IN
4.	22EIT32	Analog Integrated Circuits	3	0	0	3	III	EL
5.	22EIT33	Digital Logic Circuits	3	1	0	4	III	EL
6.	22EIT34	Electrical Measurements and Instrumentation	3	1	0	4	III	EL
7.	22EIL31	Transducers and Measurements Laboratory	0	0	2	1	III	IN
8.	22EIL32	Analog and Digital Integrated Circuits Laboratory	0	0	2	1	III	EL
9.	22EIT41	Microcontroller and its Applications	3	0	0	3	IV	EL
10.	22EIT42	Control Systems	3	1	0	4	IV	EL
11	22EIT43	Industrial Instrumentation I	3	0	0	3	IV	IN
12.	22EIL41	Microcontroller and Interfacing Laboratory	0	0	2	1	IV	EL
13.	22EIL42	Instrumentation Design and Control Systems Laboratory	0	0	2	1	IV	EL
14.	22EIT51	Industrial Instrumentation - II	3	0	0	3	V	IN
15.	22EIT52	Process Control	3	0	0	3	V	IN
17.	22EIT53	Digital Signal Processing	3	1	0	4	V	EL
18.	22EIT54	VLSI Systems	3	0	0	3	V	EL
19.	22EIL51	Industrial Instrumentation Laboratory	0	0	2	1	V	IN
20.	22EIL52	Process Control Laboratory	0	0	2	1	V	IN
21.	22EIT61	Industrial Automation using PLC, SCADA and DCS	3	0	0	3	VI	IN
22.	22EIT62	Industry 4.0 with Industrial IoT	3	0	0	3	VI	IN
23.	22EIL61	PLC and DCS Laboratory	0	0	2	1	VI	IN
24	22EIL62	Virtual Instrumentation and Industrial IoT Laboratory	0	0	2	1	VI	IN
Total Credits to be earned						**58**		

PROFESSIONAL ELECTIVES (PEs)							
S. No.	Course Code	Course Name	L	T	P	C	Domain/ Stream
Semester - V							
Elective – I							
1.	22EIE01	Biomedical Instrumentation	3	0	0	3	AI
2.	22EIE02	Instrumentation System Design	3	0	0	3	EEA
3.	22EIE03	Soft Computing Techniques	3	0	0	3	EEA
4.	22EIE04	Analytical Instrumentation	3	0	0	3	AI
5.	22EIE05	Industrial Electronics and Drives	3	0	0	3	EL
6.	22EIE06	Advanced Control Techniques	3	0	0	3	CS
Semester - VI							
Elective – II							
7.	22EIE07	SCADA and its Applications	3	0	0	3	EEA
8.	22EIE08	Virtual Instrumentation	3	0	0	3	AI
9.	22EIE09	Digital Image Processing	3	0	0	3	EEA
10.	22EIE10	Power Plant Instrumentation	3	0	0	3	IA
11.	22EIE11	Embedded Systems	3	0	0	3	AE
12.	22EIE12	Control System Components	3	0	0	3	CS
Semester - VII							
Elective - III							
13.	22EIE13	Fiber Optics and Laser Instruments	3	0	0	3	AI
14.	22EIE14	Wireless Instrumentation	3	0	0	3	AE
15.	22EIE15	Instrumentation Techniques in Agriculture	3	0	0	3	IA
16.	22EIE16	Safety in Process Industries	3	0	0	3	AI
17.	22EIE17	Instrumentation and Control in Process Industries	3	0	0	3	IA
18.	22EIE18	Total Quality Management	3	0	0	3	GE
Elective – IV							
19.	22EIE19	Instrumentation in Aircraft Navigation and Control	3	0	0	3	IA

20.	22EIE20	Industrial Data Communication	3	0	0	3	AI
21.	22EIE21	MEMS and Nano Technology	3	0	0	3	AE
22.	22EIE22	Optimal and Adaptive Control	3	0	0	3	CS
23.	22EIE23	Wearable Technology	3	0	0	3	AE
24.	22GEE01	Fundamentals of Research	3	0	0	3	GE
Elective – V							
25.	22EIE24	Instrumentation in Building Automation	3	0	0	3	IA
26.	22EIE25	Electronic Instrumentation	3	0	0	3	AL
27.	22EIE26	Piping and Instrumentation Diagrams	3	0	0	3	IA
28.	22EIE27	Machine Learning and its Applications	3	0	0	3	EEA
29.	22EIE28	Model Predictive Control	3	0	0	3	CS
30.	22EIE29	Multi Sensor Data Fusion	3	0	0	3	EEA
Semester - VIII							
Elective - VI							
31.	22EIE30	Diagnostic and Therapeutic Instruments	3	0	0	3	AI
32.	22EIE31	Instrumentation and Control in Paper Industries	3	0	0	3	IA
33.	22EIE32	Instrumentation and Control in Petro Chemical Industries	3	0	0	3	IA
34.	22EIE33	VHDL Programming and Its Applications	3	0	0	3	AE
35.	22EIE34	Computer Control of Processes	3	0	0	3	CS
36.	22EIE35	Digital Twins	3	0	0	3	EL
Total Credits to be earned						18	

***** Domain/Stream Abbreviations: IN-Instrumentation, EL-Electronics, AI-Applied Instrumentation, AE-Applied Electronics and Industry 4.0, EEA-Experimental Engineering and Analysis, IA-Industry Automation, CS-Control Systems, GE – General Engineering.

OPEN ELECTIVE COURSES OFFERED TO OTHER DEPARTMENTS (OEs)							
S. No.	Course Code	Course Name	L	T	P	C	Sem
1.	22EIO01	Measurements and Instrumentation	3	1	0	4	V
2.	22EIO02	Biomedical Instrumentation and Applications	3	1	0	4	V
3.	22EIO03	Industrial Automation	3	1	0	4	V
4.	22EIO04	PLC Programming with High Level Languages	3	1	0	4	VI
5.	22EIO05	Virtual Instrumentation	3	1	0	4	VI
6.	22EIO06	Introduction to Distributed Control Systems	3	0	0	3	VII
7.	22EIO07	Instrumentation in Aircraft Navigation and Control	3	0	0	3	VII
8.	22EIO08	Industry 4.0 with Industrial IoT	3	0	0	3	VII
9.	22EIO09	Industrial Data Communication	3	0	0	3	VII
10.	22EIO10	Wireless Instrumentation	3	0	0	3	VII
11.	22EIO11	Instrumentation Techniques in Agriculture	3	0	0	3	VII
12.	22EIO12	Environmental Sensors	3	0	0	3	VIII
13.	22EIO13	Pollution Control and Management	3	0	0	3	VIII

OPEN ELECTIVE COURSES OFFERED BY OTHER DEPARTMENTS (OE)							
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**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 Design	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
45.	22MEX02	Design of Experiments	3	0	2	4	MECH
46.	22MTO02	Robotics	3	1	0	4	MTS
47.	22MTO03	3D Printing and Design	3	1	0	4	MTS
48.	22AUO01	Automotive Electronics	3	1	0	4	ECE
49.	22ECX03	PCB Design and Fabrication	3	0	2	4	ECE

50.	22EEO07	Energy Conservation and Management	3	1	0	4	EEE
51.	22EEO08	Microprocessors and Microcontrollers Interfacing	3	1	0	4	EEE
52.	22EEO09	Electrical Safety	3	1	0	4	EEE
53.	22EEO10	VLSI System Design	3	1	0	4	EEE
54.	22EEO11	Automation for Industrial Applications	3	1	0	4	EEE
55.	22EIO04	PLC Programming with High Level Languages	3	1	0	4	EIE
56.	22EIO05	Virtual Instrumentation	3	1	0	4	EIE
57.	22CSX04	Foundations of Machine Learning	3	0	2	4	CSE
58.	22CSX05	Web Engineering	3	0	2	4	CSE
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
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	T	P	C	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
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 (Electronics and Instrumentation Engineering) Total Credits: 168

Sem	Course1	Course2	Course3	Course4	Course5	Course6	Course7	Course8	Course9	Course10	CH
I	22EGT11 Communication Skills – I (3-0-0-3)	22MAC11 Matrices and Ordinary Differential Equations (3-1-2-4)	22PHT16 Physics for Electronics and Instrumentation Engineering (3-0-0-3)	22EIT11 Electron Devices and Circuits (3-0-0-3)	22CSC11 Problem Solving and Programming in C (3-0-2-4)	22MET11 Engineering Drawing (2-1-0-3)	22PHL16 Physics Laboratory for Electronics and Instrumentation Engineering (0-0-2-1)	22MEL11 Engineering Practices Laboratory (0-0-2-1)	22VEC11 Yoga and Values for Holistic Development (1-0-1-1)	22MNT11 Student Induction Program (0-0-0-0)	23
II	22EGT21 Communication Skills - II (3-0-0-3)	22MAC21 Multivariable Calculus and Complex Analysis (3-1-2-4)	22CYT25 Chemistry for Electronics And Instrumentation Engineering (3-0-0-3)	22EIC21 Electric Circuit Analysis (3-0-2-4)	22CSC22 Data Structures using C (3-0-2-4)	22EIT21 Electrical Machines (3-0-0-3)	22TAM01 Heritage of Tamils (1-0-0-1)	22CYL11 Chemistry Laboratory for Electrical Systems (0-0-2-1)	22EIL21 Devices and Machines Laboratory (0-0-2-1)		24
III	22ITC31 Java Programming (3-0-2-4)	22EIT31 Transducers Engineering (3-0-0-3)	22EIT32 Analog Integrated Circuits (3-0-0-3)	22EIT33 Digital Logic Circuits (3-1-0-4)	22EIT34 Electrical Measurements and Instrumentation (3-1-0-4)	22MNT31 Environmental Science (2-0-0-0)	22TAM02 Tamils and Technology (1-0-0-1)	22EIL31 Transducers and Measurements Laboratory (0-0-2-1)	22EIL32 Analog and Digital Integrated Circuits Laboratory (0-0-2-1)	22EGL31 Communication Skills Development Laboratory (0-0-2-1)	22
IV	22MAT42 Transforms and Partial Differential Equations (3-1-0-4)	22ITC41 Programming in Python (3-0-2-4)	22EIT41 Microcontroller and its Applications (3-0-0-3)	22EIT42 Control Systems (3-1-0-4)	22EIT43 Industrial Instrumentation I (3-0-0-3)	22EIL41 Microcontroller and Interfacing Laboratory (0-0-2-1)	22EIL42 Instrumentation Design and Control Systems Laboratory (0-0-2-1)	22GEL41 Professional Skills Training I (0-0-0-2)			22
V	22EIT51 Industrial Instrumentation- II (3-0-0-3)	22EIT52 Process Control (3-0-0-3)	22EIT53 Digital Signal Processing (3-1-0-4)	22EIT54 VLSI Systems (3-0-0-3)	Professional Elective - I (3-0-0-3)	Open Elective – I (3-1-0-4)/ (3-0-2-4)	22EIL51 Industrial Instrumentation Laboratory (0-0-2-1)	22EIL52 Process Control Laboratory (0-0-2-1)	22GEL51 Professional Skills Training II (0-0-0-2)		24
VI	22EIT61 Industrial Automation using PLC,SCADA and DCS (3-0-0-3)	22EIT62 Industry 4.0 with Industrial IoT (3-0-0-3)	Professional Elective - II (3-0-0-3)	Open Elective – II (3-1-0-4)/ (3-0-2-4)	22EIL61 PLC and DCS Laboratory (0-0-2-1)	22EIL62 Virtual Instrumentatio n and Industrial IoT Laboratory (0-0-2-1)	22EIP61 Project Work I (0-0-8-4)	22GET31 Universal Human Values (2-0-0-2)	22GEP61 Comprehensive Test and Viva (0-0-0-2)		23
VII	22GCT71 Engineering 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)	22EIP71 Project Work II Phase I (0-0-10-5)					20
VIII	Professional Elective - VI (3-0-0-3)	Open Elective - IV (3-0-0-3)	22EIP81 Project Work II Phase II (0-0-8-4)								10

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
1	22EGT11	Communication Skills - I						✓			✓	✓	✓	✓		
1	22MAC11	Matrices and Ordinary Differential Equations	✓	✓	✓		✓									
1	22PHT16	Physics for Electronics and Instrumentation Engineering	✓	✓	✓						✓	✓		✓	✓	
1	22EIT11	Electron Devices and Circuits	✓	✓	✓	✓	✓								✓	✓
1	22CSC11	Problem Solving and Programming in C	✓	✓	✓	✓	✓				✓	✓		✓		
1	22MET11	Engineering Drawing	✓	✓	✓		✓					✓		✓		
1	22PHL16	Physics Laboratory for Electronics And Instrumentation Engineering	✓	✓	✓	✓					✓	✓		✓	✓	
1	22MEL11	Engineering Practices Laboratory	✓		✓	✓	✓	✓			✓	✓		✓	✓	✓
1	22VEC11	Yoga and Values for Holistic Development						✓		✓	✓					
2	22EGT21	Communication Skills - II						✓			✓	✓	✓	✓		
2	22MAC21	Multivariable Calculus and Complex Analysis	✓	✓	✓		✓									
2	22CYT25	Chemistry for Electronics And Instrumentation Engineering	✓	✓	✓	✓			✓						✓	✓
2	22EIC21	Electric Circuit Analysis	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓	✓
2	22CSC22	Data Structures using C	✓	✓	✓	✓										
2	22EIT21	Electrical Machines	✓	✓	✓	✓	✓								✓	✓
2	22TAM01	Heritage of Tamils						✓		✓	✓	✓		✓		
2	22CYL11	Chemistry Laboratory for Electrical Systems	✓	✓	✓	✓			✓							
2	22EIL21	Devices and Machines Laboratory	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓	✓
3	22ITC31	Java Programming	✓	✓	✓	✓										
3	22EIT31	Transducer Engineering	✓	✓	✓	✓	✓			✓				✓	✓	✓
3	22EIT32	Analog Integrated Circuits	✓	✓	✓	✓	✓								✓	✓
3	22EIT33	Digital Logic Circuits	✓	✓	✓	✓	✓								✓	✓
3	22EIT34	Electrical Measurements and Instrumentation	✓	✓	✓	✓	✓								✓	✓
3	22MNT31	Environmental Science	✓	✓	✓				✓							
3	22TAM02	Tamils and Technology						✓		✓	✓	✓		✓		

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
3	22EIL31	Transducers and Measurements Laboratory	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓	✓
3	22EIL32	Analog and Digital Integrated Circuits Laboratory	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓	✓
3	22EGL31	Communication Skills Development Laboratory									✓	✓		✓		
4	22MAT42	Transforms and Partial Differential Equations	✓	✓	✓										✓	
4	22ITC41	Python Programming	✓	✓	✓	✓										
4	22EIT41	Microcontroller and its Applications	✓	✓	✓	✓	✓					✓		✓	✓	✓
4	22EIT42	Control Systems	✓	✓	✓	✓	✓			✓		✓		✓	✓	✓
4	22EIT43	Industrial Instrumentation I	✓	✓	✓	✓	✓			✓				✓	✓	✓
4	22EIL41	Microcontroller and Interfacing Laboratory	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓	✓
4	22EIL42	Instrumentation Design and Control Systems Laboratory	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓	✓
4	22GEL41	Professional Skills Training I	✓	✓				✓	✓		✓	✓	✓	✓		
5	22EIT51	Industrial Instrumentation- II	✓	✓	✓	✓	✓			✓				✓	✓	✓
5	22EIT52	Process Control	✓	✓	✓	✓	✓			✓				✓	✓	✓
5	22EIT53	Digital Signal Processing	✓	✓	✓	✓	✓					✓		✓	✓	✓
5	22EIT54	VLSI Systems	✓	✓	✓	✓	✓					✓			✓	✓
5	22EIL51	Industrial Instrumentation Laboratory	✓	✓	✓	✓	✓	✓	✓		✓	✓			✓	✓
5	22EIL52	Process Control Laboratory	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓	✓
5	22GEL51	Professional Skills Training II	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
6	22EIT61	Industrial Automation using PLC,SCADA and DCS	✓	✓	✓	✓	✓			✓		✓			✓	✓
6	22EIT62	Industry 4.0 with Industrial IoT	✓	✓	✓	✓	✓			✓					✓	✓
6	22EIL61	PLC and DCS Laboratory	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓	✓
6	22EIL62	Virtual Instrumentation and Industrial IoT Laboratory	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓	✓
6	22EIP61	Project Work I	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
6	22GET31	Universal Human Values	✓	✓	✓	✓										
6	22GEP61	Comprehensive Test and Viva	✓	✓	✓	✓					✓	✓	✓	✓	✓	✓

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
7	22GCT71	Engineering Economics and Management	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓		
7	22EIP71	Project Work II Phase I	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
8	22EIP81	Project Work II Phase II	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Professional Elective Courses														
5	22EIE01	Biomedical Instrumentation	✓	✓	✓	✓	✓	✓		✓					✓	✓
5	22EIE02	Instrumentation System Design	✓	✓	✓	✓	✓								✓	✓
5	22EIE03	Soft Computing Techniques	✓	✓	✓	✓	✓								✓	✓
5	22EI E04	Analytical Instrumentation	✓	✓	✓	✓	✓								✓	✓
5	22EIE05	Industrial Electronics and Drives	✓	✓	✓	✓	✓								✓	✓
5	22EIE06	Advanced Control Techniques	✓	✓	✓	✓	✓					✓			✓	✓
6	22EIE07	SCADA and its Applications	✓	✓	✓	✓	✓								✓	✓
6	22EIE08	Virtual Instrumentation	✓	✓	✓	✓	✓								✓	✓
6	22EIE09	Digital Image Processing	✓	✓	✓	✓	✓			✓		✓			✓	✓
6	22EIE10	Power Plant Instrumentation	✓	✓	✓	✓	✓		✓			✓			✓	✓
6	22EIE11	Embedded Systems	✓	✓	✓	✓	✓			✓		✓			✓	✓
6	22EIE12	Control System Components	✓	✓	✓	✓	✓					✓			✓	✓
7	22EIE13	Fiber Optics and Laser Instruments	✓	✓	✓	✓	✓								✓	✓
7	22EIE14	Wireless Instrumentation	✓	✓	✓	✓	✓								✓	✓
7	22EIE15	Instrumentation Techniques in Agriculture	✓	✓	✓	✓	✓								✓	✓
7	22EIE16	Safety in Process Industries	✓	✓	✓	✓	✓	✓		✓					✓	✓
7	22EIE17	Instrumentation and Control in Process Industries	✓	✓	✓	✓	✓								✓	✓
7	22EIE18	Total Quality Management	✓	✓				✓						✓		✓
7	22EIE19	Instrumentation in Aircraft Navigation and Control	✓	✓	✓	✓	✓								✓	✓
7	22EIE20	Industrial Data Communication	✓	✓	✓	✓	✓	✓							✓	✓

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
7	22EIE21	MEMS and Nano Technology	✓	✓	✓	✓	✓								✓	✓
7	22EIE22	Optimal and Adaptive Control	✓	✓	✓	✓	✓								✓	✓
7	22EIE23	Wearable Technology	✓	✓	✓	✓	✓								✓	✓
7	22GEE02	Fundamentals of Research	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
7	22EIE24	Instrumentation in Building Automation	✓	✓	✓	✓	✓			✓		✓			✓	✓
7	22EIE25	Electronic Instrumentation	✓	✓	✓	✓	✓			✓					✓	✓
7	22EIE26	Piping and Instrumentation Diagrams	✓	✓	✓	✓	✓			✓		✓			✓	✓
7	22EIE27	Machine Learning and its Applications	✓	✓	✓	✓	✓								✓	✓
7	22EIE28	Model Predictive Control	✓	✓	✓	✓	✓								✓	✓
7	22EIE29	Multi Sensor Data Fusion	✓	✓	✓	✓	✓			✓		✓			✓	✓
8	22EIE30	Diagnostic and Therapeutic Instruments	✓	✓	✓	✓	✓	✓							✓	✓
8	22EIE31	Instrumentation and Control in Paper Industries	✓	✓	✓	✓	✓			✓		✓			✓	✓
8	22EIE32	Instrumentation and Control in Petro Chemical Industries	✓	✓	✓	✓	✓								✓	✓
8	22EIE33	VHDL Programming and Its Applications	✓	✓	✓	✓	✓					✓			✓	✓
8	22EIE34	Computer Control of Processes	✓	✓	✓	✓	✓								✓	✓
8	22EIE35	Digital Twins	✓	✓	✓	✓	✓		✓	✓	✓		✓		✓	✓
		Open Elective Courses														
5	22EIO01	Measurements and Instrumentation	✓	✓	✓	✓	✓								✓	✓
5	22EIO02	Biomedical Instrumentation and Applications	✓	✓	✓	✓	✓	✓		✓					✓	✓
5	22EIO03	Industrial Automation	✓	✓	✓	✓	✓								✓	✓
6	22EIO04	PLC Programming with High Level Languages	✓	✓	✓	✓	✓								✓	✓
6	22EIO05	Virtual Instrumentation	✓	✓	✓	✓	✓								✓	✓

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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	✓	✓	✓	✓	✓								✓	✓
8	22EIO12	Environmental Sensors	✓	✓	✓	✓	✓		✓						✓	✓
8	22EIO13	Pollution Control and Management	✓	✓	✓	✓	✓	✓		✓					✓	✓

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	✓	✓	✓	✓	✓				✓	✓		✓		
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	✓	✓	✓	✓	✓							✓		
5	22EEO05	Power Electronics and Drives	✓	✓	✓	✓	✓	✓			✓					
5	22EEO06	Sensors and Actuators	✓	✓	✓			✓						✓		
5	22EIO01	Measurements and Instrumentation	✓	✓	✓	✓	✓									
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	✓	✓	✓	✓	✓				✓	✓	✓			

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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	✓	✓	✓	✓										
5	22CYO02	Chemistry Concepts for Competitive Examinations	✓	✓	✓											
5	22CYO03	Organic Chemistry for Industry	✓	✓	✓	✓										
5	22MBO01	Cost Accounting for Engineers										✓	✓	✓		
6	22CEO01	Disaster Management	✓	✓	✓			✓	✓					✓		
6	22MEX02	Design of Experiments	✓	✓	✓	✓	✓				✓					
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	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
6	22EEO07	Energy Conservation and Management	✓	✓	✓		✓		✓	✓	✓			✓		
6	22EEO08	Microprocessors and Microcontrollers Interfacing	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓		
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	✓	✓	✓											
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	✓	✓	✓		✓	✓		✓	✓	✓		✓		
6	22FTX03	Processing of Fruits and Vegetables	✓	✓	✓		✓	✓		✓	✓	✓		✓		
6	22MAO05	Graph Theory and its Applications	✓	✓	✓											
6	22MAX01	Data Analytics using R Programming	✓	✓	✓	✓	✓									
6	22MAO06	Operations Research	✓	✓	✓											

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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	✓	✓			✓		✓					✓		
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	✓	✓	✓	✓	✓									

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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	✓	✓	✓											
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	✓		✓			✓	✓	✓						

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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	✓	✓					✓	✓	✓			✓		
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	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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. - ELECTRONICS AND INSTRUMENTATION ENGINEERING CURRICULUM – R2022
(For the students admitted in the academic year 2022-23 onwards)

SEMESTER – I									
Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
		L	T	P		CA	ESE	Total	
Theory/Theory 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
22PHT16	Physics for Electronics and Instrumentation Engineering	3	0	0	3	40	60	100	BS
22EIT11	Electron Devices and Circuits	3	0	0	3	40	60	100	PC
22CSC11	Problem Solving and Programming in C	3	0	2	4	50	50	100	ES
22MET11	Engineering Drawing	2	1	0	3	40	60	100	ES
Practical / Employability Enhancement									
22PHL16	Physics Laboratory for Electronics And Instrumentation Engineering	0	0	2	1	60	40	100	BS
22MEL11	Engineering Practices Laboratory	0	0	2	1	60	40	100	ES
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				

SEMESTER – II									
Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
		L	T	P		CA	ESE	Total	
Theory/Theory 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
22CYT25	Chemistry for Electronics and Instrumentation Engineering	3	0	0	3	40	60	100	BS
22EIC21	Electric Circuit Analysis	3	0	2	4	50	50	100	PC
22CSC22	Data Structures using C	3	0	2	4	50	50	100	ES
22EIT21	Electrical Machines	3	0	0	3	40	60	100	ES
22TAM01	Heritage of Tamils	1	0	0	1	100	0	100	HS
Practical / Employability Enhancement									
22CYL11	Chemistry Laboratory for Electrical Systems	0	0	2	1	60	40	100	BS
22EIL21	Devices and Machines Laboratory	0	0	2	1	60	40	100	ES
Total Credits to be earned					24				

B.E. - ELECTRONICS AND INSTRUMENTATION ENGINEERING CURRICULUM – R2022
(For the students admitted in the academic year 2022-23 onwards)

SEMESTER – III									
Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
		L	T	P		CA	ESE	Total	
Theory/Theory with Practical									
22ITC31	Java Programming	3	0	2	4	50	50	100	ES
22EIT31	Transducers Engineering	3	0	0	3	40	60	100	PC
22EIT32	Analog Integrated Circuits	3	0	0	3	40	60	100	PC
22EIT33	Digital Logic Circuits	3	1	0	4	40	60	100	PC
22EIT34	Electrical Measurements and Instrumentation	3	1	0	4	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 / Employability Enhancement									
22EIL31	Transducers and Measurements Laboratory	0	0	2	1	60	40	100	PC
22EIL32	Analog and Digital Integrated Circuits 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 Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
		L	T	P		CA	ESE	Total	
Theory/Theory with Practical									
22MAT42	Transforms and Partial Differential Equations	3	1	0	4	40	60	100	BS
22ITC41	Programming in Python	3	0	2	4	50	50	100	ES
22EIT41	Microcontroller and its Applications	3	0	0	3	40	60	100	PC
22EIT42	Control Systems	3	1	0	4	40	60	100	PC
22EIT43	Industrial Instrumentation I	3	0	0	3	40	60	100	PC
Practical / Employability Enhancement									
22EIL41	Microcontroller and Interfacing Laboratory	0	0	2	1	60	40	100	PC
22EIL42	Instrumentation Design and Control Systems Laboratory	0	0	2	1	60	40	100	PC
22GEL41	Professional Skills Training - I	--	--	--	2	100	0	100	EC
Total Credits to be earned					22				

B.E. - ELECTRONICS AND INSTRUMENTATION ENGINEERING CURRICULUM – R2022
(For the students admitted in the academic year 2022-23 onwards)

SEMESTER – V									
Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
		L	T	P		CA	ESE	Total	
Theory/Theory with Practical									
22EIT51	Industrial Instrumentation - II	3	0	0	3	40	60	100	PC
22EIT52	Process Control	3	0	0	3	40	60	100	PC
22EIT53	Digital Signal Processing	3	1	0	4	40	60	100	PC
22EIT54	VLSI Systems	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									
22EIL51	Industrial Instrumentation Laboratory	0	0	2	1	60	40	100	PC
22EIL52	Process Control Laboratory	0	0	2	1	60	40	100	PC
22GCL51	Professional Skills Training II	--	--	--	2	100	0	100	EC
Total Credits to be earned					24				

SEMESTER – VI									
Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
		L	T	P		CA	ESE	Total	
Theory/Theory with Practical									
22EIT61	Industrial Automation using PLC, SCADA and DCS	3	0	0	3	40	60	100	PC
22EIT62	Industry 4.0 with Industrial IoT	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									
22EIL61	PLC and DCS Laboratory	0	0	2	1	60	40	100	PC
22EIL62	Virtual Instrumentation and Industrial IoT Laboratory	0	0	2	1	60	40	100	PC
22EIP61	Project Work I	0	0	8	4	50	50	100	EC
22GET31	Universal Human Values	2	0	0	2	100	0	100	HS
22GEP61	Comprehensive Test and Viva	--	--	--	2	100	0	100	EC
Total Credits to be earned					23				

B.E. - ELECTRONICS AND INSTRUMENTATION ENGINEERING CURRICULUM – R2022
(For the students admitted in the academic year 2022-23 onwards)

SEMESTER – VII									
Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
		L	T	P		CA	ESE	Total	
Theory/Theory with Practical									
22GCT71	Engineering Economics and Management	3	0	0	3	40	60	100	HS
	Professional Elective – III	3	0	0	3	40	60	100	PE
	Professional Elective – IV	3	0	0	3	40	60	100	PE
	Professional Elective – V	3	0	0	3	40	60	100	PE
	Open Elective – III	3	0	0	3	40	60	100	OE
Practical / Employability Enhancement									
22EIP71	Project Work II Phase - I	0	0	10	5	50	50	100	EC
Total Credits to be earned					20				

SEMESTER – VIII									
Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
		L	T	P		CA	ESE	Total	
Theory/Theory 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									
22EIP81	Project Work II Phase - II	0	0	8	4	50	50	100	EC
Total Credits to be earned					10				

Total Credits: 168

B.E. - ELECTRONICS AND INSTRUMENTATION ENGINEERING CURRICULUM – R2022
(For the students admitted in the academic year 2022-23 onwards)

LIST OF PROFESSIONAL ELECTIVES (PEs)

S. No.	Course Code	Course Name	L	T	P	C	Domain/ Stream
Semester - V							
Elective – I							
1.	22EIE01	Biomedical Instrumentation	3	0	0	3	AI
2.	22EIE02	Instrumentation System Design	3	0	0	3	EEA
3.	22EIE03	Soft Computing Techniques	3	0	0	3	EEA
4.	22EIE04	Analytical Instrumentation	3	0	0	3	AI
5.	22EIE05	Industrial Electronics and Drives	3	0	0	3	EL
6.	22EIE06	Advanced Control Techniques	3	0	0	3	CS
Semester - VI							
Elective – II							
7.	22EIE07	SCADA and its Applications	3	0	0	3	EEA
8.	22EIE08	Virtual Instrumentation	3	0	0	3	AI
9.	22EIE09	Digital Image Processing	3	0	0	3	EEA
10.	22EIE10	Power Plant Instrumentation	3	0	0	3	IA
11.	22EIE11	Embedded Systems	3	0	0	3	AE
12.	22EIE12	Control System Components	3	0	0	3	CS
Semester - VII							
Elective - III							
13.	22EIE13	Fiber Optics and Laser Instruments	3	0	0	3	AI
14.	22EIE14	Wireless Instrumentation	3	0	0	3	AE
15.	22EIE15	Instrumentation Techniques in Agriculture	3	0	0	3	IA
16.	22EIE16	Safety in Process Industries	3	0	0	3	AI
17.	22EIE17	Instrumentation and Control in Process Industries	3	0	0	3	IA
18.	22GEE02	Total Quality Management	3	0	0	3	GE

Elective – IV							
19.	22EIE18	Instrumentation in Aircraft Navigation and Control	3	0	0	3	IA
20.	22EIE19	Industrial Data Communication	3	0	0	3	AI
21.	22EIE20	MEMS and Nano Technology	3	0	0	3	AE
22.	22EIE21	Optimal and Adaptive Control	3	0	0	3	CS
23.	22EIE22	Wearable Technology	3	0	0	3	AE
24.	22GEE01	Fundamentals of Research	3	0	0	3	GE
Elective – V							
25.	22EIE23	Instrumentation in Building Automation	3	0	0	3	IA
26.	22EIE24	Electronic Instrumentation	3	0	0	3	AL
27.	22EIE25	Piping and Instrumentation Diagrams	3	0	0	3	IA
28.	22EIE26	Machine Learning and its Applications	3	0	0	3	EEA
29.	22EIE27	Model Predictive Control	3	0	0	3	CS
30.	22EIE28	Multi Sensor Data Fusion	3	0	0	3	EEA
Semester - VIII							
Elective - VI							
31.	22EIE29	Diagnostic and Therapeutic Instruments	3	0	0	3	AI
32.	22EIE30	Instrumentation and Control in Paper Industries	3	0	0	3	IA
33.	22EIE31	Instrumentation and Control in Petro Chemical Industries	3	0	0	3	IA
34.	22EIE32	VHDL Programming and Its Applications	3	0	0	3	AE
35.	22EIE33	Computer Control of Processes	3	0	0	3	CS
36.	22EIE34	Digital Twins	3	0	0	3	EL
Total Credits to be earned						18	

* Domain/Stream Abbreviations: IN-Instrumentation, EL-Electronics, AI-Applied Instrumentation, AE-Applied Electronics and Industry 4.0, EEA-Experimental Engineering and Analysis, IA-Industry Automation, CS-Control Systems, GE – General Engineering.

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

SEMESTER – I

Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
		L	T	P		CA	ESE	Total	
Theory/Theory with Practical									
22EGT11	Communication Skills - I	3	0	0	3	40	60	100	HS
22MAC11	Matrices and Ordinary Differential Equations	3	0	2	4	50	50	100	BS
22PHT16	Physics for Electronics and Instrumentation Engineering	3	0	0	3	40	60	100	BS
22CSC11	Problem Solving and Programming in C	3	0	2	4	50	50	100	ES
22MET11	Engineering Drawing	2	1	0	3	40	60	100	ES
22TAM01	Heritage of Tamils	1	0	0	1	100	0	100	HS
Practical / Employability Enhancement									
22PHL16	Physics Laboratory for Electronics and Instrumentation Engineering	0	0	2	1	60	40	100	BS
22GCL12	Foundation Engineering Laboratory – II	0	0	6	3	100	0	100	ES
22VEC11	Yoga and Values for Holistic Education	--	--	--	1	100	0	100	HS
22MNT11	Student Induction Program	---	---	---	0	100	0	100	MC
Total Credits to be earned					**23**				

SEMESTER – II

Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
		L	T	P		CA	ESE	Total	
Theory/Theory with Practical									
22EGT21	Communication Skills - II	3	0	0	3	40	60	100	HS
22MAC21	Multivariable Calculus and Complex Analysis	3	0	2	4	50	50	100	BS
22CYT25	Chemistry for Electronics And Instrumentation Engineering	3	0	0	3	40	60	100	BS
22CSC22	Data Structures using C	3	0	2	4	50	50	100	ES
22EIT11	Electron Devices and Circuits	3	0	0	3	40	60	100	PC
22TAM02	Tamils and Technology	1	0	0	1	100	0	100	HS
Practical / Employability Enhancement									
22CYL11	Chemistry Laboratory for Electrical Systems	0	0	2	1	60	40	100	BS
22GCL11	Foundation Engineering Laboratory – I	0	0	6	3	100	0	100	ES
Total Credits to be earned					**22**				

B.E. - ELECTRONICS AND INSTRUMENTATION ENGINEERING CURRICULUM – R2022
(For the students admitted in the academic year 2023-24 onwards)

SEMESTER – III									
Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
		L	T	P		CA	ESE	Total	
Theory/Theory with Practical									
22ITC31	Java Programming	3	0	2	4	50	50	100	ES
22EIT36	Sensors and Transducers	3	0	0	3	40	60	100	PC
22EIC31	Networks, Signals and Systems	3	0	2	4	50	50	100	PC
22EIT33	Digital Logic Circuits	3	1	0	4	40	60	100	PC
22EIT37	Electrical and Electronic Measurements and Instrumentation	3	0	0	3	40	60	100	PC
Practical / Employability Enhancement									
22EIL31	Transducers and Measurements Laboratory	0	0	2	1	60	40	100	PC
22EIL33	Devices and Circuits Laboratory	0	0	2	1	60	40	100	PC
22MNT31	Environmental Science	2	0	0	0	100	0	100	MC
22EGL31	Communication Skills Development Laboratory	0	0	2	1	60	40	100	HS
Total Credits to be earned					**21**				

SEMESTER – IV									
Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
		L	T	P		CA	ESE	Total	
Theory/Theory with Practical									
22MAT42	Transforms and Partial Differential Equations	3	1	0	4	50	50	100	BS
22ITC41	Programming in Python	3	0	2	4	50	50	100	ES
22EIC41	Linear Control Systems	3	0	2	4	50	50	100	PC
22EIT32	Analog Integrated Circuits	3	0	0	3	40	60	100	PC
22EIT44	Industrial Instrumentation	3	0	0	3	40	60	100	PC
Practical / Employability Enhancement									
22EIL32	Analog and Digital Integrated Circuits Laboratory	0	0	2	1	60	40	100	PC
22EIL51	Industrial Instrumentation Laboratory	0	0	2	1	60	40	100	PC
22GEL41	Professional Skills Training I	--	--	--	2	100	0	100	EC
Total Credits to be earned					**22**				

B.E. - ELECTRONICS AND INSTRUMENTATION ENGINEERING CURRICULUM – R2022
(For the students admitted in the academic year 2023-24 onwards)

SEMESTER – V									
Course Code	**Course Title**	**Hours / Week**			**Credit**	**Maximum Marks**			**Category**
		L	**T**	**P**		**CA**	**ESE**	**Total**	
Theory/Theory with Practical									
22EIT55	Industrial Process Control	3	1	0	4	40	60	100	PC
22EIT56	Microprocessor and Microcontroller	3	1	0	4	40	60	100	PC
22EIT21	Electrical Machines	3	0	0	3	40	60	100	PC
22EIT54	VLSI Design	3	0	0	3	40	60	100	PC
	Professional Elective – I	3	0	0	3	40	60	100	PE
	Open Elective – I	3	0/1	2/0	4	50/ 40	50/ 60	100	OE
Practical / Employability Enhancement									
22EIL53	Process Control and Machines Laboratory	0	0	2	1	60	40	100	PC
22EIL41	Microcontroller and Interfacing Laboratory	0	0	2	1	60	40	100	PC
22GCL51	Professional Skills Training II	--	--	--	2	100	0	100	EC
Total Credits to be earned					**25**				

SEMESTER – VI									
Course Code	**Course Title**	**Hours / Week**			**Credit**	**Maximum Marks**			**Category**
		L	**T**	**P**		**CA**	**ESE**	**Total**	
Theory/Theory with Practical									
22EIT61	Industrial Automation using PLC, SCADA and DCS	3	0	0	3	40	60	100	PC
22EIT62	Industry 4.0 with Industrial IoT	3	0	0	3	40	60	100	PC
	Professional Elective – II	3	0	0	3	40	60	100	PE
	Open Elective – II	3	0/1	2/0	4	40	60	100	OE
Practical / Employability Enhancement									
22EIL61	PLC and DCS Laboratory	0	0	2	1	60	40	100	PC
22EIL62	Virtual Instrumentation and Industrial IoT Laboratory	0	0	2	1	60	40	100	PC
22EIP62	Project Work I	0	0	10	5	50	50	100	EC
22GET31	Universal Human Values	2	0	0	2	100	0	100	HS
22GEP61	Comprehensive Test and Viva	---	---	---	2	100	0	100	EC
Total Credits to be earned					**24**				

B.E. - ELECTRONICS AND INSTRUMENTATION ENGINEERING CURRICULUM – R2022
(For the students admitted in the academic year 2023-24 onwards)

SEMESTER – VII									
Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
		L	T	P		CA	ESE	Total	
Theory/Theory with Practical									
22GCT71	Engineering Economics and Management	3	0	0	3	40	60	100	HS
22EIT71	Digital Signal Processing and its Applications	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									
22EIP72	Project Work II Phase I	0	0	12	6	50	50	100	EC
Total Credits to be earned					**21**				

SEMESTER – VIII									
Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
		L	T	P		CA	ESE	Total	
Theory/Theory 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									
22EIP81	Project Work II Phase II	---	---	8	4	50	50	100	EC
Total Credits to be earned					**10**				

Total Credits: 168

B.E. - ELECTRONICS AND INSTRUMENTATION ENGINEERING CURRICULUM – R2022
(For the students admitted in the academic year 2023-24 onwards)

LIST OF PROFESSIONAL ELECTIVES (PEs)							
S. No.	Course Code	Course Name	L	T	P	C	Domain/ Stream
Semester - V							
Elective – I							
1.	22EIE01	Biomedical Instrumentation	3	0	0	3	AI
2.	22EIE02	Instrumentation System Design	3	0	0	3	EEA
3.	22EIE03	Soft Computing Techniques	3	0	0	3	EEA
4.	22EIE04	Analytical Instrumentation	3	0	0	3	AI
5.	22EIE05	Industrial Electronics and Drives	3	0	0	3	EL
6.	22EIE06	Advanced Control Techniques	3	0	0	3	CS
Semester - VI							
Elective – II							
7.	22EIE07	SCADA and its Applications	3	0	0	3	EEA
8.	22EIE08	Virtual Instrumentation	3	0	0	3	AI
9.	22EIE09	Digital Image Processing	3	0	0	3	EEA
10.	22EIE10	Power Plant Instrumentation	3	0	0	3	IA
11.	22EIE11	Embedded Systems	3	0	0	3	AE
12.	22EIE12	Control System Components	3	0	0	3	CS
Semester - VII							
Elective - III							
13.	22EIE13	Fiber Optics and Laser Instruments	3	0	0	3	AI
14.	22EIE14	Wireless Instrumentation	3	0	0	3	AE
15.	22EIE15	Instrumentation Techniques in Agriculture	3	0	0	3	IA
16.	22EIE16	Safety in Process Industries	3	0	0	3	AI
17.	22EIE17	Instrumentation and Control in Process Industries	3	0	0	3	IA

18.	22GEE02	Total Quality Management	3	0	0	3	GE
Elective – IV							
19.	22EIE18	Instrumentation in Aircraft Navigation and Control	3	0	0	3	IA
20.	22EIE19	Industrial Data Communication	3	0	0	3	AI
21.	22EIE20	MEMS and Nano Technology	3	0	0	3	AE
22.	22EIE21	Optimal and Adaptive Control	3	0	0	3	CS
23.	22EIE22	Wearable Technology	3	0	0	3	AE
24.	22GEE01	Fundamentals of Research	3	0	0	3	GE
25.	22EIE23	Instrumentation in Building Automation	3	0	0	3	IA
26.	22EIE24	Electronic Instrumentation	3	0	0	3	AL
27.	22EIE25	Piping and Instrumentation Diagrams	3	0	0	3	IA
28.	22EIE26	Machine Learning and its Applications	3	0	0	3	EEA
29.	22EIE27	Model Predictive Control	3	0	0	3	CS
30.	22EIE28	Multi Sensor Data Fusion	3	0	0	3	EEA
Semester - VIII							
Elective - VI							
31.	22EIE29	Diagnostic and Therapeutic Instruments	3	0	0	3	AI
32.	22EIE30	Instrumentation and Control in Paper Industries	3	0	0	3	IA
33.	22EIE31	Instrumentation and Control in Petro Chemical Industries	3	0	0	3	IA
34.	22EIE32	VHDL Programming and Its Applications	3	0	0	3	AE
35.	22EIE33	Computer Control of Processes	3	0	0	3	CS
36.	22EIE34	Digital Twins	3	0	0	3	EL
Total Credits to be earned						18	

* Domain/Stream Abbreviations: IN-Instrumentation, EL-Electronics, AI-Applied Instrumentation, AE-Applied Electronics and Industry 4.0, EEA-Experimental Engineering and Analysis, IA-Industry Automation, CS-Control Systems, GE – General Engineering.

LIST OF OPEN ELECTIVE COURSES OFFERED TO OTHER DEPARTMENTS (OEs)							
S. No.	Course Code	Course Name	L	T	P	C	Sem
1.	22EIO01	Measurements and Instrumentation	3	1	0	4	V
2.	22EIO02	Biomedical Instrumentation and Applications	3	1	0	4	V
3.	22EIO03	Industrial Automation	3	1	0	4	V
4.	22EIO04	PLC Programming with High Level Languages	3	1	0	4	VI
5.	22EIO05	Virtual Instrumentation	3	1	0	4	VI
6.	22EIO06	Introduction to Distributed Control Systems	3	0	0	3	VII
7.	22EIO07	Instrumentation in Aircraft Navigation and Control	3	0	0	3	VII
8.	22EIO08	Industry 4.0 with Industrial IoT	3	0	0	3	VII
9.	22EIO09	Industrial Data Communication	3	0	0	3	VII
10.	22EIO10	Wireless Instrumentation	3	0	0	3	VII
11.	22EIO11	Instrumentation Techniques in Agriculture	3	0	0	3	VII
12.	22EIO12	Environmental Sensors	3	0	0	3	VIII
13.	22EIO13	Pollution Control and Management	3	0	0	3	VIII

<table>
<tr><td colspan="8">22EGT11 - COMMUNICATION SKILLS I</td></tr>
<tr><td colspan="8">(Common to All Engineering and Technology Branches)</td></tr>
<tr><td>Programme & Branch</td><td>All B.E./B.Tech. Branches</td><td>Sem.</td><td>Category</td><td>L</td><td>T</td><td>P</td><td>Credit</td></tr>
<tr><td>Prerequisites</td><td>Nil</td><td>I</td><td>HS</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td>Preamble</td><td colspan="7">This course is designed to impart required levels of Communication Skills and Proficiency in English language necessary for different professional contexts.</td></tr>
<tr><td>Unit – I</td><td colspan="5">Grammar, Vocabulary, Listening, Speaking, Reading & Writing</td><td colspan="2">9</td></tr>
<tr><td colspan="8">Grammar: Parts of speech - Tenses - Types of sentences: Assertive, Imperative, Interrogative & Exclamatory – Affirmative & Negative - Gerunds & Infinitives - Vocabulary: Affixes - Synonyms & Antonyms - Listening: Types of listening - Barriers to listening - Listening to short talks - TV shows - Speaking: Verbal & Non-verbal communication - Pair conversation - Role play - Reading: Types of Reading – Intensive: scanning, word by word, survey - Writing: Dialogue writing, Informal Letters - Paragraph writing</td></tr>
<tr><td>Unit – II</td><td colspan="5">Grammar, Vocabulary, Listening, Speaking, Reading & Writing</td><td colspan="2">9</td></tr>
<tr><td colspan="8">Grammar: Voices - Impersonal passives - Vocabulary: Homonyms, Homophones & Homographs - Listening: Importance of listening - Listening to announcements & radio broadcasts - Speaking: Persuasive & Impromptu talks - Narrating a story - Reading: Reading comprehension - Articles from Newspapers/Magazines - Cloze exercises - Writing: Essay writing, Jumbled sentences</td></tr>
<tr><td>Unit – III</td><td colspan="5">Grammar, Vocabulary, Listening, Speaking, Reading & Writing</td><td colspan="2">9</td></tr>
<tr><td colspan="8">Grammar: Prepositions - Vocabulary: Compound Nouns - Listening: Listening to TED Talks, Commentaries - Speaking: Self Introduction - Reading: Extensive: speed, skimming - Identifying lexical & contextual meanings - Writing: Instructions & Warnings - Formal letters: Seeking permission for Industrial visits & Inviting guests</td></tr>
<tr><td>Unit – IV</td><td colspan="5">Grammar, Vocabulary, Listening, Speaking, Reading & Writing</td><td colspan="2">9</td></tr>
<tr><td colspan="8">Grammar: Articles & Determiners - Vocabulary: Technical Vocabulary - Analogy - Unscrambling words - Logical reasoning - Listening: Listening to conversations - Speaking: Tongue twisters - Skill Sharing - Note-taking - Reading: Note making - Paraphrasing & Summarizing - Writing: Recommendations & Suggestions - Business letters: Enquiry, Calling for quotations & placing orders</td></tr>
<tr><td>Unit – V</td><td colspan="5">Grammar, Vocabulary, Listening, Speaking, Reading & Writing</td><td colspan="2">9</td></tr>
<tr><td colspan="8">Grammar: Cause and effect expressions - Vocabulary: Abbreviations & acronyms, Definitions Listening: Listening to eminent personalities - Speaking: Commonly mispronounced words - Welcome address, Chief guest address & Vote of thanks - Reading - IELTS type passages - Writing: Preparing transcript for a speech - Interpreting news articles & advertisements</td></tr>
<tr><td colspan="8" align="right">Total:45</td></tr>
<tr><td colspan="8">TEXT BOOK:</td></tr>
<tr><td>1.</td><td colspan="7">Sanjay Kumar & Pushp Lata, “Communication Skills”, 2nd Edition, Oxford University Press, New Delhi, 2018.</td></tr>
<tr><td colspan="8">REFERENCES:</td></tr>
<tr><td>1.</td><td colspan="7">Ashraf Rizvi, "Effective Technical Communication", 2nd Edition, McGraw-Hill India, 2017.</td></tr>
<tr><td>2.</td><td colspan="7">S. P. Dhanavel, "English and Communication Skills for Students of Science and Engineering", Orient BlackSwan Publishers, Hyderabad, 2009.</td></tr>
<tr><td>3.</td><td colspan="7">Jack C. Richards and Chuck Sandy, “Passages” Student’s Book 1, 3rd Edition, Cambridge University Press, New York, 2014.</td></tr>
<tr><td colspan="8"></td></tr>
</table>

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	use language effectively by acquiring vocabulary and syntax in context	Applying (K3)
CO2	listen and comprehend different spoken discourses from a variety of situations	Applying (K3)
CO3	speak confidently in different professional contexts and with peers	Creating (K6)
CO4	comprehend different genres of texts by adopting various reading strategies	Understanding (K2)
CO5	write legibly and flawlessly at varied professional contexts proficiently with appropriate choice of words and structures	Creating (K6)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						2			1	3	1	1
CO2									2	3		1
CO3									2	3		2
CO4						1				3	1	1
CO5										3		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		37	30			33	100
CAT2		30	30			40	100
CAT3		33	34			33	
ESE		17	63			20	100

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

22MAC11 - MATRICES AND ORDINARY DIFFERENTIAL EQUATIONS							
(Common to all Engineering and Technology branches)							
Programme & Branch	**All BE/BTech Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**1**	**BS**	**3**	**1***	**2***	**4**

Preamble	To provide the skills to the students for solving different real time problems by applying matrices and ordinary differential equations.	
Unit – I	**Matrices:**	**9**
Introduction **–** Characteristic equation – Eigen values and Eigen vectors of a real matrix – Properties of Eigen values and Eigen vectors (without proof) – Cayley – Hamilton theorem (Statement and applications only) - Orthogonal matrices – Orthogonal transformation of a symmetric matrix to diagonal form – Quadratic form – Nature of Quadratic forms - Reduction of quadratic form to canonical form by orthogonal transformation – Applications of Eigen values and Eigen vectors: Stretching of an elastic membrane.		
Unit – II	**Ordinary Differential Equations:**	**9**
Introduction – Solutions of First order differential equations: Exact differential equations – Leibnitz's Linear Equation – Bernoulli's equation –Clairaut's equation - Applications: Law of natural growth and decay.		
Unit – III	**Ordinary Differential Equations of Higher Order:**	**9**
Linear differential equations of second and higher order with constant coefficients - Particular Integrals for the types: e^{ax} – cosax / sinax – x^n – $e^{ax}x^n$, e^{ax} sinbx and e^{ax} cosbx – x^n sinax and x^n cosax – Differential Equations with variable coefficients: Euler-Cauchy's equation – Legendre's equation.		
Unit – IV	**Applications of Ordinary Differential Equations:**	**9**
Method of variation of parameters – Simultaneous first order linear equations with constant coefficients – Applications of differential equations: Simple harmonic motion – Electric circuits (Differential equations and associated conditions need to be given).		
Unit – V	**Laplace Transform:**	**9**
Laplace Transform: Conditions for existence – Transform of elementary functions – Basic properties – Derivatives and integrals of transforms –Transforms of derivatives and integrals – Transform of unit step function – Transform of periodic functions. Inverse Laplace transform: Inverse Laplace transform of elementary functions – Partial fraction method – Convolution theorem (Statement only) – Applications: Solution of linear ODE of second order with constant coefficients.		

LIST OF EXPERIMENTS / EXERCISES:

1.	Introduction to MATLAB
2.	Computation 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 Simultaneous first order ODEs
6.	Solving second order ODE by variation of parameters
7.	Determining Laplace and inverse Laplace transform of basic functions
8.	Solution of Second order ODE by employing Laplace transforms

Lecture:45, Tutorials and Practical:15, Total:60

TEXT BOOK:

1.	Ramana B V, "Higher Engineering Mathematics", 1st Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2018.

REFERENCES/ MANUAL / SOFTWARE:	
1.	Kreyszig E, "Advanced Engineering Mathematics ", 10th Edition, John Wiley, New Delhi, India, 2016.
2.	Kandasamy P., Thilagavathy K. and Gunavathy K., “Engineering Mathematics For First Year B.E/B.Tech”, Reprint Edition 2014, S.Chand and Co., New Delhi.
3.	Duraisamy C., Vengataasalam S., Arun Prakash K. and Suresh M., "Engineering Mathematics - I", 2nd Edition, Pearson India Education, New Delhi, 2018.
4.	Grewal B.S., “Higher Engineering Mathematics" 44thEdition, Khanna Publishers, New Delhi, 2018.
5.	MATLAB – Laboratory Manual

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	solve engineering problems which needs matrix computations.	Applying (K3)
CO2	identify the appropriate method for solving first order ordinary differential equations.	Applying (K3)
CO3	solve higher order linear differential equations with constant and variable coefficients.	Applying (K3)
CO4	apply the concept of ordinary differential equations for modeling and finding solutions to engineering problems.	Applying (K3)
CO5	apply Laplace Transform to find solutions of Linear Ordinary Differential Equations	Applying (K3)
CO6	understand the basics of MATLAB, solve ordinary differential equations and compute Laplace transforms using MATLAB.	Applying (K3), Manipulation (S2)

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	3	2											
CO2	3	3	2											
CO3	3	3	2											
CO4	3	3	2											
CO5	3	3	3											
CO6					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	10	20	70	-	-	-	100
CAT2	10	20	70	-	-	-	100
CAT3	10	20	70	-	-	-	100
ESE	10	20	70	-	-	-	100

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

***Alternate week**

22PHT16 – PHYSICS FOR ELECTRONICS AND INSTRUMENTATION ENGINEEERING							
Programme & Branch	**BE- Electronics & Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**1**	**BS**	**3**	**0**	**0**	**3**

Preamble	This course aims to impart the knowledge on oscillations and waves, acoustics, ultrasonics, quantum physics, conductors, superconductors, semiconductors and dielectrics. It also describes the applications of aforementioned topics in instrumentation engineering.	
Unit – I	**Oscillations and Waves:**	**9**
Periodic motion – Oscillations – Simple harmonic motion – Differential equation of simple harmonic motion – Forced oscillations – Damped oscillations – Application of simple harmonic motion in torsional pendulum, cantilever and LC circuit – Resonance – Waves – Equation of plane progressive wave – Types of progressive waves – Reflection and transmission of waves at a boundary (qualitative) – Energy transport of progressive waves.		
Unit – II	**Acoustics and Ultrasonics:**	**9**
Classification of sound – Characteristics of sound – Reverberation and reverberation time – Growth and decay of sound – Sabine's formula for reverberation time – Determination of sound absorption coefficient – Factors affecting acoustics of buildings and the remedies – Ultrasonics – Properties of ultrasonic waves – Generation of ultrasonic waves – Magnetostrictive generator and Piezoelectric generator – Non-destructive testing – Flaw detection.		
Unit – III	**Quantum physics:**	**9**
Blackbody radiation – Planck's theory – Compton scattering – Matter waves – Properties of matter waves – Heisenberg uncertainty principle (qualitative) – Schrodinger's time-independent and time-dependent wave equations – Physical significance of wave function – Particle in a one-dimensional box.		
Unit – IV	**Conducting and Superconducting materials:**	**9**
Classical free electron theory of metals – Electrical conductivity – Drawbacks of classical free electron theory – Quantum free electron theory (qualitative) – Fermi distribution function – Effect of temperature on Fermi function – Superconductivity – Temperature dependence of resistivity – Critical field – Meissner effect – Critical current – Persistent current – Isotope effect – Type-I superconductors and Type-II superconductors – Cryotron.		
Unit – V	**Semiconducting and Dielectric materials:**	**9**
Intrinsic semiconductor – Carrier concentration – Fermi level – Electrical conductivity and band gap – Extrinsic semiconductors (qualitative) – Dielectric constant – Types of polarization mechanisms: Electronic, ionic, orientational and space-charge – Dielectric loss – Dielectric breakdown – Applications of dielectric materials in capacitor.		
		Total:45

TEXT BOOK:

1.	Avadhanulu M.N., Kshirsagar P.G. and Arun Murthy T.V.S., "A Textbook of Engineering Physics", 11th Edition, S. Chand & Company Pvt. Ltd., New Delhi, 2019. (Units I,II,III,IV,V)

REFERENCES:

1.	Gaur R.K. and Gupta S.L., "Engineering Physics", 8th Edition, Dhanpat Rai and Sons, New Delhi, 2009.
2.	Charles Kittel, "Introduction to Solid State Physics", 8th Edition, John Wiley & Sons, New Jersey, 2004.
3.	Tamilarasan K. and Prabu K., "Materials Science", 1st Edition, McGraw Hill Education Pvt. Ltd., New Delhi, 2019.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	make use of the concepts of oscillatory and wave motion to comprehend the phenomena related to the propagation of elastic waves.	Applying (K3)
CO2	apply the concepts of growth and decay of sound energy in a hall to compute Sabine's formula and to recognize the requirements of acoustically good buildings and also to describe the production of ultrasonic wave and the testing materials by non-destructive method.	Applying (K3)
CO3	use the concepts of quantum mechanics to describe the behavior of electrons in a metal by solving Schrodinger's wave equations.	Applying (K3)
CO4	apply the concepts of classical and quantum free electron theory of metals to compute the electrical conductivity and to comprehend the effect of temperature on Fermi function and also to apply the concept of Cooper pair to comprehend the properties, types and application of superconductors.	Applying (K3)
CO5	use the concept of density of states to compute the carrier concentration, electrical conductivity, band gap of intrinsic semiconductor. To use concepts of electric polarization to comprehend the select polarization mechanisms in dielectrics and the related phenomena.	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	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	1	
CO5	3	2	2						2	2		2	1	

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	35	50				100
CAT2	15	35	50				100
CAT3	15	35	50				100
ESE	10	30	60				100

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

22EIT11 - ELECTRON DEVICES AND CIRCUITS							
Programme & Branch	**B.E. & Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**1/2**	**PC**	**3**	**0**	**0**	**3**

Preamble	Electron Devices and circuits deals with diodes and special diodes along with its applications. It also focus on BJT Biasing, working of FET, different types of amplifiers, feedback amplifiers and oscillators.

Unit – I	**Diode Applications and Special Devices:**	**9**
Semiconductors – PN junction Diode: Volt-Ampere Characteristics, Effect of temperature on Diode Characteristics, Applications: Clippers, Clampers and Voltage multipliers. Special Devices: Varactor diode – Tunnel diode – PIN diode - LCD – LDR - Surface Mount Devices – OLED.		
Unit – II	**BJT Biasing and Stabilization:**	**9**
Characteristics of BJT – Current gains in CB, CE and CC Configuration– Load line and Operating point - Thermal runaway – Stability and Stability Factor. Transistor Biasing: Fixed bias circuits and Voltage - divider bias – Hybrid model of CE configuration.		
Unit – III	**FET, MOSFET and UJT:**	**9**
Construction, Characteristics and Applications of JFET – JFET parameters – FET in CS, CD and CG configurations. MOSFET Types and its characteristics – UJT as relaxation oscillator.		
Unit – IV	**Differential Amplifier, Large Signal Amplifier and Tuned Amplifier:**	**9**
Differential amplifier using BJT – Differential and common mode gain, CMRR. Power Amplifiers: Class A, Class B Amplifier and Push Pull amplifier. Tuned amplifiers: Single Tuned Amplifier and Double Tuned Amplifier.		
Unit – V	**Feedback Amplifiers and Oscillators:**	**9**
Feedback amplifiers – Basic Concept of Feedback - Effects of negative feedback – Types of Negative Feedback Connections: Voltage / current, series/shunt feedback amplifiers. Oscillators: Classification of Oscillators - Conditions for Oscillation – RC oscillators and LC oscillators.		
		Total:45

TEXT BOOK:

1.	R.S.Sedha, “A Text Book of Applied Electronics”, Revised Second Edition, S Chand & Co Ltd, New Delhi, 2022

REFERENCES:

1.	Salivahanan, Suresh Kumar, “Electronic Devices and Circuits”, 4th Edition, Mc.Graw Hill Education (India) Private Limited, Bengaluru, 2017.
2.	Robert L. Boylestad, Louis Nashelsky, “Electronic Devices and Circuit Theory”, 11th Edition, Pearson New International Edition, New Delhi, 2015

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	describe the diode and special electronic devices for various applications	Understanding(K2)
CO2	determine the stability factor of BJT	Applying (K3)
CO3	illustrate the construction, operation and application of FET, MOSFET and UJT	Understanding (K2)
CO4	explain the construction and operation of differential, tuned and power amplifiers	Understanding (K2)
CO5	construct feedback and oscillator circuits using transistors	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	2											2	2
CO2	3	3	1	1	1								3	3
CO3	3	2											2	2
CO4	3	2											2	2
CO5	3	3	1	1	1								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	10	55	35	-	-	-	100
CAT2	10	55	35	-	-	-	100
CAT3	10	55	35	-	-	-	100
ESE	10	55	35	-	-	-	100

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

<table>
<tr><td colspan="8">22CSC11 - PROBLEM SOLVING AND PROGRAMMING IN C</td></tr>
<tr><td colspan="8">(Common to All Engineering and Technology branches except CSE, IT, CSD, AIDS & AIML)</td></tr>
<tr><td>Programme & Branch</td><td>All BE/BTech Engineering & Technology branches , except CSE, IT, CSD, AIDS & AIML</td><td>Sem.</td><td>Category</td><td>L</td><td>T</td><td>P</td><td>Credit</td></tr>
<tr><td>Prerequisites</td><td>Nil</td><td>1</td><td>ES</td><td>3</td><td>0</td><td>2</td><td>4</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td>Preamble</td><td colspan="7">The course aims to provide exposure to problem-solving through programming. It introduces all the fundamental concepts of C Programming. This course provides adequate knowledge to solve problems using C</td></tr>
<tr><td>Unit – I</td><td colspan="6">Introduction to C and Operators:</td><td>9</td></tr>
<tr><td colspan="8">The structure of a C program – Compiling and executing C program – C Tokens – Character set in C – Keywords – identifiers-Basic data Types – Variables – constants – Input / Output statements – Operators</td></tr>
<tr><td>Unit – II</td><td colspan="6">Control Statements and Arrays:</td><td>9</td></tr>
<tr><td colspan="8">Decision-making and looping statements, Arrays: Declaring, initializing and accessing arrays – operations on arrays – Two-dimensional arrays and their operations.</td></tr>
<tr><td>Unit – III</td><td colspan="6">Functions:</td><td>9</td></tr>
<tr><td colspan="8">Functions: Introduction- Using functions, function declaration and definition – function call – return statement – passing parameters to functions: basic data types and arrays – storage classes – recursive functions</td></tr>
<tr><td>Unit – IV</td><td colspan="6">Strings and Pointers:</td><td>9</td></tr>
<tr><td colspan="8">Strings: Introduction – operations on strings: finding length, concatenation, comparing and copying – string and character manipulation functions, Arrays of strings. Pointers : declaring pointer variables – pointer expression and arithmetic, pointers and 1D arrays, pointers and strings</td></tr>
<tr><td>Unit – V</td><td colspan="6">User-defined Data Types and File Handling:</td><td>9</td></tr>
<tr><td colspan="8">User-defined data types: Structure: Introduction – nested structures– arrays of structure – structure and functions -unions – enumerated data type. File Handling : Introduction - opening and closing files – reading and writing data to files -Manipulating file position indicator : fseek(), ftell() and rewind()</td></tr>
</table>

LIST OF EXPERIMENTS / EXERCISES:

1.	Programs for demonstrating the use of different types of format Specifiers
2.	Programs for demonstrating the use of different types of operators like arithmetic, logical, relational, and ternary operators
3.	Programs for demonstrating the use of using decision making statements
4.	Programs for demonstrating the use of repetitive structures
5.	Programs for demonstrating one-dimensional arrays
6.	Programs for demonstrating two-dimensional arrays
7.	Programs to demonstrate modular programming concepts using functions
8.	Programs to demonstrate recursive functions.
9.	Programs to demonstrate strings (Using built-in and user-definedfunctions)
10.	Programs to illustrate the use of pointers
11.	Programs to illustrate the use of structures and unions
12.	Programs to implement file Handling

Lecture:45, Practical:30, Total:75

TEXT BOOK:

1.	Reema Thareja, “Programming in C ”, 2nd Edition, Oxford University Press, New Delhi, 2018.

REFERENCES/ MANUAL / SOFTWARE:

1.	Yashavant Kanetkar, "Let us C", 16th Edition, BPB Publications, 2018.
2.	Sumitabha Das, “Computer Fundamentals and C Programming”, 1st Edition, McGraw Hill, 2018.
3.	Balagurusamy E., "Programming in ANSI C", 7th Edition, McGraw Hill Education, 2017.
4.	Behrouz A. Forouzan & Richard F.Gilberg, “Computer Science A Structured Programming Approach Using C”, 3rd Edition, Cengage,2017.
5.	https://www.cprogramming.com/tutorial/c-tutorial.html

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	develop simple programs using input/output statements and operators	Applying (K3), Precision (S3)
CO2	identify the appropriate looping and control statements in C and develop applications using these statements	Applying (K3), Precision (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)
CO5	make use of user-defined data types and file concepts to solve given problems	Applying (K3), Precision (S3)

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	2	2	2	1				1	1		1		
CO2	3	2	2	2	1				1	1		1		
CO3	3	2	2	2	1				1	1		1		
CO4	3	2	2	2	1				1	1		1		
CO5	3	2	2	2	1				1	1		1		

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	10	30	60				100
CAT2	10	30	60				100
CAT3	10	30	60				100
ESE	10	30	60				100

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

22MET11 - ENGINEERING DRAWING

(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.

Unit – I | General Principles of Orthographic Projection: | 6+3

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: | 6+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.

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.

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.

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.

Lecture: 30, Tutorial:15, Total:45

TEXT BOOK:

1.	Natarajan.K.V. “A Textbook of Engineering Graphics”,35th Edition, Dhanalakshmi Publishers, Chennai, 2022,

REFERENCES:

1.	Venugopal K. and Prabhu Raja V., “Engineering Graphics”, 16th Edition, New Age International Publishers, Chennai, 2022.
2.	Basant Agrawal, Agrawal C.M., “Engineering Drawing”, 3rd Edition, McGraw Hill Education, 2019.
3.	Parthasarathy N.S., Vela Murali. “Engineering Drawing”, 1st Edition, Oxford University Press, 2015.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	interpret international standards of drawings and sketch the projections of points, lines and planes	Applying (K3)
CO2	draw the projections of 3D primitive objects like prisms, pyramids, cylinders and cones	Applying (K3)
CO3	construct the various sectional views of solids like prisms, pyramids, cylinders and cones	Applying (K3)
CO4	develop the lateral surfaces of simple and truncated solids	Applying (K3)
CO5	sketch the isometric projections of simple and truncated solids and convert isometric drawing into orthographic projection	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	2			2					3		2		
CO2	3	2	1		2					3		2		
CO3	3	2	1		2					3		2		
CO4	3	2	1		2					3		2		
CO5	3	2	1		2					3		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	6	9	85				100
CAT2	6	9	85				100
CAT3	6	9	85				100
ESE	10	10	80				100

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

22TAM01 - தமிழர் மரபு							
(Common to All Engineering and Technology Branches)							
Programme & Branch	**All BE / BTech Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**1 / 2**	**HS**	**1**	**0**	**0**	**1**

Preamble	தமிழர்களின் மொழி, இலக்கியம், ஓவியங்கள், சிற்பக்கலைகள், நாட்டுப்புறக் கலைகள், வீர விளையாட்டுக்கள், திணைக் கோட்பாடுகள், இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பைப் பற்றிய அறிவை வழங்குவதே இந்த பாடத்தின் நோக்கமாகும்.	
அலகு – I	மொழி மற்றும் இலக்கியம்	3
இந்திய மொழிக் குடும்பங்கள் - திராவிட மொழிகள் - தமிழ் ஒரு செம்மொழி - தமிழ் செவ்விலக்கியங்கள் - சங்க இலக்கியத்தின் சமயச் சார்பற்ற தன்மை - சங்க இலக்கியத்தில் பகிர்தல் அறம் - திருக்குறளில் மேலாண்மைக் கருத்துக்கள் - தமிழ் காப்பியங்கள், தமிழகத்தில் சமண பௌத்த சமயங்களின் தாக்கம் - பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள் – சிற்றிலக்கியங்கள் - தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி - தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.		
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.		
அலகு – III	நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுக்கள்	3
தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஒயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்.		
அலகு – IV	தமிழர்களின் திணைக் கோட்பாடுகள்	3
தமிழகத்தின் தாவரங்களும், விலங்குகளும் - தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் - தமிழர்கள் போற்றிய அறக்கோட்பாடு- சங்க காலத்தில் தமிழகத்தில் எழுத்தறிவும் கல்வியும் - சங்ககால நகரங்களும் துறை முகங்களும் - சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி - கடல்கடந்த நாடுகளில் சோழர்களின் வெற்றி.		
அலகு – V	இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு	3
இந்திய விடுதலைப்போரில் தமிழர்களின் பங்கு - இந்தியாவின் பிறபகுதிகளில் தமிழ் பண்பாட்டின் தாக்கம் - சுயமரியாதை இயக்கம் - இந்திய மருத்துவத்தில் சித்த மருத்துவத்தின் பங்கு – கல்வெட்டுகள், கையெழுத்துப்படிகள் - தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு.		
Total: 15		
TEXT BOOK:		

1.	ஆ. பூபாலன், தமிழர் மரபு, VRB Publishers Pvt Ltd, 2022.
REFERENCES:	
1.	தமிழக வரலாறு- மக்களும் பண்பாடும்- கே கே பிள்ளை (வெளியீடு தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)
2.	கணினித்தமிழ் - முனைவர் இல. சுந்தரம் (விகடன் பிரசுரம்)
3.	கீழடி - வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம்.(தொல்லியல் துறை வெளியீடு)
4.	பொருநை - ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு)

COURSE OUTCOMES: படிப்பை முடித்தவுடன், மாணவர்கள்		BT Mapped (Highest Level)
CO1	தமிழ் மொழி மற்றும் இலக்கியத்தில் மதிப்புமிக்க கருத்துக்களை விளக்க முடியும்.	Understanding (K2)
CO2	தமிழர்களின் சிற்பம் மற்றும் அவர்களின் ஓவியங்கள் பற்றி விளக்க முடியும்.	Understanding (K2)
CO3	தமிழர்களின் நாட்டுப்புற மற்றும் தற்காப்புக் கலைகளைப் பற்றி சுருக்கமாகக் கூற முடியும்.	Understanding (K2)
CO4	தமிழர்களின் திணைக் கோட்பாடுகளைப் பற்றி விளக்க முடியும்.	Understanding (K2)
CO5	இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு பற்றி விளக்க முடியும்.	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		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 – 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	60					100
CAT2	40	60					100
CAT3	40	60					100
ESE	NA						

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

<table>
<tr><td colspan="8">22TAM01 - HERITAGE OF TAMILS</td></tr>
<tr><td colspan="8">(Common to All Engineering and Technology Branches)</td></tr>
<tr><td>Programme & Branch</td><td>All BE / BTech Branches</td><td>Sem.</td><td>Category</td><td>L</td><td>T</td><td>P</td><td>Credit</td></tr>
<tr><td>Prerequisites</td><td>Nil</td><td>1 / 2</td><td>HS</td><td>1</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td>Preamble</td><td colspan="7">The objective of this course is to impart knowledge about Tamil language, literature, paintings, sculptures, folk arts, heroic games, doctrines, contribution of Tamils to Indian culture.</td></tr>
<tr><td>UNIT I</td><td colspan="6">Language and Literature</td><td>3</td></tr>
<tr><td colspan="8">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.</td></tr>
<tr><td>UNIT II</td><td colspan="6">Heritage - Rock Art Paintings to Modern Art – Sculpture</td><td>3</td></tr>
<tr><td colspan="8">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.</td></tr>
<tr><td>UNIT III</td><td colspan="6">Folk and Martial Arts</td><td>3</td></tr>
<tr><td colspan="8">Therukoothu – karagattam - villu pattu - kaniyan koothu – oyillattam - leather puppetry – silambattam – valari - tiger dance - sports and games of tamils.</td></tr>
<tr><td>UNIT IV</td><td colspan="6">Thinai Concept of Tamils</td><td>3</td></tr>
<tr><td colspan="8">Flora and fauna of tamils & aham and puram concept from tholkappiyam and sangam literature - aram concept of tamils - education and literacy during sangam age - ancient cities and ports of sangam age - export and import during sangam age - overseas conquest of cholas.</td></tr>
<tr><td>UNIT V</td><td colspan="6">Contribution of Tamils to Indian National Movement and Indian Culture</td><td>3</td></tr>
<tr><td colspan="8">Contribution of tamils to indian freedom struggle - the cultural influence of tamils over the other parts of india – self-respect movement - role of siddha medicine in indigenous systems of medicine – inscriptions & manuscripts – print history of tamil books.</td></tr>
<tr><td colspan="8" align="right">Total: 15</td></tr>
<tr><td colspan="8">TEXT BOOK:</td></tr>
<tr><td>1.</td><td colspan="7">S.Muthuramalingam, M.Saravanakumar, Heritage of Tamils, Yes Dee Publishing Pvt Ltd, 2023.</td></tr>
<tr><td colspan="8">REFERENCES:</td></tr>
<tr><td>1.</td><td colspan="7">Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukarasu) (Published by : International Institute of Tamil Studies).</td></tr>
<tr><td>2.</td><td colspan="7">The Contribution of Tamil of the Tamils to Indian Culture(Dr.M.Valarmathi)(Puplished by International Institute of Tamil Studies).</td></tr>
<tr><td>3.</td><td colspan="7">Keeladi – ‘Sangam City C ivilzation on the banks of river Vaigai; (Jointly Published by: Department of Archaeology & Tamilnadu Text Book and Educational Services Corporation, Tamilnadu).</td></tr>
<tr><td colspan="8"></td></tr>
</table>

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	explain valuable concepts in language and literature of tamils.	Understanding (K2)
CO2	illustrate about the tamils sculpture and their paintings.	Understanding (K2)
CO3	summarize about the tamils folk and martial arts.	Understanding (K2)
CO4	explain the thinai concept of tamils.	Understanding (K2)
CO5	explain the contribution of Tamils to the Indian National Movement and Indian culture.	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		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 – 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	60					100
CAT2	40	60					100
CAT3	40	60					100
ESE	NA						

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

22TAM02 - தமிழரும் தொழில்நுட்பமும்							
(Common to All Engineering and Technology Branches)							
Programme & Branch	**All BE/BTech Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**2 / 3**	**HS**	**1**	**0**	**0**	**1**

முன்னுரை	தமிழ் கலாச்சாரத்தோடு ஒன்றிய தொழில் நுட்பங்களை பற்றிப் எடுத்துரைத்தல்	
அலகு – I	நெசவு மற்றும் பானை தொழில்நுட்பம்	3
சங்க காலத்தில் நெசவு தொழில் – பானைத் தொழில்நுட்பம் கருப்பு சிவப்பு பாண்டங்கள் – பாண்டகளில் கீறல் குறியீடுகள்		
அலகு – II	வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்	3
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 தொழில்நுட்பம்	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.		
அலகு – IV	வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில்நுட்பம்	3
அணை, ஏரி, குளங்கள், மதகு – சோழர்கால குமிழித் தூம்பின் முக்கியத்துவம் – கால்நடை பராமரிப்பு – கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் – வேளாண்மை மற்றும் வேளாண்மை சார்ந்த செயல்பாடுகள் – கடல்சார் அறிவு – மீன்வளம் – முத்து மற்றும் முத்துக்குளித்தல் – பெருங்கடல் குறித்த பண்டைய அறிவு – அறிவுசார் சமூகம்.		
அலகு – V	அறிவியல் தமிழ் மற்றும் கணினித்தமிழ்	3
அறிவியல் தமிழின் வளர்ச்சி – கணினிதத்தமிழ் வளர்ச்சி – தமிழ் நூல்களை மின்பதிப்பு செய்தல் – தமிழ் மென்பொருட்கள் உருவாக்கம் – தமிழ் இணையக் கல்விக்கழகம் – தமிழ் மின் நூலகம் – இணையத்தில் தமிழ் அகராதிகள் சொற்குவைத் திட்டம்.		
Total:15		

TEXT BOOK:

1.	தமிழக வரலாறு - மக்களும் பண்பாடும் - கே கே பிள்ளை (வெளியீடு தமிழ்நாடு பாடநூல் மற்றும் கல்வியில் பணிகள் கழகம்), உலகத் தமிழாராய்ச்சி நிறுவனம், சென்னை, 2002
2.	கணினித்தமிழ் முனைவர் இல. சுந்தரம், விகடன் பிரசுரம், 2016

REFERENCES:	
1.	கீழடி-வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம்.(தொல்லியல் துறை வெளியீடு)
2.	பொருநை-ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு)
3.	Social Life of Tamils (Dr.K.K.Pillay) A joint Publication of TNTB & ESC and RMRL – (in print)
4.	Social Life of the Tamils – The Classical Period (Dr.S.Sigaravelu) (Published by: International Institute of Tamil Studies).
5.	Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukarasu) (Published by : International Institute of Tamil Studies)
6.	The Contribution of the Tamil to Indian Culture (Dr.M.Valarmathi) (Puplished by International Institute of Tamil Studies).
7.	Keeladi – 'Sangam City Civilzation on the banks of river Vaigai; (Jointly Published by: Department of Archaeology & Tamilnadu Text Book and Educational Services Corporation, Tamilnadu)
8.	Studies in the History of India with Special Reference to Tamilnadu (Dr.K.K.Pillay) (Published by: The Author)
9.	Porunai Civilization (Jointly Published by: Department of Archaeology & Tamilnadu Textbook and Educational Services Corporation, Tamilnadu)
10.	Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

COURSE OUTCOMES: படிப்பை முடித்தவுடன், மாணவர்கள்		BT Mapped (Highest Level)
CO1	தமிழ் கலாச்சாரம் மற்றும் தமிழ் சமூகத்தினுடைய நெசவு மற்றும் பானை தொழில்நுட்பம் பற்றி விளக்க முடியும்.	Understanding (K2)
CO2	தமிழர்களின் வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்ப ஆற்றல் பற்றி விளக்க முடியும்.	Understanding (K2)
CO3	தமிழர்களின் உற்பத்தித் தொழில்நுட்பம் பற்றி சுருக்கமாகக் கூற முடியும்.	Understanding (K2)
CO4	தமிழர்களின் வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில்நுட்பம் பற்றி விளக்க முடியும்.	Understanding (K2)
CO5	தமிழர்களின் அறிவியல் தமிழ் மற்றும் கணினித்தமிழ் பற்றி விளக்க முடியும்.	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		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 – 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	60					100
CAT2	40	60					100
CAT3	40	60					100
ESE	NA						

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

22TAM02 - TAMILS AND TECHNOLOGY							
(Common to All Engineering and Technology Branches)							
Programme & Branch	**All BE/BTech Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**2 / 3**	**HS**	**1**	**0**	**0**	**1**

Preamble	This course aims to impart the essential knowledge on the tamil culture and related technology	
UNIT – I	**WEAVING AND CERAMIC TECHNOLOGY**	**3**
Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.		
UNIT – II	**DESIGN AND CONSTRUCTION TECHNOLOGY**	**3**
Designing and Structural construction House & Designs in household materials during Sangam Age – Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram – Sculptures and Temples of Mamallapuram – Great Temples of Cholas and other worship places – Temples of Nayaka Period – Type study (Madurai Meenakshi Temple) – Thirumalai Nayakar Mahal – Chetti Nadu Houses, Indo – Saracenic architecture at Madras during British Period.		
UNIT – III	**MANUFACTURING TECHNOLOGY**	**3**
Art of Ship Building – Metallurgical studies – Iron industry – Iron smelting, steel – Copper and gold – Coins as source of history – Minting of Coins – Beads making – industries Stone beads – Glass beads –Terracotta beads –Shell beads/ bone beats – Archeological evidences – Gem stone types described in Silappathikaram.		
UNIT – IV	**AGRICULTURE AND IRRIGATION TECHNOLOGY**	**3**
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	**SCIENTIFIC TAMIL & TAMIL COMPUTING**	**3**
Development of Scientific Tamil – Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project.		
		Total:15

TEXT BOOK:

1.	Social Life of Tamils (Dr.K.K.Pillay) A joint Publication of TNTB & ESC and RMRL – (in print)
2.	Social Life of the Tamils – The Classical Period (Dr.S.Sigaravelu) (Published by: International Institute of Tamil Studies).

REFERENCES:

1.	தமிழக வரலாறு - மக்களும் பண்பாடும் - கே கே பிள்ளை (வெளியீடு தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்), உலகத் தமிழாராய்ச்சி நிறுவனம், சென்னை, 2002
2.	கணினித்தமிழ் முனைவர் இல. சுந்தரம், விகடன் பிரசுரம், 2016
3.	கீழடி வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம்.(தொல்லியல் துறை வெளியீடு)
4.	பொருநை ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு
5.	Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukarasu) (Published by : International Institute of Tamil Studies)
6.	The Contribution of the Tamils to Indian Culture (Dr.M.Valarmathi)(Puplished by International Institute of Tamil Studies).
7.	Keeladi – 'Sangam City Civilzation on the banks of river Vaigai; (Jointly Published by: Department of Archaeology & Tamilnadu Text Book and Educational Services Corporation, Tamilnadu)
8.	Studies in the History of India with Special Reference to Tamilnadu (dr.K.K.Pillay) (Published by : The Author)
9.	Porunai Civilization (Jointly Published by: Department of Archaeology & Tamilnadu Textbook and Educational Services Corporation, Tamilnadu)
10.	Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

COURSE OUTCOMES: **On completion 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)

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		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 – 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	60					100
CAT2	40	60					100
CAT3	40	60					100
ESE	NA						

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

22PHL16 - PHYSICS LABORATORY FOR ELECTRONICS AND INSTRUMENTATION ENGINEERING							
Programme & Branch	**BE- Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**1**	**BS**	**0**	**0**	**2**	**1**

Preamble	This course aims to impart hands on training in the determination of parameters such as rigidity modulus, AC frequency, velocity of ultrasonic wave, compressibility of a liquid, specific resistance, thermal conductivity, band gap, Hall coefficient and knowledge on the working of LCR circuit, p-n diode and UJT, and also to impart skills on writing coding / developing project / product related to societal requirement.

LIST OF EXPERIMENTS / EXERCISES:

1.	Determination of the rigidity modulus of the given metallic wire using torsional pendulum / Studying the variation of current and voltage in a series LCR circuit.
2.	Determination of the frequency of alternating current using electrically vibrating tuning fork (Melde's apparatus).
3.	Determination of the velocity of ultrasonic waves in a liquid and the compressibility of the liquid using ultrasonic interferometer.
4.	Determination of the specific resistance of the given metallic wire using Carey-Foster's bridge.
5.	Determination of the thermal conductivity of a bad conductor using Lee's disc.
6.	Determination of the band gap of a given semiconducting material using post-office box.
7.	Observation of the I-V characteristics of a p-n junction diode.
8.	Observation of the I-V characteristics of a uni junction transistor / Determination of Hall coefficient of a material using Hall effect arrangement.
9.	Determination of the thickness of a thin wire using air-wedge method.
10.	Writing coding for any one of the above experiments / developing a project / a product.

Total:30

REFERENCES/ MANUAL /SOFTWARE:

1.	Physics Laboratory Manual / Record, Department of Physics, 1st Edition, 2020.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	determine the rigidity modulus of a wire using the concepts of twisting couple or to study a series LCR circuit. To determine AC frequency and the velocity of ultrasound in a liquid using the concept of formation of standing waves.	Applying (K3), Precision (S3)
CO2	determine the specific resistance using the principle of Wheatstone bridge and the thermal conductivity of a bad conductor using the concept of heat conduction through materials. To determine the band gap of semiconductor materials using the concept of variation of resistance with temperature and to obtain the I-V characteristics of a p-n junction diode.	Applying (K3), Precision (S3)
CO3	obtain the I-V characteristics of a UJT using the concept of creation of a region with negative resistance or to determine the Hall coefficient of a material using the concept of Hall effect. To determine and thickness of a thin film using the concept of interference and also to write coding / do project / develop product.	Applying (K3), Precision (S3)

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	2	2	3					2	2		2	1	
CO2	3	2	2	3					2	2		2	1	
CO3	3	2	2	3					2	2		2	1	

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

22GCL12 – FOUNDATION LABORATORY - ELECTRICAL, IoT AND WEB							
(Common to all BE/BTech branches)							
Programme& Branch	**All BE/BTech branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**1 /2**	**ES**	**0**	**0**	**6**	**3**

Preamble	This course is designed to provide a foundational knowledge on engineering with hands-on experience on the house wiring, Internet of Things and Web Technologies.

LIST OF EXPERIMENTS / EXERCISES:

PART A – Electrical Installation (30 Hours)	
1.	Develop wiring diagrams using software tools.
2.	Identify and select suitable components for Energy Measurement and Circuit Protection
3.	Design a wiring circuit integrating Energy Meter, MCB and RCCB
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.
PART B – Internet of Things (30 Hours)	
1.	Design a Single layer PCB layout designing
2.	Fabricate Single layer PCB printing
3.	Assembling, soldering and desoldering practice on single layer PCB
4.	GPIO programming in ESP8266
5.	Sensor and actuator interfacing with internet enabled microcontroller device
6.	Sensor and actuator calibration
7.	Integration of microcontroller based system with Cloud platform
PART C – Web Technologies (30 Hours)	
1.	Design a website for an application using HTML and CSS.
2.	Convert the designed website into responsive website using Bootstrap.
3.	Add dynamism to the website by using JavaScript and embed the Social Media components to the website.
4.	Incorporate database interaction to the website.
5.	Deploy the developed website in the server.
	Total:90

REFERENCES/ MANUAL /SOFTWARE:

1.	Laboratory Manual
2.	Eric T.Freeman,Elisabeth Robson, "Head First JavaScript Programming A Brain-Friendly Guide", 1st Edition, O'Reilly , 2014.
3.	Eric T.Freeman,Elisabeth Robson, "Head First HTML and CSS",2nd Edition, O'Reilly , 2012
4.	Lynn Beighley,"Head First SQL",1st Editin, O'Reilly,2007.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	design electrical wiring circuits for buildings based on their requirement	Applying(K3), Precision (S3)
CO2	develop IoT based solutions and PCB for real world use cases.	Applying (K3), Precision (S3)
CO3	design and host an interactive dynamic website.	Applying(K3), Precision (S3)

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	2	2	1					1					
CO2	3	2	2	1					1					
CO3	3	2	2	1					1					

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

22MEL11 - ENGINEERING PRACTICES LABORATORY							
(Common to All Engineering and Technology Branches)							
Programme & Branch	**All BE/BTech Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**1**	**ES**	**0**	**0**	**2**	**1**

Preamble	This course is designed to provide a hands-on experience in basic of mechanical and electrical engineering practices.

LIST OF EXPERIMENTS / EXERCISES:

	PART A – MECHANICAL ENGINEERING
1.	Prepare a Square / Rectangular / V-Shape Projection with its Counterpart for Mating and Perform the Drilling, Tapping, and Assembling Tasks from the given Square / Rectangular MS Plates using Modern Power Tools.
2.	Prepare T / L / Lap Joint from given Wooden Work Piece and Make a Box / Tray out of Plywood using Modern Power Tools.
3.	Perform the Thread Formation on a GI/PVC Pipe and Prepare a Water Line from the Overhead Tank that is Leak-Proof.
4.	Make a Butt / Lap / Tee Joint of MS Plate using Arc Welding Process and Welding Simulator.
5.	**Activity:** Prepare an Innovative Model with the Knowledge from Fitting / Carpentry / Plumbing / Welding Involving Modern Power Tools.
	PART B – ELECTRICAL AND ELECTRONICS ENGINEERING
6.	Wiring circuit for fluorescent lamp and Stair case wiring
7.	Wiring Circuit of Incandescent lamp using Impulse Relay
8.	Measurement of Earth Resistance
9.	Soldering of Simple Circuits and trouble shooting
10.	Implementation of half wave and full wave Rectifier using diodes
	Total:30

REFERENCES/ MANUAL /SOFTWARE:

1.	Engineering Practices Laboratory Manual.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	plan the sequence of operations for effective completion of the planned models / innovative articles	Creating (K6) Manipulation (S2)
CO2	identify and use appropriate modern power tools and complete the exercises/models accurately	Applying (K3) Manipulation (S2)
CO3	perform house wiring and realize the importance of earthing	Applying (K3), Manipulation (S2)
CO4	soldering with simple electronics circuits	Applying (K3), Manipulation (S2)
CO5	trouble shoot the electrical and electronic circuits	Applying (K3), Manipulation (S2)

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		3	1	3	1			3	3		3		
CO2	3		3	1	3				3	3		3		
CO3	3		3	2	1				2	2		3	3	2
CO4	3		2	1	1				2	3		3	3	2
CO5	3		3	2	1				2	2		3	3	2

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

22VEC11 - YOGA AND VALUES FOR HOLISTIC DEVELOPMENT							
(Common to All Engineering and Technology Branches)							
Programme & Branch	**All B.E./B.Tech. Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**1 / 2**	**HS**	**1**	**0**	**1**	**1**

Preamble	Yoga or yogasanas are considered as art and science of healthy living by our ancient gurus. It is method to bring harmony of body and mind for general wellbeing. Yoga is considered as one of the greatest gifts to the world by Indians for healthy living. Students in particular are benefitted by learning yoga.	
Unit – I	**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 – 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 – 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.		
Unit – IV	**Asanas:**	**2**
Prayer - Starting & Closing - Preparatory practices – Loosening Practices – Meaning, Definitions and Objectives of Asanas - Principles of Practicing Asanas. Asanas: Standing – Sitting – Prone – Supine – Suryanamaskar.		
Unit – V	**Pranayama and Meditation:**	**2**
Breathing Practices for awareness - Definitions and Objectives of Pranayama - Principles of Practicing Pranayama. Pranayama: Nadi Shuddhi - Kapalabathi – Sitali – Sitkari – Bhranari – Ujjayi – Relaxation Techniques – Meditation.		
		Lecture: 10, Practical: 10, Total:20

TEXT BOOK:

1.	Swami satyananda saraswathi, "Asana pranayama mudra bandha", Bihar school of yoga, 4th Edition, 1969.
2.	Swami mukthi Bodhanandha, "Hatha yoga pradipika", Bihar school of yoga, 4th Edition, 1985.

REFERENCES:

1.	B.K.S. Iyenkar, "Yoga the path of holistic health", DK Limited, 2nd Edition, 1969.
2.	Selvarasu, "Kriya cleansing in yoga", Aruvi yoga, 3rd Edition, 2002.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	realize the importance of yoga in physical health.	Applying (K3)
CO2	realize the importance of yoga in mental health.	Applying (K3)
CO3	realize the role of yoga in personality development and diet.	Applying (K3)
CO4	do the loosening practices, Asanas and realize its benefits.	Applying (K3)
CO5	do the practice of Pranayama, meditation and realize its benefits	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						3		2	1			
CO2						3		2				
CO3						3		3				
CO4						3		2	3			
CO5						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	-	-	-	-	-	-	-
CAT2	-	-	-	-	-	-	-
CAT3	20	30	50	-	-	-	100
ESE	-	-	-	-	-	-	-

* ±3% may be varied (CAT3 – 100 marks)

<table>
<tr><td colspan="8">22EGT21 - COMMUNICATION SKILLS II</td></tr>
<tr><td colspan="8">(Common to All Engineering and Technology Branches)</td></tr>
<tr><td>Programme & Branch</td><td>All B.E./B.Tech. Branches</td><td>Sem.</td><td>Category</td><td>L</td><td>T</td><td>P</td><td>Credit</td></tr>
<tr><td>Prerequisites</td><td>Communication Skills I</td><td>2</td><td>HS</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td>Preamble</td><td colspan="7">This course is designed to equip students with the necessary skills to listen, read, write and speak so as to develop their linguistic and communicative competencies.</td></tr>
<tr><td>Unit – I</td><td colspan="5">Grammar, Vocabulary, Listening, Speaking, Reading & Writing</td><td colspan="2">9</td></tr>
<tr><td colspan="8">Grammar: Sentence Patterns - Simple, Compound & Complex sentences - Vocabulary: Portmanteau words - One word substitution - Listening: Speeches from company CEOs - TV debates Speaking: Just-a-minute talk - Group discussion - Reading: Reading for Gist - Writing: Job application letter with resume – Transcoding</td></tr>
<tr><td>Unit – II</td><td colspan="5">Grammar, Vocabulary, Listening, Speaking, Reading & Writing</td><td colspan="2">9</td></tr>
<tr><td colspan="8">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 Picture</td></tr>
<tr><td>Unit – III</td><td colspan="5">Grammar, Vocabulary, Listening, Speaking, Reading & Writing</td><td colspan="2">9</td></tr>
<tr><td colspan="8">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</td></tr>
<tr><td>Unit – IV</td><td colspan="5">Grammar, Vocabulary, Listening, Speaking, Reading & Writing</td><td colspan="2">9</td></tr>
<tr><td colspan="8">Grammar: Degrees of Comparison - Punctuations – Fragments & run-ons - Vocabulary: British & American - Spelling & words - Listening: Listening to global accents - listening to motivational speeches - Speaking: Narrating personal milestones - Sports commentaries - Movie Enactment - Reading: Narrative passages - Writing: E mail - Agenda & Minutes of Meeting - Special & Technical reports</td></tr>
<tr><td>Unit – V</td><td colspan="5">Grammar, Vocabulary, Listening, Speaking, Reading & Writing</td><td colspan="2">9</td></tr>
<tr><td colspan="8">Grammar: Purpose and Function - If clause - Error detection - Vocabulary: Coding & Decoding - Alphabet test - Listening: Listening to sample HR Interviews - Speaking: Introduction to phonetics - Stress, rhythm & Intonation – Guided & unguided speeches/conversations - Giving feedback – Debate - Reading: Key Note speeches - Newspaper reports - short technical texts from journals Writing: Circulars - Critical Appreciation of a non-detailed text - Technical proposals</td></tr>
<tr><td colspan="8">Total:45</td></tr>
<tr><td colspan="8">TEXT BOOK:</td></tr>
<tr><td>1.</td><td colspan="7">Sanjay Kumar & Pushp Lata, “Communication Skills”, 2nd Edition, Oxford University Press, New Delhi, 2018.</td></tr>
<tr><td colspan="8">REFERENCES:</td></tr>
<tr><td>1.</td><td colspan="7">Meenakshi Raman and Sangeeta Sharma. “Technical Communication- Principles and Practice”. 4th Edition, Oxford University Press, New Delhi, 2022.</td></tr>
<tr><td>2.</td><td colspan="7">Murphy Raymond, "English Grammar in Use", 5th Edition, Cambridge University Press, New York, 2019.</td></tr>
<tr><td>3.</td><td colspan="7">Jack C. Richards and Chuck Sandy, “Passages” Student’s Book 2, 3rd Edition, Cambridge University Press, New York, 2014.</td></tr>
<tr><td colspan="8"></td></tr>
</table>

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	use functional grammar for improving communication skills	Applying (K3)
CO2	listen and comprehend different accents and infer implied meanings	Applying (K3)
CO3	speak clearly, initiate and sustain a discussion and negotiate using appropriate communicative strategies	Creating (K6)
CO4	read different genres of texts, infer implied meanings and critically analyze and evaluate them	Understanding (K2)
CO5	produce different types of narrative, descriptive expository texts and understand creative, critical, analytical and evaluative writing	Creating (K6)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						2			1	3	1	1
CO2									2	3		1
CO3									2	3		2
CO4						1				3	1	1
CO5										3		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		37	30			33	100
CAT2		7	50			43	100
CAT3		17	50			33	100
ESE		15	45			40	100

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

22MAC21 - MULTIVARIABLE CALCULUS AND COMPLEX ANALYSIS							
(Common to CIVIL, MECH, MTS, ECE, EEE, EIE & FT branches)							
Programme & Branch	**B.E & Civil, Mech, MTS, ECE, EEE, EIE & FT branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**2**	**BS**	**3**	**1***	**2***	**4**

Preamble	To impart the knowledge of partial derivatives, evaluation of real and complex integrals, vector calculus and analytic functions to the students for solving the problems related to various engineering disciplines.	
Unit – I	**Functions of Several Variables:**	**9**
Functions of two or more variables – Partial derivatives – Total differential – Taylor's series for functions of two variables – Applications: Maxima and minima – Constrained maxima and minima – Lagrange's multiplier method.		
Unit – II	**Multiple Integrals:**	**9**
Double integration in cartesian coordinates – Change of order of integration – Application: Area between two curves – Triple integration in cartesian coordinates – Volume as triple integrals.		
Unit – III	**Vector Calculus:**	**9**
Directional derivative – Gradient of a scalar point function – Divergence of a vector point function – Curl of a vector – Solenoidal and Irrotational vectors – Vector Integration: Introduction – Green's, Stoke's and Gauss divergence theorems (without proof) – Verification of the above theorems and evaluation of integrals using them.		
Unit – IV	**Analytic Functions:**	**9**
Functions of a complex variable – Analytic functions – Necessary and sufficient conditions (excluding proof) – Cauchy–Riemann equations (Statement only) – Properties of analytic function (Statement only) – Harmonic function – Construction of analytic function – Applications: Fluid flow – Conformal mapping: w = z + a, az, 1/z – Bilinear transformation.		
Unit – V	**Complex Integration:**	**9**
Introduction – Cauchy's theorem (without proof) – Cauchy's integral formula – Taylor's and Laurent series – Singularities – Classification – Cauchy's residue theorem (without proof) – Applications: Evaluation of definite integrals involving sine and cosine functions over the circular contour.		

LIST OF EXPERIMENTS / EXERCISES:

1.	Finding ordinary 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 Milne-Thomson method for constructing analytic function
7.	Determination of Mobius transformation for the given set of points
8.	Finding poles and residues of an analytic function

Lecture:45, Tutorials and Practical:15, Total:60

TEXT BOOK:

1.	Ramana B V, "Higher Engineering Mathematics", 1st Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2018.

REFERENCES/ MANUAL / SOFTWARE:

1.	Kreyszig E, "Advanced Engineering Mathematics ", 10th Edition, John Wiley, New Delhi, India, 2016.
2.	Kandasamy P., Thilagavathy K. and Gunavathy K., "Engineering Mathematics For First Year B.E/B.Tech", Reprint Edition 2014, S.Chand and Co., New Delhi
3.	Duraisamy C., Vengataasalam S., Arun Prakash K. and Suresh M., "Engineering Mathematics - I", 2nd Edition, Pearson India Education, New Delhi, 2018.
4.	Grewal B.S, "Higher Engineering Mathematics" 44thEdition, Khanna Publishers, New Delhi, 2018.
5.	MATLAB – Laboratory Manual

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	compute the total derivatives and extreme values of multivariable functions.	Applying (K3)
CO2	evaluate multiple integrals and apply them to compute the area and volume of the regions.	Applying (K3)
CO3	apply the concepts of derivatives and line integrals of vector functions in engineering problems.	Applying (K3)
CO4	construct analytic functions and bilinear transformations and determine the image of given region under the given conformal mapping.	Applying (K3)
CO5	apply the techniques of complex integration to evaluate real and complex integrals over suitable closed curves.	Applying (K3)
CO6	demonstrate MATLAB programming to understand the concepts of functions of two variables, vector operators, multiple integrals and complex variables.	Applying (K3), Manipulation (S2)

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	3	2											
CO2	3	3	2											
CO3	3	3												
CO4	3	3												
CO5	3	3	3											
CO6					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	10	30	60	-	-	-	100
CAT2	10	30	60	-	-	-	100
CAT3	10	30	60	-	-	-	100
ESE	10	30	60	-	-	-	100

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

***Alternate week**

22CYT25 - CHEMISTRY FOR ELECTRONICS AND INSTRUMENTATION ENGINEERING							
Programme & Branch	**B.E & Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**2**	**BS**	**3**	**0**	**0**	**3**

Preamble	This course aims to equip the engineering students to realize the importance of electrochemistry, corrosion, metal finishing, electrochemical storage devices, fuel & combustion and the need for e-waste management.	
Unit – I	**ELECTROCHEMISTRY AND CORROSION**	**9**
Electrochemistry: Introduction – cells – types – representation of galvanic cell – electrode potential – Nernst equation (derivation of cell EMF) – calculation of cell EMF from single electrode potential – reference electrode: construction, working and applications of standard hydrogen electrode – potentiometric titrations (redox) – conductometric titrations – mixture of weak and strong acid Vs strong base. **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).		
Unit – II	**INDUSTRIAL METAL FINISHING**	**9**
Introduction – technological importance of metal finishing- methods of metal finishing - essentials of metal finishing: polarization, decomposition potential and overpotential – surface preparation – electroplating: process – effect of plating variables on the nature of electrodeposit – electroplating of chromium and silver-electroless plating: process – various steps involved in electroless plating – electroless nickel plating process-advantages of electroless plating- distinction between electroplating and electroless plating – manufacturing of electronic component-printed circuit board (PCB) fabrication.		
Unit – III	**ELECTROCHEMICAL STORAGE DEVICES**	**9**
Batteries: Introduction**-** types of batteries – discharging and charging of battery – characteristics of battery – battery rating – various tests on battery – primary battery: silver button cell – secondary battery: Ni-Cd battery –modern battery: lithium-ion battery – maintenance of batteries – choice of batteries for electric vehicle applications. **Fuel Cells:** Introduction-Importance and classification of fuel cells – description, principle, components and applications of fuel cells: H_2-O_2 fuel cell, alkaline fuel cell, molten carbonate fuel cell and direct methanol fuel cell.		
Unit – IV	**FUELS AND COMBUSTION**	**9**
Introduction – classification of fuels – characteristics of a good fuel – combustion – calorific values – gross and net calorific values – theoretical calculation of calorific value by Dulong's formula – flue gas analysis by Orsat's method – solid fuels – coal and its varieties – proximate analysis – significance – metallurgical coke – Otto-Hoffman byproduct method – liquid fuel – refining of petroleum – manufacture of synthetic petrol – hydrogenation of coal – bergius process – knocking: spark ignition engine – octane number, compression ignition engine – cetane number – power alcohol and biodiesel – gaseous fuel – water gas – introduction of Bharat Stage Emission Standard (BSES) system.		
Unit – V	**E-WASTE AND ITS MANAGEMENT**	**9**
Introduction-E- Waste – definition – sources of e-waste– hazardous substances in e-waste – effects of e-waste on environment and human health- need for e-waste management– e-waste handling rules – waste minimization techniques for managing e-waste – recycling of e-waste – disposal treatment methods of e- waste- mechanism of extraction of precious metal from leaching solution – global scenario of E-waste – E-waste in India- case studies.		
		Total:45

TEXT BOOK:

1.	Wiley Editorial Board," Wiley Engineering Chemistry", 2nd Edition, Wiley India Pvt. Ltd, New Delhi, Reprint 2019.for Unit-I, II, III, IV.
2.	Palanisamy P.N., Manikandan P., Geetha A., Manjula Rani K.& Kowshalya V.N., "Environmental Science", Revised Edition, Pearson Education, New Delhi, 2019, for Unit-V.

REFERENCES:

1.	Palanisamy P.N., Manikandan P., Geetha A.& Manjula Rani K., "Applied Chemistry", 6th Edition, Tata McGraw Hill Education Private Limited, New Delhi, 2019.
2.	Payal B. Joshi, Shashank Deep, "Engineering Chemistry", Oxford University Press, New Delhi, 2019.
3.	Palanna O., "Engineering Chemistry", McGraw Hill Education, New Delhi, 2018.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	apply the principle of electrochemistry and corrosion for various applications	Applying (K3)
CO2	apply the concept of plating techniques in industrial metal finishing	Applying (K3)
CO3	use the concepts of batteries, fuel cells and their applications in various fields.	Applying (K3)
CO4	apply the concepts of fuels and combustion for engineering applications	Applying (K3)
CO5	utilize the knowledge to handle the e-waste and reduce its impacts on environment	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	2	1	1										
CO2	3	2	1	1										
CO3	3	2	1	1										
CO4	3	2	1	1										
CO5	3	2	1	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	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)

22EIC21- ELECTRIC CIRCUITS ANALYSIS							
Programme & Branch	**B.E. & Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**2**	**PC**	**3**	**0**	**2**	**4**

Preamble	To establish a firm understanding of basic laws of electric circuits and networks, and to provide a comprehensive insight into the techniques for analysing the circuits theoretically.	
Unit – I	**DC Circuits:**	**9**
Review of electric circuit elements and Kirchhoff's Laws-Dependent and independent sources- open and short circuits- Source transformation-Voltage and current relationship in R,L and C- Steady state analysis of RL, RC and RLC circuits.		
Unit – II	**Network Theorems:**	**9**
Mesh analysis-Nodal Analysis – Star-Delta transformation -Superposition theorem – Thevenin's and Norton's theorem-Maximum Power transfer theorem.		
Unit – III	**Network Synthesis:**	**9**
Realizability of one port network- Hurwitz polynomials-Positive Real Functions- RL, RC network using Cauer methods, LC networks using Foster method-applications of passive networks synthesize in filters.		
Unit – IV	**Single phase and Three phase AC Circuits:**	**9**
Single phase AC Circuits: Phase relation in resistor, inductor, capacitor-Phasor diagram-Series and parallel RLC circuits-power and power factor. **Three phase AC circuits:** Interconnection of three phase sources and loads –line and phase quantities-voltage, current and power in three phase star and delta connected balanced loads- Power measurement in three phase balanced circuits: Two wattmeter method.		
Unit – V	**Time and frequency domain analysis;**	**9**
DC Transient response analysis: - RL, RC and RLC series circuits. R**esonance analysis:** Ideal RLC series and parallel resonance-Impedance and current variations- Bandwidth-Q factor- Magnification factor.		

LIST OF EXPERIMENTS / EXERCISES:

1.	Measurement of current, voltage, power and power factor in single phase load
2.	RC transient response analysis
3.	Frequency Response analysis of RLC circuits
4.	Experimental verification of Maximum Power Transfer theorem
5.	Three phase power measurement using two wattmeter method
6.	Verification of superposition theorem in DC circuits
7.	Determination of effective resistance in DC circuit using Star Delta transformation

Lecture:45, Practical:30, Total:75

TEXT BOOK:

1.	Sudhakar A and Shyammohan S Palli , "Circuits and Networks Analysis and Synthesis", 4th Edition , Tata McGraw-Hill, New Delhi, 2010.

REFERENCES:

1.	Ravish R.Singh, "Networks Analysis and Synthesis", 2nd Edition, Tata McGraw-Hill, New Delhi, 2013.
2.	William H. Hayt, Jr. Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuit Analysis", McGraw Hill Science Engineering, 8th Edition, 2016.
3.	Charles K. Alexander, Mathew N.O. Sadiku, "Fundamentals of Electric Circuits", 5th Edition, McGraw Hill, 2015.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped** **(Highest Level)**
CO1	determine the electrical parameters in the fundamental DC circuit	Applying (K3)
CO2	interpret the behavior of DC resistive circuits using network theorems	Analyzing (K4)
CO3	identify suitable network from the given transfer function	Applying (K3)
CO4	determine the electrical parameters in single and three phase AC circuits	Applying (K3)
CO5	assess the characteristics of RLC circuits in time and frequency domain	Analyzing (K4)

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	3	1	1	1								3	3
CO2	3	3	2	2	2								3	3
CO3	3	2	1	3	1	1		1	2	3		1	3	3
CO4	3	3	1	3	1	1		1	2	3		1	3	3
CO5	3	3	1	3	1	1		1	2	3		1	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	5	30	65				100
CAT2	5	30	65				100
CAT3	5	30	65				100
ESE	5	30	65				100

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

<table>
<tr><td colspan="9">22CSC22 – DATA STRUCTURES USING C</td></tr>
<tr><td colspan="9">(Common to ECE, EEE, EIE and MTS Branches)</td></tr>
<tr><td>Programme & Branch</td><td>BE - ECE, EEE, EIE and MTS Branches</td><td>Sem.</td><td>Category</td><td>L</td><td>T</td><td>P</td><td>Credit</td></tr>
<tr><td>Prerequisites</td><td>Programming in C</td><td>2</td><td>ES</td><td>3</td><td>0</td><td>2</td><td>4</td></tr>
<tr><td colspan="9"></td></tr>
<tr><td>Preamble</td><td colspan="8">This course is indented to introduce the concept of elementary data structures and notion of algorithms to novice learner from cross disciplines in Engineering and Technology.</td></tr>
<tr><td>Unit – I</td><td colspan="6">List:</td><td>9</td></tr>
<tr><td colspan="9">Data Structures - Abstract Data Types (ADT) - List ADT and Array Implementation - Linked List - Doubly Linked List - Circular Linked List – Application : Polynomial Addition</td></tr>
<tr><td>Unit – II</td><td colspan="6">Stack and Queues:</td><td>9</td></tr>
<tr><td colspan="9">Stack ADT – Array and Linked List implementation of Stacks - Application: Balancing Parenthesis- Infix to Postfix Conversion - Postfix Expression Evaluation - Queue ADT – Array and Linked List implementation of Queues - Applications</td></tr>
<tr><td>Unit – III</td><td colspan="6">Trees:</td><td>9</td></tr>
<tr><td colspan="9">Trees-Preliminaries – Binary Trees –Binary Tree Traversals - The Search Tree ADT – Binary Search Trees–Priority Queues (Binary Heap)- Application: Expression Tree</td></tr>
<tr><td>Unit – IV</td><td colspan="6">Graphs:</td><td>9</td></tr>
<tr><td colspan="9">Graphs – Definitions – Elementary Graph Operations- Traversals – Shortest-Path Algorithms: Unweighted Shortest Paths – Dijkstra‟s Algorithm – Minimum Spanning Tree: Prim‟s Algorithm- Kruskal‟s Algorithm – Applications: Biconnectivity.</td></tr>
<tr><td>Unit – V</td><td colspan="6">Sorting and Hashing:</td><td>9</td></tr>
<tr><td colspan="9">Sorting - Preliminaries – Insertion Sort – Quicksort – Merge sort – Heapsort – Hashing – General Idea – Hash Function – Separate Chaining – Open addressing.</td></tr>
<tr><td colspan="9"></td></tr>
<tr><td colspan="9">LIST OF EXPERIMENTS / EXERCISES:</td></tr>
<tr><td>1.</td><td colspan="8">Implementation of C programs using pointers</td></tr>
<tr><td>2.</td><td colspan="8">Implementation of singly linked list and its operations</td></tr>
<tr><td>3.</td><td colspan="8">Implementation of doubly linked list and its operations</td></tr>
<tr><td>4.</td><td colspan="8">Implementation of Stack and its operations</td></tr>
<tr><td>5.</td><td colspan="8">Implementation of Queue and its operations</td></tr>
<tr><td>6.</td><td colspan="8">Implementation of Stack and Queue using Singly Linked List</td></tr>
<tr><td>7.</td><td colspan="8">Convert a given In-fix Expression into Post-fix Expression using Stack ADT</td></tr>
<tr><td>8.</td><td colspan="8">Evaluate the Post-fix Expression using Stack ADT</td></tr>
<tr><td>9.</td><td colspan="8">Implementation of Binary Search Tree traversals</td></tr>
<tr><td>10.</td><td colspan="8">Implementation of sorting algorithms: Insertion and Quick sort</td></tr>
<tr><td colspan="9" align="right">Lecture:45, Practical:30, Total:75</td></tr>
<tr><td colspan="9">TEXT BOOK:</td></tr>
<tr><td>1.</td><td colspan="8">Weiss M. A., "Data Structures and Algorithm Analysis in C", 2nd Edition, Pearson Education Asia, New Delhi, 2016.</td></tr>
<tr><td colspan="9">REFERENCES/ MANUAL / SOFTWARE:</td></tr>
<tr><td>1.</td><td colspan="8">Horowitz Sahni, Andreson Freed, "Fundamentals of Data Structures in C", 2nd Edition, Universities Press, Hyderabad, 2011.</td></tr>
<tr><td>2.</td><td colspan="8">Langsam Y.M., Augenstein J. and Tenenbaum A. M., “Data Structures using C and C++”, 2nd Edition, Pearson Education, 2015.</td></tr>
</table>

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	apply List ADT for solving the given problems	Applying (K3)
CO2	make use of arrays and linked lists to create Stack and Queue ADTs.	Applying (K3)
CO3	utilize Tree ADT to develop simple application	Applying (K3)
CO4	make use of Graph ADT for standard problems	Applying (K3)
CO5	illustrate the use of standard sorting and Hashing Techniques	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	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 – 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	40	50				100
CAT2	5	35	60				100
CAT3	5	35	60				100
ESE	5	35	60				100

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

22EIT21 - ELECTRICAL MACHINES								
Programme & Branch	**B.E. & Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**2/5**	**ES/PC**	**3**	**0**	**0**	**3**

Preamble	This course discusses the construction, operation and behavior of various electrical machines used in real time applications.	
Unit – I	**DC Machines:**	**9**
DC Generator: Principle of working – construction –classification – EMF equation – Applications. DC Motor: Construction and Principle of Operation–Back EMF –Torque Equation, Characteristics of Series and Shunt motor – Starters : Three Point starter – Speed Control: Armature and Field Control- Applications.		
Unit – II	**Transformer:**	**9**
Single Phase Transformer: Construction of a Transformer – Types– E.M.F. Equation– Voltage Transformation Ratio (K) –Simplified Equivalent Circuit of a Loaded Transformer. Open-circuit Test – Short-circuit Test –Voltage Regulation– Efficiency of a Transformer. Autotransformer: Principle of Operation and Applications.		
Unit – III	**Induction Motors:**	**9**
Three-phase Induction Motors: Construction –Squirrel Cage and Slip-Ring rotors - Principle of Operation – Slip – Torque-Slip Characteristics. Methods of Starting of 3-Phase Induction Motors –Speed Control. Single-Phase Induction Motors: Types–Self-Starting –Split-Phase Induction Motor – Capacitor-Start Motor – Capacitor-Start Capacitor-Run Motor – Shaded-Pole Motor-Applications.		
Unit – IV	**Synchronous Machines:**	**9**
Construction-Principle of Operation of generator and Motor– Types of rotors– EMF Equation of generator–Starting Methods of Synchronous Motor-V Curves and Inverted V curves – Applications.		
Unit – V	**Special Machines:**	**9**
Construction, Principle of Operation and Applications: Universal Motor – Brushless D.C. Motor–Stepper Motor: Permanent Magnet-Variable Reluctance –Hybrid. D.C. Servomotor – A.C. Servomotor.		
		Total:45

TEXT BOOK:

1.	Mehta V.K. and Rohit Mehta, "Principles of Electrical Machines", 2nd Edition, S.Chand & Co. Ltd., New Delhi, 2016.

REFERENCES:

1.	Rajput R.K.,"Electrical Machines", 6th Edition, Laxmi Publications, New Delhi, 2018
2.	Gupta J.B., "Electrical Machines", 4th Edition, S.K. Kataria& Sons, New Delhi, Reprint 2014
3.	Theraja B.L. and Theraja A.K, "A text book of Electrical Technology", Vol.II, S.Chand & Co. Ltd., New Delhi, Reprint-2012.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	describe the construction and operation of DC Machines	Understanding (K2)
CO2	assess the performance characteristics of machines	Applying (K3)
CO3	outline the starting and speed control techniques of DC and AC Motors	Understanding (K2)
CO4	identify suitable electrical machine for various applications	Understanding (K2)
CO5	describe the construction and operation of special machines	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											2	2
CO2	3	2	1	1	1								3	3
CO3	3	1											2	2
CO4	3	1											2	2
CO5	3	1											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	60	20				100
CAT3	20	60	20				100
ESE	20	60	20				100

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

22CYL11 - CHEMISTRY LABORATORY FOR ELECTRICAL SYSTEMS							
(Common to ECE, EEE and EIE Branches)							
Programme & Branch	**B.E - ECE, EEE & EIE**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**1 / 2**	**BS**	**0**	**0**	**2**	**1**

Preamble	This course aims to impart the basic concepts of volumetric, conductometric, potentiometric, viscometry, spectrophotometric and pH metry experiments for the estimation of given samples and thereby, to improve the analytical skills. This course also aims to impart the significance of DO, alkalinity, Cu^{2+} and Cr^{6+} in electrical systems.

LIST OF EXPERIMENTS / EXERCISES:	
1.	Iodometric analysis of copper content from discarded PCBs.
2.	Volumetric analysis of chromium prepared from electroplating sludge.
3.	Find the amount of mineral acids present in the given solution by conductometric based sensor electrode.
4.	Determination of concentration of H^+ ion in a solution using H^+ sensing electrode.
5.	Potentiometric approach using a Pt electrode for the estimation of iron in the given sample.
6.	Determination of molecular weight of a polymer / liquid by Ostwald viscometer.
7.	Spectrophotometric method for the determination of Iron in steel.
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.	Estimation of alkalinity of river and borewell water collected from different places.
10.	Determination of dissolved oxygen in the given wastewater sample.
11.	Electroplating process (Demonstration).
12.	Proximate analysis of Coal- determines moisture, volatile matter and ash content of a given sample of coal (Demonstration).
	Total:30

REFERENCES/ MANUAL /SOFTWARE:	
1.	Palanisamy P.N., Manikandan P., Geetha A. and Manjula Rani K., “Chemistry Laboratory Manual”, 1st Edition, Rajaganapathy Publishers, Erode, 2022.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	estimate the amount of hardness, alkalinity, DO, Cu and Cr present in the given sample.	Applying (K3), Precision (S3)
CO2	analyze the amount of acids present in the given sample using conductivity and pH meter.	Applying (K3), Precision (S3)
CO3	demonstrate the potentiometric and spectrophotometric method for the estimation of Fe and Viscometer for the determination of molecular weight of a polymer.	Applying (K3), Precision (S3)

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	2	1	3			3							
CO2	3	2	1	3			3							
CO3	3	2	1	3			2							

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

22GCL11 – FOUNDATION LABORATORY - MANUFACTURING, DESIGN AND ROBOTICS							
(Common to all BE/BTech branches)							
Programme& Branch	**All BE/BTech branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**1 / 2**	**ES**	**0**	**0**	**6**	**3**

Preamble	This course is designed to provide foundational knowledge on engineering with hands-on experience on developing a prototype model with the basic knowledge of Computer-aided Design, Manufacturing Processes, 3D Printing Technology, Robotics and Embedded Control.

LIST OF EXPERIMENTS / EXERCISES:

PART A – Manufacturing (30 Hours)	
1.	Selection of product, free hand sketching and detailing
2.	Construction of model using Arc/TIG/MIG/Gas/Spot welding operations
3.	Enhancing the model with sheet metal
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.	3D part modelling of the component using CAD software
3.	Engineering Analysis of the component model
4.	Generate the component using 3D printer
5.	Value addition to the produced component using CNC milling machine, CNC laser cutting machine and CNC router
PART C – Robotics (30 Hours)	
1.	Design of electronic circuit and its debugging
2.	Interfacing of sensors, actuators and wireless communion modules with microcontroller
3.	Assembly of Tracker Robot with accessories
4.	Development of control strategies for motion control, path planning and obstacle avoidance
5.	Demonstration and testing of Robot in static environment
	Total:90

REFERENCES/ MANUAL /SOFTWARE:

1.	Laboratory Manual
2.	AutoCAD 2020 and SOLID WORKS 2018 Software

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	develop the prototype model using mechanical operations like welding, forming and machining processes	Applying (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 Router	Applying (K3), Precision (S3)
CO3	design and develop the autonomous robot for real-time applications	Applying (K3), Precision (S3)

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	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 – Moderate, 3 – Substantial, BT- Bloom’s Taxonomy

22EIL21 - DEVICES AND MACHINES LABORATORY							
Programme & Branch	**B.E. & Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**2**	**ES**	**0**	**0**	**2**	**1**

Preamble	This laboratory aims for a better understanding of the operation of electronic circuits and give practical exposure to learn the characteristics of AC and DC machines

LIST OF EXPERIMENTS / EXERCISES:

1.	Clipper and clamper circuits using diodes
2.	Determination of hybrid parameters in CE configuration
3.	Determination of FET parameters.
4.	BJT based RC Phase shift oscillator
5.	Verification of UJT as relaxation oscillator
6.	Load test on DC series motor
7.	Speed control of DC shunt motor
8.	Load test on squirrel cage induction motor
9.	Predetermination of efficiency and regulation on single phase transformer
10.	Load test on three phase alternator

Total:30

REFERENCES/ MANUAL /SOFTWARE:

1.	Devices and Circuits Lab Manual

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	Determine the characteristics and parameters of transistors	Applying (K3), Precision (S3)
CO2	Generate waveforms using PN junction diode and BJT	Applying (K3), Precision (S3)
CO3	demonstrate the performance characteristics of DC and AC machines	Applying (K3), Precision (S3)

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	2	1	3	1	1		1	2	3		1	3	3
CO2	3	3	1	3	1	1		1	2	3		1	3	3
CO3	3	3	1	3	1	1		1	2	3		1	3	3

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

22ITC31 - JAVA PROGRAMMING							
(Common to ECE,EEE,EIE,MTS Engineering Branches)							
Programme& Branch	**ECE,EEE,EIE,MTS**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Problem Solving and Programming in C**	**3**	**ES**	**3**	**0**	**2**	**4**

Preamble	This course provides the fundamental object-oriented concepts of Java programming including inheritance, exception handling, multithreading, Generics, and Collections.

Unit – I	**Classes and Objects**	**9**
History and Evolution of Java – An Overview of Java–Data Types, Variables and Arrays– Operators –Control Statements– Classes: Class Fundamentals-objects – Assigning Object Reference Variables – Introducing Methods –Constructors – this keyword – Garbage Collection – Stack Class.		
Unit – II	**Inheritance, Packages, and Interfaces**	**9**
Overloading Methods – Objects as Parameters –Argument Passing – Returning Objects –Recursion–Access Control–Static – Nested and Inner Classes–Command–Line Arguments – Variable Length Arguments. Inheritance – Basics– Super keyword - Multilevel Hierarchy-Method Overriding–Dynamic Method Dispatch –Abstract Classes – final with Inheritance. Packages and Interfaces: Packages and Member Access- Importing Packages – Interfaces.		
Unit – III	**Exception Handling and Multithreading**	**9**
Exception Handling basics – Multiple catch Clauses – Nested try Statements – Java's Built-in Exceptions – User-defined Exception. Multithreaded Programming: Java Thread Model - Creating a Thread and Multiple Threads – Priorities – Synchronization – Inter Thread Communication- Suspending – Resuming, and Stopping Threads –Multithreading.		
Unit – IV	**I/O and Generics**	**9**
Enumerations – Wrappers – Auto boxing – Annotation Basics. I/O Basics – Reading and Writing Console I/O –Reading and Writing Files. Generics: Introduction – Generic Classes & Methods - Example–Parameters, Constructors and Interfaces		
Unit – V	**String Handling and Collections**	**9**
String Handling: String constructors – operations – Character Extraction – String Comparison – Searching Strings – Modifying Strings – String Buffer. Collection Framework: Overview – Collection Interfaces – Collection Classes.		

LIST OF EXPERIMENTS / EXERCISES:

1.	Write Java programs using operators, arrays, and control statements
2.	Develop a stack and queue data structures using classes and objects
3.	Program to demonstrate inheritance & polymorphism
4.	Develop an application using interfaces by accessing superclass constructors and methods
5.	Develop applications using packages and exception handling
6.	Program to demonstrate thread concepts
7.	Write Java program to illustrate file and string manipulations
8.	Implement Java program to illustrate collection frameworks

Lecture:45, Practical:30, Total:75

TEXT BOOK:

1. Herbert Schildt, "Java: The Complete Reference", 11th Edition, McGraw Hill Education, New Delhi, 2019. (Units I - V)

REFERENCES/ MANUAL / SOFTWARE:

1. Cay S.Horstmann, "Core Java Fundamentals", Eleventh Edition, Prentice Hall, 2018.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	apply the concepts of classes and objects to solve simple problems	Applying (K3)
CO2	develop programs using inheritance, packages, and interfaces	Applying (K3)
CO3	make use of exception-handling mechanisms and multithreaded models to solve real-world problems	Applying (K3)
CO4	develop Java applications with I/O packages and generics concepts	Applying (K3)
CO5	apply string handling functions and collection classes and interfaces	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	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 – 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	10	20	70				100
CAT3	10	20	70				100
ESE	10	20	70				100

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

22EIT31-TRANSDUCERS ENGINEERING							
Programme & Branch	**B.E. & Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
Prerequisites	**Nil**	**3**	**PC**	**3**	**0**	**0**	**3**

Preamble	This course explains the concepts of measurement systems, units and standards. Also it imparts theoretical and practical aspects of resistive, inductive, capacitive and other special types of transducers.	
Unit – I	**Measurements and Instrumentation of Transducers:**	**9**
Block diagram of a Measurement system. Fundamental and Derived units –Standards of Measurement. Classification of Errors: Error analysis, Statistical methods, Odds and uncertainty. Classification of transducers – Selection of transducers.		
Unit – II	**Characteristics of Transducers:**	**9**
Static characteristics: Accuracy, Precision, Resolution, Threshold, Sensitivity, Linearity, Hysteresis, Range and Span. Dynamic characteristics: Impulse and random response of Zero order transducer. Step and Ramp response of First and Second order transducers.		
Unit – III	**Variable Resistance Transducers:**	**9**
Resistive Transducers: Resistance Potentiometer: Loading effect on Potentiometer. Resistance Strain gauges: Unbonded and Bonded type strain gauges. Applications: Temperature Measurement using RTD and Thermistor – Gas flow measurement using hot-wire Anemometer – measurement of moisture in solids and wood – level measurement using resistive tapes.		
Unit – IV	**Variable Inductance Transducers:**	**9**
Inductive Transducers: Simple inductance and Mutual inductance Transducers – Induction Potentiometers. Linear Variable Differential Transformers – Variable reluctance transducers – Eddy current transducers. Applications: Displacement measurement - Thickness Measurement – Position Measurement.		
Unit – V	**Variable Capacitance Transducers and Other Transducers:**	**9**
Capacitive Transducers: Variable area type – Variable dielectric type – Variable distance type. Applications: Capacitive Thickness Transducers–Capacitive Moisture Transducers - Capacitive Level Transducer. Other Transducers: Piezoelectric Transducers - Magnetostrictive Transducers – Hall Effect Transducers – SQUID Sensors –Film sensors – Smart sensors.		
		Total:45

TEXT BOOK:

1.	Vijayachitra S., "Transducers Engineering" 1st Edition, Prentice Hall of India, New Delhi,2016.

REFERENCES:

1.	Murthy D.V.S., “Transducers and Instrumentation”, 2nd Edition, Prentice Hall of India, New Delhi, 2010.
2.	Doebelin E.A., “Measurement Systems: Applications and Design”, 5th Edition, Tata McGraw Hill Publishing Company, New Delhi, 2008.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	explain the measurement of physical quantities, conversion and classification of transducers	Understanding (K2)
CO2	summarize the concepts of various characteristics of Transducers	Understanding (K2)
CO3	apply the selected types of resistive transducers for various applications	Applying (K3)
CO4	apply the selected types of inductive transducers for various applications	Applying (K3)
CO5	apply various types of capacitive transducers and other transducers for selected applications	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	2						1				1	2	2
CO2	3	2						1				1	2	2
CO3	3	3	1	1	1			2				1	3	3
CO4	3	3	1	1	1			2				1	3	3
CO5	3	3	1	1	1			2				1	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	30	70					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)

22EIT36 – SENSORS AND TRANSDUCERS								
Programme & Branch	**BE & Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
Prerequisites	**Nil**	**3**	**PC**	**3**	**0**	**0**	**3**

Preamble	This course explains the concepts of measurement systems, units and standards. Also it imparts theoretical and practical aspects of resistive, inductive, capacitive and other special types of transducers.	
Unit – I	**Measurements and Instrumentation of Transducers:**	
Block diagram of a Measurement system. Fundamental and Derived units –Standards of Measurement. Classification of Errors: Error analysis, Statistical methods, Odds and uncertainty. Classification of transducers – Selection of transducers.		
Unit – II	**Characteristics of Transducers:**	**9**
Static characteristics: Accuracy, Precision, Resolution, Threshold, Sensitivity, Linearity, Hysteresis, Range and Span. Dynamic characteristics: Impulse and random response of Zero order transducer. Step and Ramp response of First and Second order transducers.		
Unit – III	**Variable Resistance Transducers:**	**9**
Resistive Transducers: Resistance Potentiometer: Loading effect on Potentiometer. Resistance Strain gauges: Unbonded and Bonded type strain gauges – Load Cells. Applications: Temperature Measurement using RTD and Thermistor – Gas flow measurement using hot-wire Anemometer – measurement of moisture in solids and wood – level measurement using resistive tapes.		
Unit – IV	**Variable Inductance Transducers:**	**9**
Inductive Transducers: Simple inductance and Mutual inductance Transducers – Induction Potentiometers. Linear Variable Differential Transformers – Variable reluctance transducers – Eddy current transducers. Applications: Displacement measurement - Thickness Measurement – Position Measurement.		
Unit – V	**Variable Capacitance Transducers and Other Transducers:**	**9**
Capacitive Transducers: Variable area type – Variable dielectric type – Variable distance type. Applications: Capacitive Thickness Transducers–Capacitive Moisture Transducers - Capacitive Level Transducer. Other Transducers: Piezoelectric Transducers - Magnetostrictive Transducers – Hall Effect Transducers – SQUID Sensors –Film sensors – Vibration Transducer - Smart sensors. Self-Generating Sensors : Pyroelectric Sensors.		
		Total:45

TEXT BOOK:

1.	Vijayachitra S., "Transducers Engineering" 1st Edition, Prentice Hall of India, New Delhi,2016.

REFERENCES:

1.	Murthy D.V.S., “Transducers and Instrumentation”, 2nd Edition, Prentice Hall of India, New Delhi, 2010.
2.	Doebelin E.A., “Measurement Systems: Applications and Design”, 5th Edition, Tata McGraw Hill Publishing Company, New Delhi, 2008.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	explain the measurement of physical quantities, conversion and classification of transducers	Understanding (K2)
CO2	summarize the concepts of various characteristics of Transducers	Understanding (K2)
CO3	apply the selected types of resistive transducers for various applications	Applying (K3)
CO4	apply the selected types of inductive transducers for various applications	Applying (K3)
CO5	apply various types of capacitive transducers and other transducers for selected applications	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	2						1				1	2	2
CO2	3	2						1				1	2	2
CO3	3	3	1	1	1			2				1	3	3
CO4	3	3	1	1	1			2				1	3	3
CO5	3	3	1	1	1			2				1	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	30	70					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)

22EIT32 - ANALOG INTEGRATED CIRCUITS							
Programme & Branch	**B.E. &Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**3/4**	**PC**	**3**	**0**	**0**	**3**

Preamble	Analog Integrated Circuits course dealt with circuits of signals free to vary from zero to full power supply voltage. The contents in this course make use of integrated circuit components constructed using opamps and special function ICs.

Unit – I	**Basics and Characteristics of OPAMP:**	**9**
Introduction-Basics information of operational amplifier -Ideal operational amplifier –Operational amplifier Internal Circuit-Differential Amplifier-Transfer Characteristics. DC Characteristics: Input bias current-Input offset current-Input offset voltage -Thermal drift. AC characteristics: Frequency response-Frequency Compensation -Slew Rate.		
Unit – II	**Applications of Operational Amplifier:**	**9**
Introduction-Inverting, Non inverting, Voltage follower, Summing Amplifier, Subtractor, Differentiator, Integrator, Comparators. Wave generators: Schmitt trigger, Astable and Monostable Multivibrator - RC phase shift oscillator. Precision diode. Active Filters: I order Low pass filters.		
Unit – III	**D-A and A-D Converters**:	**9**
Characteristics: Resolution, Quantization, Range, Settling time. Digital to Analog Converter: Types: Weighted R, R-2R and Inverted R-2R. Analog to Digital Converter: Types: Flash type, Dual slope, and Successive approximation, Sigma delta.		
Unit – IV	**Special ICs**:	**9**
Timer (IC 555) Introduction- Description of Functional block diagram - Monostable and Astable mode of operation. Voltage controlled oscillator (IC 566) – Monolithic Phase locked loop (IC 565).Voltage regulator IC: Series op-amp regulator (78XX) –Switching Mode Power Supply (SMPS).		
Unit – V	**Analog Signal Conditioning**:	**9**
Introduction- Analog Data Representation- Signal Level and Bias Changes, Linearization, conversions, Signal transmission: Current to Voltage converter. Differential Instrumentation Amplifier –Common mode rejection, Differential and Common Mode gain. Analog Controllers: Proportional, Integral and Derivative mode Controllers.		
		Total:45

TEXT BOOK:

1.	Roy Choudhury D. and Shail Bala Jain," Linear Integrated Circuits", 5th Edition, Reprint, New Age International Publishers, New Delhi, 2018.

REFERENCES:

1.	Curtis D. Johnson, "Process Control Instrumentation Technology", 8th Edition, Pearson Education Limited, London, 2015.
2.	Sergio Franco, "Design with Operational Amplifiers and Analog Integrated Circuits", 4th Edition, Tata McGraw-Hill, New Delhi, 2016.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	interpret the basics and characteristics of opamp	Understanding (K2)
CO2	apply the circuit of opamp for mathematical operation, waveform generation and filter.	Applying (K3)
CO3	implement A/D and D/A converters for real time application	Applying (K3)
CO4	summarize the functional blocks of special ICs.	Applying (K3)
CO5	develop analog signal conditioning circuits using opamp circuits	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	2											2	2
CO2	3	3	1	1	1								3	3
CO3	3	3	1	1	1								3	3
CO4	3	3	1	1	1								3	3
CO5	3	3	1	1	1								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	10	50	40				100
CAT2	10	20	70				100
CAT3	10	20	70				100
ESE	10	20	70				100

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

22EIT33 - DIGITAL LOGIC CIRCUITS							
Programme & Branch	**B.E. & Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**3**	**PC**	**3**	**1**	**0**	**4**

Preamble	To impart the acquaintance about Boolean algebra, logic gates, combinational and sequential logic, logic families, memory and programmable logic devices	
Unit – I	**Boolean Algebra and Minimization Techniques:**	**9+3**
Number systems and conversions **–** Boolean logic operations – Basic laws of Boolean Algebra – DeMorgan's theorems – Sum of Products and Product of Sums – Karnaugh Map (Two-variable, Three variable, Four-variable) – Quine McCluskey or Tabular method of minimization of logic functions -Don't care condition– Logic gates.		
Unit – II	**Combinational Circuits:**	**9+3**
Procedure for the Design of Combinational circuits – Half adder – Full adder – Half subtractor – Full subtractor – Multiplexers: 4-to-1 and 8-to-1 Multiplexers, Implementation of Boolean expressions using multiplexers – Demultiplexers: 1-to-4 and 1-to-8 Demultiplexers – Decoders: 3-to-8 and 4-to-16 Decoders. Encoders: Octal-to-Binary Encoder – Parity Checkers– Code Converters: BCD-to-Binary converters, Binary-to-Gray code converters – Magnitude Comparators: Single bit Magnitude Comparator		
Unit – III	**Synchronous Sequential Circuits:**	**9+3**
Latches and Flip-flops: Latches – Flip-Flops – S-R, D, J-K and T Flip-flops – Triggering and Characteristics equations of Flip-flops- Master-Slave Flip-flops Realization of one Flip-flop using other Flip-flops - Synchronous Sequential Circuits: General sequential circuit model – Design of synchronous sequential circuits - State reduction and assignment - Analysis of synchronous sequential circuits –Design of synchronous counters: Design of MOD-3 counter –Shift Registers: Universal shift registers.		
Unit – IV	**Asynchronous Sequential Circuits:**	**9+3**
Design of Fundamental mode asynchronous sequential circuits-primitive state / flow table- Problems in asynchronous circuits: Cycles, Races, Hazards –Design of hazard free switching circuits: Static, Dynamic and Essential hazards elimination – Asynchronous counter.		
Unit – V	**Logic Families and Memory:**	**9+3**
Logic Families: Introduction – Characteristics of Digital ICs: Speed of operation, Power dissipation, Fan-in, Fan-out, Noise immunity or noise margin - Transistor Transistor Logic (TTL): Two input TTL NAND Gate – Emitter Coupled Logic (ECL): Inverter. Memory and Programmable Logic Devices: Introduction – Classification of memories – Basic memory structure - Read Only Memory (ROM) : Architecture and types – Random Access Memory (RAM) - Types of RAM: Static RAM, Dynamic RAM - Introduction to PLA, PAL and FPGA.		
		Lecture:45, Tutorial:15, Total:60

TEXT BOOK:

1.	Salivahanan S., and Arivazhagan S., "Digital Circuits and Design", 5th Edition, Oxford University Press, New Delhi, 2018.

REFERENCES:

1.	M. Morris R. Mano, and Michael D. Ciletti, "Digital Design with an Introduction to the Verilog HDL, VHDL, and System Verilog", 6th Edition, Pearson Education, New Delhi, 2018.
2.	AnandKumar A., "FundamentalsofDigitalCircuits", 4th Edition, Prentice Hall of India, New Delhi, 2016.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	simplify the boolean expressions	Applying (K3)
CO2	implement the combinational logic circuits	Applying (K3)
CO3	apply synchronous sequential logic for implementing digital circuits	Applying (K3)
CO4	implement digital circuits using asynchronous sequential logics	Applying (K3)
CO5	identify the role of logic families and memory devices	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	3	1	1	1								3	3
CO2	3	3	1	1	1								3	3
CO3	3	3	1	1	1								3	3
CO4	3	3	1	1	1								3	3
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	10	30	60				100
CAT2	10	30	60				100
CAT3	10	40	50				
ESE	5	25	70				100

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

<table>
<tr><td colspan="8">22EIT34 - ELECTRICAL MEASUREMENTS AND INSTRUMENTATION</td></tr>
<tr><td>Programme & Branch</td><td>B.E. &Electronics and Instrumentation Engineering</td><td>Sem.</td><td>Category</td><td>L</td><td>T</td><td>P</td><td>Credit</td></tr>
<tr><td>Prerequisites</td><td>Nil</td><td>3</td><td>PC</td><td>3</td><td>1</td><td>0</td><td>4</td></tr>
</table>

<table>
<tr><td>Preamble</td><td colspan="2">The course imparts the knowledge on Principles, Constructions, Dynamics of Electrical and Electronic Measuring Instruments. It discusses the comprehensive techniques for measurement of current, voltage, power energy with Instruments, Potentiometers and Bridges.</td></tr>
<tr><td>Unit – I</td><td>Measurement of Voltage and Current:</td><td>9+3</td></tr>
<tr><td colspan="3">Introduction to essential requirements of instruments- Three operating forces of analog instruments - Permanent Magnet Moving Coil (PMMC): Construction of PMMC Instruments - Torque Equation- Ammeter Shunts- Voltmeter Multipliers. Moving Iron Instruments: General Torque Equation - Classification – Construction - Comparison between Attraction and Repulsion types of Instruments.</td></tr>
<tr><td>Unit – II</td><td>Measurement of Power and Energy:</td><td>9+3</td></tr>
<tr><td colspan="3">Introduction to Electrodynamometer type instruments- Electrodynamometer Wattmeter: Construction – Theory- Torque Equation- Errors. Single Phase Induction Type Meters: Construction –Theory and Operation of Single Phase Induction Type Energy Meters .Testing of Energy Meters: Phantom loading.</td></tr>
<tr><td>Unit – III</td><td>Potentiometers and Instrument Transformers:</td><td>9+3</td></tr>
<tr><td colspan="3">D.C. Potentiometers: Introduction - Basic Potentiometer Circuit – Standardization - Laboratory type (Crompton’s) potentiometer – Applications.
Instrument Transformers: use of Instrument transformers- Ratios-Burden. Design Features of C.T Current Transformers (C.T) – Potential Transformers (P.T). Difference between C.T and P.T. Measurement of Power using Instrument Transformers.</td></tr>
<tr><td>Unit – IV</td><td>Measurement of Resistance and Impedance with Bridges:</td><td>9+3</td></tr>
<tr><td colspan="3">Classification of Resistances- Measurement of Medium Resistance - Wheat Stone Bridge - Limitations of Wheat Stone Bridge. Low Resistance- Kelvin Double Bridge. High Resistance – Meggar (Earth tester). A.C. Bridges: Introduction - Sources and Detectors - Measurement of Self Inductance & Capacitance: Maxwell’s Inductance Bridge - Capacitance Bridge - Anderson’s Bridge - Schering Bridge - Wien’s Bridge- Sources of Errors in Bridge Circuits.</td></tr>
<tr><td>Unit – V</td><td>Digital Instrumentation (Block Diagram Approach):</td><td>9+3</td></tr>
<tr><td colspan="3">Digital Multimeter, Cathode Ray Oscilloscope. Impedance Measurement: Q meter. RMS Measurement: True RMS Meters. Digital meters: Time, Period and Frequency measurements. Digital Voltmeters: Ramp type Voltmeters. Shielding and Grounding.</td></tr>
<tr><td colspan="3" align="right">Lecture:45, Tutorial:15, Total:60</td></tr>
</table>

TEXT BOOK:

1.	Sawhney A.K. “A Course in Electronic Measurements and Instrumentation",2nd Edition, DhanpatRai & Co. Pvt. Ltd, New Delhi ,2015.

REFERENCES:

1.	Robert B. Northrop, “Introduction to Instrumentation and Measurements”, 3rd Edition, CRC Press, 2017.
2.	Kalsi, H.S., “Electronic Instrumentation”, 3rdedition, Tata McGraw Hill Publishing Company, New Delhi, 2012.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	utilize the working principle of meters for measurement of Voltage and Current	Applying (K3)
CO2	utilize the working principle of meters for measurement of Power and Energy	Applying (K3)
CO3	apply potentiometers and instrument transformers for measurement of electrical parameters.	Applying (K3)
CO4	measure the unknown impedance using AC bridges	Applying (K3)
CO5	explore the recent developments in Digital Measurements and Instruments	Understanding (K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO2
CO1	3	2	1	1	1								3	3
CO2	3	2	1	1	1								3	3
CO3	3	2	1	1	1								3	3
CO4	3	2	1	1	1								3	3
CO5	3	1											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	10	60	30				100
CAT2	10	60	30				100
CAT3	10	75	15				100
ESE	10	60	30				100

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

22EIT37- ELECTRICAL AND ELECTRONIC MEASUREMENTS AND INSTRUMENTATION

Programme & Branch	**BE & Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
Prerequisites	**Nil**	**3**	**PC**	**3**	**0**	**0**	**3**

Preamble	The course imparts the knowledge on Principles, Constructions, Dynamics of Electrical and Electronic Measuring Instruments. It discusses the comprehensive techniques for measurement of current, voltage, power energy with Instruments, Potentiometers and Bridges.	
Unit – I	**Measurement of Voltage and Current:**	
Introduction to essential requirements of instruments- Three operating forces of analog instruments - Permanent Magnet Moving Coil (PMMC): Construction of PMMC Instruments - Torque Equation- Ammeter Shunts- Voltmeter Multipliers. Moving Iron Instruments: General Torque Equation - Classification – Construction - Comparison between Attraction and Repulsion types of Instruments.		
Unit – II	**Measurement of Power and Energy:**	**9**
Introduction to Electrodynamometer type instruments- Electrodynamometer Wattmeter: Construction – Theory- Torque Equation- Errors. Single Phase Induction Type Meters: Construction –Theory and Operation of Single Phase Induction Type Energy Meters .Testing of Energy Meters: Phantom loading.		
Unit – III	**Potentiometers and Instrument Transformers:**	**9**
D.C. Potentiometers: Introduction - Basic Potentiometer Circuit – Standardization - Laboratory type (Crompton's) potentiometer – Applications. Instrument Transformers: use of Instrument transformers- Ratios-Burden. Design Features of C.T Current Transformers (C.T) – Potential Transformers (P.T). Difference between C.T and P.T. Measurement of Power using Instrument Transformers.		
Unit – IV	**Measurement of Resistance and Impedance with Bridges:**	**9**
Classification of Resistances- Measurement of Medium Resistance - Wheat Stone Bridge - Limitations of Wheat Stone Bridge. Low Resistance- Kelvin Double Bridge. High Resistance – Meggar (Earth tester). A.C. Bridges: Introduction - Sources and Detectors - Measurement of Self Inductance & Capacitance: Maxwell's Inductance Bridge - Capacitance Bridge - Anderson's Bridge - Schering Bridge - Wien's Bridge- Sources of Errors in Bridge Circuits.		
Unit – V	**Digital Instrumentation (Block Diagram Approach):**	**9**
Digital Multimeter, Cathode Ray Oscilloscope. Impedance Measurement: Q meter. RMS Measurement: True RMS Meters. Digital meters: Time, Period and Frequency measurements. Digital Voltmeters: Ramp type Voltmeters. Shielding and Grounding.		
		Total:45

TEXT BOOK:

1.	Sawhney A.K. "A Course in Electronic Measurements and Instrumentation",2nd Edition, DhanpatRai & Co. Pvt. Ltd, New Delhi ,2015.

REFERENCES:

1.	Robert B. Northrop, "Introduction to Instrumentation and Measurements", 3rd Edition, CRC Press, 2017.
2.	Kalsi, H.S., "Electronic Instrumentation", 3rd Edition, Tata McGraw Hill Publishing Company, New Delhi, 2012.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	utilize the working principle of meters for measurement of Voltage and Current	Applying (K3)
CO2	utilize the working principle of meters for measurement of Power and Energy	Applying (K3)
CO3	apply potentiometers and instrument transformers for measurement of electrical parameters	Applying (K3)
CO4	measure the unknown impedance using AC bridges	Applying (K3)
CO5	explore the recent developments in Digital Measurements and Instruments	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	2	1	1	1			2				1	3	3
CO2	3	2	1	1	1			2				1	3	3
CO3	3	2	1	1	1			2				1	3	3
CO4	3	1	1	1	1			1				1	3	3
CO5	3	1						2				1	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	10	60	30				100
CAT2	10	60	30				100
CAT3	10	60	30				100
ESE	10	60	30				100

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

22EIC31 - NETWORKS, SIGNALS AND SYSTEMS							
Programme & Branch	**BE & Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**3**	**PC**	**3**	**0**	**2**	**4**

Preamble	To impart knowledge on electric circuit analysis and to provide fundamental concepts of continuous and discrete signals and systems.	
Unit – I	**Steady State Analysis:**	**9**
DC Circuit: Review of electric circuit elements and Kirchhoff's Laws-Dependent and independent sources- open and short circuits-Source transformation-Voltage and current relationship in R,L and C. **AC Circuit: Single phase:** Phase relation in resistor, inductor, capacitor-Phasor diagram-Series RLC circuits-power and power factor. **Three phase:** Interconnection of three phase sources and loads –line and phase quantities. Power measurement in three phase balanced circuits: Two wattmeter method.		
Unit – II	**Network Theorems:**	**9**
Mesh analysis-Nodal Analysis – Source transformation - Star-Delta transformation -Superposition theorem – Thevenin's and Norton's theorem-Maximum Power transfer theorem.		
Unit – III	**Time and Frequency Domain Analysis:**	**9**
DC Transient response analysis: - Steady state analysis of RL, RC and RLC series circuits. R**esonance analysis:** Ideal RLC series and parallel resonance-Impedance and current variations- Bandwidth-Q factor- Magnification factor.		
Unit – IV	**Continuous and Discrete Time Signals:**	**9**
Classification- Analog to Digital conversion- Sampling – Aliasing - Signal representation: step, ramp, parabolic, sinusoidal and exponential. Periodical signals-Odd and Even signals-Energy and Power signals - Signal transformations.		
Unit – V	**Continuous and Discrete Time Systems:**	**9**
Classification of systems: static and dynamic -time variant and invariant – linear and nonlinear - stable and unstable- causal and non causal-recursive and non recursive. Relation between Laplace and Z transform-Response analysis of linear systems with impulse and step input in continuous and discrete domain using Laplace and Z transform.		

LIST OF EXPERIMENTS / EXERCISES:

1.	Determination of effective resistance in DC circuit using Star -Delta transformation
2.	Verification of Superposition theorem in DC circuits
3.	Experimental verification of Maximum Power Transfer theorem
4.	Measurement of current, voltage, power and power factor in single phase load
5.	RC transient response analysis
6.	Frequency response analysis of RLC circuits
7.	Verification of periodicity in analog signals using MATLAB
8.	Verification of periodicity in digital signals using MATLAB
9.	Stability analysis of continuous -time systems using MATLAB
10.	Stability analysis of discrete-time systems using MATLAB

Lecture:45, Practical:30, Total:75

TEXT BOOK:

1.	Sudhakar A and Shyammohan S Palli , "Circuits and Networks Analysis and Synthesis", 4th Edition , Tata McGraw-Hill, New Delhi, 2010 for Unit I,II,III
2.	NagoorKani A., "Signals and Systems", McGraw Hill Education(India) Pvt. Ltd., New Delhi, 2010 for Unit IV,V

REFERENCES:

1.	Ravish R. Singh, "Networks Analysis and Synthesis", 2 nd Edition, McGraw Hill Education (India) Pvt. Ltd., New Delhi, 2019.
2.	William H. Hayt, Jr. Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuit Analysis", McGraw Hill Science Engineering, 8th Edition, 2016.
3.	Salivahanan S. "Digital Signal Processing", 4th Edition, Tata McGraw Hill , New Delhi, 2020

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	determine the steady state analysis in DC and AC circuits	Applying (K3), Precision (S3)
CO2	interpret the behavior of DC resistive circuits using network theorems	Analyzing (K4), Precision (S3)
CO3	assess the characteristics of RLC circuits in time and frequency domain	Applying (K3), Precision (S3)
CO4	analyze continuous- time signals in time and frequency domain	Analyzing (K4), Precision (S3)
CO5	analyze discrete- time systems in time and frequency domain	Analyzing (K4), Precision (S3)

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	3	1	1	1								3	3
CO2	3	3	2	2	2								3	3
CO3	3	2	1	3	1	1		1	2	3		1	3	3
CO4	3	3	1	3	1	1		1	2	3		1	3	3
CO5	3	3	1	3	1	1		1	2	3		1	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	5	20	65	10			100
CAT2	5	20	65	10			100
CAT3	5	20	65	10			100
ESE	5	20	65	10			100

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

22MNT31 - ENVIRONMENTAL SCIENCE								
(Common to All BE/BTech branches)								
Programme & Branch	**All B.E/B.Tech Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**3 / 6**	**MC**	**2**	**0**	**0**	**0**
Preamble	This course provides an approach to understand the various natural resources, ecosystem, bio-diversity, pollution control & monitoring methods for sustainable life and also to provide knowledge and to create awareness for engineering students on biological sciences.						
Unit – I	**Environmental Studies and Natural Resources**						**5**
Introduction to Environmental Science – uses, over-exploitation and conservation of forest, water, mineral, food, energy and land resources–case studies							
Unit – II	**Ecosystem and Biodiversity**						**5**
Ecosystems: 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, acid rain, ozone layer depletion (b)Water pollution (c) Soil pollution - Role of an individual in prevention of pollution - case studies.							
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	**Introduction to Biological Science**						**5**
Functions of Carbohydrates, lipids, proteins and nucleic acids - Cells and its organelles - plasma membrane, mitochondria and nucleus- Heredity and DNA - organization of DNA in cells - Genes and chromosomes- Cell division -Types of cell division- mitosis & meiosis - Cell cycle and molecules that control cell cycle.							
							Total:25

TEXT BOOK:

1.	Anubha Kaushik, and Kaushik C.P., “Environmental Science and Engineering”, 6th Multicolour Edition, New Age International Pvt. Ltd., New Delhi, 2018, for Unit-I, II, III, IV.
2.	Rastogi.SC, “Cells and Molecular Biology”, 2nd Edition, reprint, New Age International (P) Limited Publishers, New Delhi, 2008, for Unit-V.

REFERENCES:

1.	Palanisamy P.N., Manikandan P., Geetha A., Manjula Rani K., Kowshalya V.N., “Environmental Science”, Pearson Education, New Delhi, Revised Edition 2019.
2.	Mukhtar Ahmad, “Text book of modern biochemistry", Volume I & II, Oxford & IBH Publishing Co. Pvt. LTD, Delhi, 1995.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	illustrate the various natural resources and role of individual for its conservation	Understanding (K2)
CO2	elaborate the features of ecosystem and biodiversity to find the need for conservation.	Understanding (K2)
CO3	manipulate the sources, effects and control methods of various environmental pollution.	Applying (K3)
CO4	make use of the knowledge of EIA and environmental legislation laws towards sustainability.	Applying (K3)
CO5	explain the functions of carbohydrates, lipids, proteins, nucleic acids, Cells and its organelles	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	2	1					3							
CO2	2	1					3							
CO3	3	2	1				3							
CO4	3	2	1				3							
CO5	3	1												

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	NA						
ESE	NA						

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

22EIL31 – TRANSDUCERS AND MEASUREMENTS LABORATORY							
Programme & Branch	**B.E. & Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**3**	**PC**	**0**	**0**	**2**	**1**

Preamble	To infer the characteristics of various transducers and Perform various electrical measurements using Instruments and Bridges.

LIST OF EXPERIMENTS / EXERCISES:

1.		Measurement of temperature using thermocouple, thermistor and resistance temperature detector and infer their I-O characteristics
2.		Measurement of strain using strain gauge and load cell and infer their characteristics as resistance transducers.
3.	(a) (b)	Measurement of displacement using inductive transducer and test its characteristics Test the characteristics of DC potentiometer as resistance transducer
4.		Measurement of speed using photoelectric tachometer and proximity sensor
5.	(a) (b)	Test the characteristics of Hall effect transducers Test the characteristics of Piezoelectric transducer.
6.		Range extension for DC ammeter and Voltmeter.
7.		Calibration of single phase Energy meter and LPF Wattmeter using Phantom loading and Verification with Trivector meter
8.		Measurement of Current and Voltage using CT and PT
9.		Measurement of Resistance using Wheatstone bridge and Kelvin double bridge
10.		Measurement of Inductance and Capacitance using Anderson's bridge and Schering bridge

Total:30

REFERENCES/ MANUAL /SOFTWARE:

1.	Laboratory Manual

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	grasp and perform the measurements of different physical parameters using transducers and realize the characteristics	Applying(K3), Precision (S3)
CO2	follow the measurement of various electrical quantities using instruments	Applying(K3), Precision (S3)
CO3	determine the unknown resistance, capacitance and inductance using various bridge circuits proficiently	Applying(K3), Precision (S3)

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	2	1	3	1	2		1	2	3		1	3	3
CO2	3	2	1	3	1	2		1	2	3		1	3	3
CO3	3	2	1	3	1	2		1	2	3		1	3	3

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

22EIL32 - ANALOG AND DIGITAL INTEGRATED CIRCUITS LABORATORY

Programme & Branch	**B.E. & Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**3/4**	**PC**	**0**	**0**	**2**	**1**

Preamble	This course provides practical knowledge on Integrated circuits design for given specification. It enables to design and verify analog, digital circuits using ICs and simulation software.

LIST OF EXPERIMENTS / EXERCISES:

1.	Design and Verification of Full adder and Full Subtractor circuits, JK Flip flop, D Flip flop,
2.	Design and implementation of Binary to Gray and Gray to Binary code converters
3.	Design and implementation of Encoder, Decoder and Multiplexers
4.	Design and implementation of 4 – bit modulo counters
5.	Design and implementation of 4-bit shift registers
6.	Design and implementation of inverting and non-inverting amplifiers using operational amplifier
7.	Design and implementation of Adder & Comparator circuits using operational amplifier
8.	Design and implementation of Integrator and Differentiator circuits using operational amplifier
9.	Implementation of NE/SE 555 timer in Astable and Monostable modes
10.	Simulation of opamp based circuits Anadigam and Implementation in FPAA

Total:30

REFERENCES/ MANUAL /SOFTWARE:

1.	Lab Manual
2.	Software: Anadigm tool

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	Design Combinational and Sequential digital circuits using ICs.	Applying(K3), Precision (S3)
CO2	Design linear, non linear, data converters and wave shaping circuits using operational amplifier	Applying(K3), Precision (S3)
CO3	Design circuits with IC555 timer and perform simulation with CAD tools	Applying(K3), Precision (S3)

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	2	1	3	1	2		1	2	3		1	3	3
CO2	3	2	1	3	1	2		1	2	3		1	3	3
CO3	3	2	1	3	1	2		1	2	3		1	3	3

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

22EIL33 - DEVICES AND CIRCUITS LABORATORY							
Programme & Branch	**BE & Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**3**	**PC**	**0**	**0**	**2**	**1**

Preamble	The Devices and circuits lab aims to assist the students in obtaining a better understanding of the operation of electronic circuits experimented by determining the parameters, generating and analyzing the waveforms.

LIST OF EXPERIMENTS / EXERCISES:

1.	Zener diode as voltage regulator
2.	Clipper and clamper circuits using diodes
3..	Determination of hybrid parameters in CE configuration
4.	Determination of FET parameters.
5.	UJT as relaxation oscillator
6.	BJT as Differential Amplifier
7.	Frequency response of BJT amplifier
8.	BJT based RC Phase shift oscillator
9.	BJT based Astable Multivibrator
10.	BJT based Monostable Multivibrator

Total:30

REFERENCES/ MANUAL /SOFTWARE:

1.	Devices and Circuits Lab Manual

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	Determine the characteristics and parameters of transistors	Applying (K3), Precision (S3)
CO2	Generate waveforms using diodes and transistors	Applying (K3), Precision (S3)
CO3	Analyzing the frequency response of BJT	Applying (K3), Precision (S3)

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	2	1	3	1	1		1	2	3		1	3	3
CO2	3	3	1	3	1	1		1	2	3		1	3	3
CO3	3	3	1	3	1	1		1	2	3		1	3	3

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

22EGL31 - COMMUNICATION SKILLS DEVELOPMENT LABORATORY							
(Common to All Engineering and Technology Branches)							
Programme & Branch	**All B.E./B.Tech Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**3 / 4**	**HS**	**0**	**0**	**2**	**1**

Preamble	This course is designed to impart necessary skills to listen, speak, read and write in order to obtain better professional communication skills.

LIST OF EXPERIMENTS / EXERCISES:

1.	Self Introduction & Mock Interview
2.	Job Application letter with Resume
3.	Presentation: A Technical topic / Project report & a Case study
4.	Situational Dialogues / Telephonic Conversations
5.	Group Discussion
6.	Reading Aloud
7.	Listening Comprehension
8.	Writing Company Profiles
9.	Preparing reviews of a book/product/movie
10.	Pronunciation Test
	Total: 30

REFERENCES/ MANUAL /SOFTWARE:

1.	Laboratory Manual
2.	Orell Digital Language Lab Software

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped** **(Highest Level)**
CO1	enhance effective listening and reading skills	Understanding (K2), Imitation (S1)
CO2	acquire professional skills required for workplace/higher education	Applying (K3), Naturalization (S5)
CO3	use English language skills effectively in various situations	Applying (K3), Articulation (S4)

Mapping of COs with POs and PSOs

COs/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1									2	3		3
CO2									2	2		2
CO3									2	2		2

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

22MAT42- TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS							
(Common to Electrical and Electronics Engineering& Electronics and Instrumentation Engineering Branches)							
Programme & Branch	**BE - Electrical and Electronics Engineering& Electronics and Instrumentation Engineering Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**4**	**BS**	**3**	**1**	**0**	**4**

Preamble	To provide the skills for handling discrete and continuous time signals by applying Fourier transform and Z-Transform and impart knowledge in partial differential equations and express functions in terms of Fourier series.	
Unit – I	**Fourier Series:**	**9+3**
Dirichlet's conditions – General Fourier series – Change of interval – Odd and even functions – Half range Sine series – Half range Cosine series – Harmonic analysis.		
Unit – II	**Fourier Transform:**	**9+3**
Fourier Integral theorem (without proof) – Fourier transform pair – Properties (without proof) – Transforms of simple functions – Fourier Sine and Cosine transforms – Properties (without proof) – Convolution theorem and Parseval's identity (Statement and applications only).		
Unit – III	**Z –Transform:**	**9+3**
Definition – Z-transform of some basic functions – Elementary properties – Inverse Z-transform: Partial fraction method – Residue method – Convolution theorem – Applications of Z-transforms: Solution of difference equations.		
Unit – IV	**Partial Differential Equations:**	**9+3**
Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions – Lagrange's linear equation – Solution of homogeneous linear partial differential equations of higher order with constant coefficients.		
Unit – V	**Applications of Partial Differential Equations:**	**9+3**
Classification of second order quasi linear partial differential equations – Solutions of one dimensional wave equation – One dimensional heat equation – Steady state solution of two dimensional heat equation (excluding insulated edges).		
		Lecture:45, Tutorial:15, Total:60

TEXT BOOK:	
1.	Ramana B V, "Higher Engineering Mathematics", 1st Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2018.
REFERENCES:	
1.	Veerarajan T., "Transforms and Partial Differential Equations", 3rd Edition, Tata Mc Graw Hill Education Pvt. Ltd., New Delhi, 2013.
2.	Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, John Wiley & Sons, Limited, 2019.
3.	Grewal B S, "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, New Delhi, 2015.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	express the given function or data in terms of Fourier series.	Applying (K3)
CO2	understand the concept of Fourier transform and its properties which will provide the ability to formulate and solve physical problems in engineering.	Understanding (K2)
CO3	possess knowledge of Z transform to analyze linear time invariant systems.	Applying (K3)
CO4	formulate and solve higher order partial differential equations.	Applying (K3)
CO5	apply Fourier series techniques in solving one and two dimensional heat flow problems and one dimensional wave equations.	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	2	1										2	
CO2	3	3	2										3	
CO3	3	3	2											
CO4	3	2	1										1	
CO5	3	3	2										1	

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	10	30	60	-	-	-	100
CAT2	10	30	60	-	-	-	100
CAT3	10	30	60	-	-	-	100
ESE	10	35	55	-	-	-	100

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

<table>
<tr><td colspan="8">22ITC41 – PROGRAMMING IN PYTHON</td></tr>
<tr><td colspan="8">(Common to ECE, EEE, EIE, MTS Engineering branches)</td></tr>
<tr><td>Programme& Branch</td><td>ECE,EEE,EIE,MTS</td><td>Sem.</td><td>Category</td><td>L</td><td>T</td><td>P</td><td>Credit</td></tr>
<tr><td>Prerequisites</td><td>ProblemSolvingandProgramming in C</td><td>4</td><td>ES</td><td>3</td><td>0</td><td>2</td><td>4</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td>Preamble</td><td colspan="7">This course introduces the core Python programming. It emphasizes developing Python programs with alldatatypes,functions, classes,objects,and NumPy</td></tr>
<tr><td>Unit – I</td><td colspan="6">Introduction:</td><td>9</td></tr>
<tr><td colspan="8">Problem-solvingstrategies–programdesigntools–Typesoferrors–TestingandDebugging-Basics:Literals–variablesandidentifiers–datatypes-inputoperation–comments–reservedwords–indentation–OperatorsandExpressions–Decision ControlStatements:Introduction–conditionalstatement–iterativestatements–NestedLoops–break,continueandpassstatements—elseinloops.</td></tr>
<tr><td>Unit – II</td><td colspan="6">Lists,TuplesandDictionary:</td><td>9</td></tr>
<tr><td colspan="8">Lists:Access, update, nested, cloning, operations, methods, comprehensions, looping- Tuple:Create, utility, access, update,delete, operations, assignments, returning multiple values, nested tuples, index, and count method - Dictionary: Create, access, addandmodify,delete,sort,looping,nested,built-inmethods—listvstuplevs dictionary.</td></tr>
<tr><td>Unit – III</td><td colspan="6">StringsandRegularExpressions:</td><td>9</td></tr>
<tr><td colspan="8">Strings: Concatenation, append, multiply on strings–Immutable–formatting operator– Built-in string methods and functions–sliceoperation–functions–operators–comparing –iterating –string module–Regular Expressions – match, search, sub,findall and finditerfunctions–flagoptions.</td></tr>
<tr><td>Unit – IV</td><td colspan="6">FunctionsandModules:</td><td>9</td></tr>
<tr><td colspan="8">Functions:Introduction-definition–call–variable scope and life time–return statement – function arguments – lambda function – documentation strings– programming practices recursivefunction -Modules: Modules – packages–standard library methods–function redefinition.</td></tr>
<tr><td>Unit – V</td><td colspan="6">ObjectOrientation:</td><td>9</td></tr>
<tr><td colspan="8">Class and Objects: Class and objects– class methods and self– constructor–class and object variables–destructor–public and private data member.NumPy: NumPy Arrays–Computation on NumPyArrays .MatplotLib: Lineplots–Scatter Plots</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td colspan="8">LIST OF EXPERIMENTS / EXERCISES:</td></tr>
<tr><td>1.</td><td colspan="7">Programsusingconditionalandloopingstatements</td></tr>
<tr><td>2.</td><td colspan="7">Implementationoflistandtupleoperations</td></tr>
<tr><td>3.</td><td colspan="7">Implementationofdictionaryoperations</td></tr>
<tr><td>4.</td><td colspan="7">Perform variousstringoperations</td></tr>
<tr><td>5.</td><td colspan="7">Useregularexpressionsforvalidatinginputs</td></tr>
<tr><td>6.</td><td colspan="7">Demonstrationof differenttypesoffunctionsandparameter passing</td></tr>
<tr><td>7.</td><td colspan="7">Developprogramsusingclasses andobjects</td></tr>
<tr><td>8.</td><td colspan="7">Performcomputationon NumPyarrays</td></tr>
<tr><td>9.</td><td colspan="7">Drawdifferenttypes ofplotsusing Matplotlib</td></tr>
<tr><td colspan="8">Lecture:45, Practical:30, Total:75</td></tr>
<tr><td colspan="8">TEXT BOOK:</td></tr>
<tr><td>1.</td><td colspan="7">ReemaThareja.,“PythonProgrammingusingproblemsolvingapproach”,3rd impression,OxfordUniversityPress.,NewDelhi,2017.</td></tr>
<tr><td colspan="8">REFERENCES/ MANUAL / SOFTWARE:</td></tr>
<tr><td>1.</td><td colspan="7">NageswaraRao,“Core PythonProgramming”, 2nd Edition, DreamTechPress, NewDelhi,2018.</td></tr>
<tr><td>2.</td><td colspan="7">JakeVanderPlas,”Python Data ScienceHandbookEssentialToolsforWorking with Data”,O’Reillypublishers,1st Edition, 2016.</td></tr>
</table>

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	use basic Python constructs to build simple programs	Applying(K3), Precision(S3)
CO2	apply list, tuple, and dictionary to handle a variety of data.	Applying(K3), Precision(S3)
CO3	apply strings and regular expressions for searching and retrieval	Applying(K3), Precision(S3)
CO4	solve the problems using functions and modules.	Applying(K3), Precision(S3)
CO5	apply object-oriented concepts and perform basic data science operations using Python	Applying(K3), Precision(S3)

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	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 – 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	15	75				100
CAT2	10	15	75				100
CAT3	10	15	75				100
ESE	10	15	75				100

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

22EIT41 - MICROCONTROLLER AND ITS APPLICATIONS							
Programme & Branch	**B.E. & Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Digital Logic Circuits**	**4**	**PC**	**3**	**0**	**0**	**3**

Preamble	To get acquaintance with the architecture of 8085 processor and 8051 microcontroller, apply the embedded programming concepts for interfacing peripherals with the controller and to implement the applications of microcontrollers.

Unit – I	**8085 Microprocessor:**	**9**
Introduction to 8085 Microprocessor-Architecture-Pin configuration-Interrupts–Instruction Set –Addressing Modes–Timing Diagrams–Memory Interfacing –Simple Assembly Language Programs for arithmetic operations.		
Unit – II	**8051 Microcontroller:**	**9**
Introduction to 8051 Microcontroller- Architecture- Memory Organization- Special function registers – Program Counter – PSW register –Stack - Instruction set-Addressing modes.		
Unit – III	**8051 Programming:**	**9**
I/O Ports – Timer (Mode 1) / Counter– Serial Communication - Interrupt (Timer, Serial communication) – Programming in Embedded C: I/O port programming- Timer programming-Counter programming-Serial port programming-Interrupt programming		
Unit – IV	**Peripheral Interfacing with 8051:**	**9**
Programming in Embedded C: Keypad- LCD – Sensors- A/D and D/A converters- DC Motor -Stepper motor – Servo motor.		
Unit – V	**Applications of Microcontrollers(Block Diagram Approach):**	**9**
Smart Card reader, Automated Meter Reading System, Washing machine, Speedometer, Healthcare monitoring systems, 3D Printers, Smart Home automation system.		
		Total:45

TEXT BOOK:

1.	Senthil Kumar N., Saravanan M., Jeevananthan S., “Microprocessors and Microcontrollers”, 2nd Edition, Oxford University Press, New Delhi, 2016.

REFERENCES:

1.	Gaonkar R.S, “Microprocessor Architecture, Programming, and Applications with the 8085”, 6th Edition, Prentice Hall of India, New Delhi, 2013.
2.	Soumitra Kumar Mandal, “Microprocessors and Microcontrollers Architecture Programming and System Design 8085,8086 and 8051”, 8th Edition, McGraw Hill Education (India) Pvt. Ltd., New Delhi,2013.
3.	Muhammad Ali Mazidi, Janice GillispieMazidi, Rolin D. McKinlay , “The 8051 Microcontroller and Embedded Systems Using Assembly and C”, 2nd Edition, Pearson Education, New Delhi ,2013.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	infer the basic concepts of 8085 microprocessor	Understanding(K2)
CO2	summarize the basic concepts of 8051 microcontroller	Understanding(K2)
CO3	write embedded c programs for 8051	Applying(K3)
CO4	interface peripheral devices with 8051 microcontroller	Applying(K3)
CO5	interpret the applications of microcontroller	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	2								2		1	2	2
CO2	3	2								2		1	2	2
CO3	3	3	1	1	1					2		1	3	3
CO4	3	3	1	1	1					2		1	3	3
CO5	3	2								2		1	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	40	40				100
CAT2	20	30	50				100
CAT 3	20	30	50				100
ESE	10	40	50				100

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

22EIT42 - CONTROL SYSTEMS								
Programme & Branch	**B.E. & Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**4**	**PC**	**3**	**1**	**0**	**4**

Preamble	This course provides the concepts of the mathematical modeling, response and stability analysis of linear systems in time and frequency domain	
Unit – I	**Mathematical Modeling:**	**9+3**
Open loop and closed loop systems-Derivation of transfer function models and state space models(phase variable): Electrical Systems and Mechanical Systems with single and two degree of freedom, Electromechanical Systems: DC Motor - conversion of state model to transfer function- Electrical Analogy of Mechanical Systems. Transfer function derivation using block diagram reduction and signal flow graphs.		
Unit – II	**Time Response of Systems:**	**9+3**
Poles, Zeros and System Response-Type and Order of System -Significance of Test Signals-Step response analysis and specifications of first order system and second order under damped System. Steady State Error and Error Constant –State Transition Matrix- time domain solutions of state models of second order systems with impulse input using Laplace transform method.		
Unit – III	**Stability Analysis in Time Domain:**	**9+3**
Concepts of Stability - Pole Locations and Stability - Routh Hurwitz Criterion - Root Locus Technique: conditions – angle and magnitude criterion – root locus construction –design of control loop gain.		
Unit – IV	**Frequency Response of Systems:**	**9+3**
Concept of Frequency Response, Frequency Response Analysis: Bode Plot and Polar Plot-gain margin and phase margin-deriving transfer function model from bode plot-Stability analysis in Frequency Domain: Nyquist Stability Criterion.		
Unit – V	**Compensators and Controllers in Time Domain:**	**9+3**
Effect of addition of poles and zeros on second order system response and system stability - Need for Compensator - Ideal Compensation on Time Response: P, PI, PD and PID controller - Design procedure of Lag and Lead Compensator via Root Locus.		
		Lecture:45, Tutorial:15, Total:60

TEXT BOOK:

1.	Norman S. Nise," Control Systems Engineering", 7th Edition, Reprint, Wiley-India Publishers, New Delhi, 2022.

REFERENCES:

1.	Nagrath I.J., Gopal M., “Control Systems Engineering”, 6th Edition, New Age International Pvt. Ltd., New Delhi, 2017
2.	Ogata K., “Modern Control Engineering”, 5th Edition, Pearson Education, New Delhi, 2010.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	derive mathematical models by identifying various components of the control system	Applying (K3)
CO2	analyze transient and steady state response of first and second order systems	Analyzing (K4)
CO3	examine the stability of the systems in time domain.	Analyzing (K4)
CO4	analyze the frequency response of the systems.	Analyzing (K4)
CO5	examine the performance of Compensators	Analyzing (K4)

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	2	1	1	1			1		2		1	3	3
CO2	3	3	2	2	2			1		2		1	3	3
CO3	3	3	2	2	2			1		2		1	3	3
CO4	3	3	2	2	2			1		2		1	3	3
CO5	3	3	2	2	2			1		2		1	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	5	25	35	35			100
CAT2	5	25	35	35			100
CAT3	5	25	35	35			100
ESE	5	25	35	35			100

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

22EIC41- LINEAR CONTROL SYSTEMS

Programme & Branch	BE & Electronics and Instrumentation Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	4	PC	3	0	2	4

Preamble	This course provides the concepts of the mathematical modeling, response and stability analysis of linear systems in time and frequency domain	
Unit – I	**Mathematical Modeling:**	**9**
Open loop and closed loop systems-Derivation of transfer function models and state space models(phase variable): Electrical Systems and Mechanical Systems with single and two degree of freedom, Electromechanical Systems: DC Motor - conversion of state model to transfer function- Electrical Analogy of Mechanical Systems. Transfer function derivation using block diagram reduction and signal flow graphs.		
Unit – II	**Time Response of Systems:**	**9**
Poles, Zeros and System Response-Type and Order of System -Significance of Test Signals-Step response analysis and specifications of first order system and second order under damped System. Steady State Error and Error Constant –State Transition Matrix- time domain solutions of state models of second order systems with impulse input using Laplace transform method.		
Unit – III	**Stability Analysis in Time Domain:**	**9**
Concepts of Stability - Pole Locations and Stability - Routh Hurwitz Criterion - Root Locus Technique: conditions – angle and magnitude criterion – root locus construction –design of control loop gain.		
Unit – IV	**Frequency Response of Systems:**	**9**
Concept of Frequency Response, Frequency Response Analysis: Bode Plot and Polar Plot-gain margin and phase margin-deriving transfer function model from bode plot-Stability analysis in Frequency Domain: Nyquist Stability Criterion.		
Unit – V	**Compensators and Controllers in Time Domain:**	**9**
Effect of addition of poles and zeros on second order system response and system stability - Need for Compensator - Ideal Compensation on Time Response: P, PI, PD and PID controller - Design procedure of Lag and Lead Compensator via Root Locus.		

LIST OF EXPERIMENTS / EXERCISES:

1.	Transfer function of Armature controlled DC motor
2.	Time response analysis of second order systems using MATLAB
3.	State space analysis of second order systems using MATLAB
4.	Analysis of the stability via Root Locus using MATLAB
5.	Effect of addition of poles and zeros on system response using MATLAB
6.	Effect of addition of poles and zeros on stability using MATLAB
7.	Frequency domain analysis via Bode plot using MATLAB
8.	Effect of P,PI,PID controllers on time response of system using MATLAB
9.	Design of Lead compensator using MATLAB
10.	Design of Lag compensator using MATLAB

Lecture:45, Practical:30, Total:75

TEXT BOOK:

1.	Norman S. Nise," Control Systems Engineering", 7th Edition, Reprint, Wiley-India Publishers, New Delhi, 2022.

REFERENCES:

1.	Nagrath I.J., Gopal M., “Control Systems Engineering”, 6th Edition, New Age International Pvt. Ltd., New Delhi, 2017
2.	Ogata K., “Modern Control Engineering”, 5th Edition, Pearson Education, New Delhi, 2010.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	derive mathematical models by identifying various components of the control system	Applying (K3), Precision (S3)
CO2	analyze transient and steady state response of first and second order systems	Analyzing (K4), Precision (S3)
CO3	examine the stability of the systems in time domain.	Analyzing (K4), Precision (S3)
CO4	analyze the frequency response of the systems.	Analyzing (K4), Precision (S3)
CO5	examine the performance of Compensators	Analyzing (K4), Precision (S3)

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	2	1	1	1			1		2		1	3	3
CO2	3	3	2	2	2			1		2		1	3	3
CO3	3	3	2	2	2			1		2		1	3	3
CO4	3	3	2	2	2			1		2		1	3	3
CO5	3	3	2	2	2			1		2		1	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	5	25	35	35			100
CAT2	5	25	35	35			100
CAT3	5	25	35	35			100
ESE	5	25	35	35			100

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

22EIT43 - INDUSTRIAL INSTRUMENTATION I							
Programme & Branch	**B.E. & Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**4**	**PC**	**3**	**0**	**0**	**3**

Preamble	This course imparts the knowledge of instruments used for the measurement of Temperature and Pressure with their principles. It will also provide the methods for the measurement of Force, Torque, Speed, Acceleration and Vibration.	
Unit – I	**Temperature Measurement I:**	**9**
Physical Effects utilized to measure Temperature – Temperature Scales – Mechanical Thermometers: Filled system Thermometers – Metallic - Expansion Thermometers – Special Temperature Indicating Devices – Bulb Installations– Solid state temperature sensors		
Unit – II	**Temperature Measurement II:**	**9**
Electrical Thermometers: Resistance Thermometers – Thermistors – Thermocouples – Radiation Pyrometers. Fiber-optic Temperature measurement systems – Ultrasonic Thermometers –Temperature switch.		
Unit – III	**Pressure Measurement I:**	**9**
Units of pressure – Mechanical Pressure Measurement: Manometers – Elastic type pressure gauges: Bourdon type– Metallic Diaphragm – Capsule – Bellows. Electrical Methods of Pressure Measurement: Strain-Gauge – Capacitance – Potentiometric – Resonant Wire – Piezoelectric – Magnetic– Optical.		
Unit – IV	**Pressure Measurement II:**	**9**
Vacuum sensors: Mechanical Vacuum Gauges: McLeod gauge – Thermal Vacuum Gauges: Knudsen gauge – Pirani gauge – Thermocouple vacuum gauge – Ionisation Vacuum Gauges – Testing and Calibration of Pressure Detectors: Dead weight tester – Pressure Switches.		
Unit – V	**Force, Torque, Speed, Acceleration and Vibration:**	**9**
Force(Weight) Measurement: Mechanical Load Cells – Elastic deflection force transducers – Torque Measurement: Rotary torque sensors – Stationary Sensors – Torque measurement using proximity sensors – Speed Measurements: Stroboscopic tachometers – AC tachometer generator – DC tachometer generator – Eddy current drag-cup tachometer – Acceleration Measurement: Seismic acceleration pickups – variable reluctance accelerometers – Vibration measurement: Mechanical vibration sensors.		
		Total:45

TEXT BOOK:

1. Krishnaswamy K. & Vijayachitra S. "Industrial Instrumentation", 2nd Edition, New Age International Publishers, New Delhi, 2019

REFERENCES:

1. Singh S. K.," Industrial Instrumentation and Control", 3rd Edition, Mcgraw Hill Education India, New Delhi, 2017.
2. Patranabis D., "Principles of Industrial Instrumentation", 3rd Edition, Mcgraw Hill Education India, New Delhi, 2017.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	explain the theory and working behind temperature measurement and mechanical thermometers	Understanding (K2)
CO2	interpret the working of various types of electrical thermometers and determine the unknown temperature	Applying (K3)
CO3	interpret the theory and working of pressure measuring instruments for various industrial applications	Applying (K3)
CO4	explain the construction and working of vacuum measuring instruments	Understanding (K2)
CO5	summarize the various measuring parameters such as force, torque, speed, acceleration and vibration for industrial applications	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	2						2				1	2	2
CO2	3	3	1	1	1			2				1	3	3
CO3	3	3	1	1	1			2				1	3	3
CO4	3	2						2				1	2	2
CO5	3	2						2				1	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)**

22EIT44 - INDUSTRIAL INSTRUMENTATION

Programme & Branch	**BE & Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Transducer Engineering**	**4**	**PC**	**3**	**0**	**0**	**3**

Preamble	This Course enhances the students to understand all the processes involved in the industries, the various unit operations and be able to apply control schemes to these processes to get the output with desired specifications.	
Unit – I	**Pressure Measurement:**	**9**
Units and Terminologies; Measurement: U Tube manometer, Elastic type: C-type, Spiral, Helical, Electrical type: capacitive, potentiometric, piezo resistive; Vacuum measuring type: McLeod, Ionization, Thermal conductivity, Pirani gauge. Calibration: Deadweight tester		
Unit – II	**Temperature Measurement**	**9**
Units and Terminologies; Measurement: Bimetallic and mercury filled thermometers, RTD, Thermistor, thermocouples; pyrometers: total radiation type and optical type; Temperature switches.		
Unit – III	**Flow Measurement:**	**9**
Units and Terminologies; Measurement: Orifice, Venturi; Positive Displacement Type, Rotameter, Turbine Type; Electrical Type: Electromagnetic, Ultrasonic; Vortex Shedding, Flow Meter Selection, Calibration: dynamic weighing.		
Unit – IV	**Level Measurement:**	**9**
Units and Terminologies; sight glass, float level switch, displacer type, air-purge, boiler drum level measurement; Electrical: resistance tape, capacitive type, radar type, ultrasonic type.		
Unit – V	**Viscosity, Density, Humidity and Moisture Measurement:**	**9**
Viscosity Terminologies; capillary and efflux cup viscometers; Density measurement: float type and ultrasonic type; Humidity: Psychrometers; Dew cell; Electrolytic hygrometer; Moisture measurement: electrolytic type, piezoelectric and resistance moisture gauges.		
		Total:45

TEXT BOOK:

1.	Krishnaswamy K., & Vijayachitra S., "Industrial Instrumentation", 2nd Edition, New Age International Publishers, New Delhi, 2019.

REFERENCES:

1.	Singh. S.K, “Industrial Instrumentation and Control”, Third Edition, Mc Graw Hill Education India, New Delhi, 2017.
2.	Patranabis D, Principles of Industrial Instrumentation, Third Edition, Tata McGraw Hill Education, New Delhi, 2017.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	demonstrate the construction and working of various pressure measuring instruments for industrial applications	Applying (K3)
CO2	demonstrate the working of various types of temperature sensing devices and determine the unknown temperature	Understanding (K2)
CO3	determine the flow rate using various types of mechanical flow meters and identify suitable flow meters for various applications	Applying (K3)
CO4	determine the fluid level using various types of level measuring instruments and identify suitable level gauges for various applications	Understanding (K2)
CO5	illustrate the construction and working of viscosity, density, Humidity and Moisture measuring instruments	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	2	1	1	1			2				1	3	3
CO2	3	2	1	1	1			2				1	3	3
CO3	3	2	1	1	1			2				1	3	3
CO4	3	1						1					2	2
CO5	3	2						2				1	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	10	50	40				100
CAT2	10	50	40				100
CAT3	10	50	40				100
ESE	10	50	40				100

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

22EIL41 - MICROCONTROLLER AND INTERFACING LABORATORY							
Programme & Branch	**B.E. & Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**4**	**PC**	**0**	**0**	**2**	**1**

Preamble	To incorporate practical exposure on programming and interfacing concepts in processor and controller and implement programming using Verilog HDL

LIST OF EXPERIMENTS / EXERCISES:

1.	Arithmetic operations using 8085 microprocessor
2.	Code conversion using 8085 microprocessor
Interfacing of Peripherals with 8051 microcontroller:	
3.	Interfacing of switches and relays
4.	Interfacing of LED and Seven segment display
5.	Interfacing of Keypad and LCD
6.	Interfacing of ADC and DAC
7.	Interfacing of DC motor
8.	Interfacing of stepper motor
9.	Design and Simulation of Combinational and Sequential Circuits using Verilog HDL
10.	Design and Implementation of Digital circuits in FPGA using Verilog HDL
	Total:30

REFERENCES/ MANUAL /SOFTWARE:

1.	Laboratory Manual
2.	V- RIDE Software
3.	Xilinx Software

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	build programs using embedded C	Applying(K3), Precision (S3)
CO2	design interfacing circuits with 8051 microcontroller	Applying(K3), Precision (S3)
CO3	develop Verilog HDL programming for digital circuits and implement in FPGA	Analyzing(K4), Precision (S3)

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	2	1	3	1	2		**1**	2	**3**		1	3	3
CO2	3	2	1	3	1	2		**1**	2	**3**		1	3	3
CO3	3	3	2	3	2	2		**1**	2	**3**		1	3	3

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

22EIL42- INSTRUMENTATION DESIGN AND CONTROL SYSTEMS LABORATORY

Programme & Branch	**B.E. & Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**4**	**PC**	**0**	**0**	**2**	**1**

Preamble	To design signal conditioning circuits for various instrumentation systems and also to analyze the response of composite systems in time and frequency domain.

LIST OF EXPERIMENTS / EXERCISES:

1.	Design of instrumentation amplifiers
2.	Design of PWM generator circuits for V to F converter.
3.	Design of signal conditioning circuit for RTD and Thermistor
4.	Design of signal conditioning circuit for optical sensors
5.	Preparation of Piping and Instrumentation diagram , documentation of instrumentation project and project scheduling
6.	Derivations of Transfer function of DC motor.
7.	Time response analysis of first and second order systems.
8.	State space analysis of second order systems using MATLAB.
9.	Stability analysis in time and frequency domain using MATLAB.
10.	Effect of P, PI and PID controller on time response.

Total:30

REFERENCES/ MANUAL /SOFTWARE:

1.	Laboratory Manual
2.	MATLAB User Manual

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	Develop signal conditioning circuits and prepare Piping and Instrumentation diagram for various process applications	Applying(K3), Precision S3)
CO2	derive the transfer function of the systems using the measured parameters	Applying(K3), Precision S3)
CO3	analyze the response and stability in time and frequency domain.	Analyzing(K4), Precision S3)

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	2	1	3	1	2		1	2	3		1	3	3
CO2	3	2	1	3	1	2		1	2	3		1	3	3
CO3	3	3	2	3	2	2		1	2	3		1	3	3

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

22EIL51 - INDUSTRIAL INSTRUMENTATION LABORATORY

Programme& Branch	**BE & Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Industrial Instrumentation I**	**4/5**	**PC**	**0**	**0**	**2**	**1**

Preamble	To measure various industrial parameters such as flow, level, temperature, and infer the characteristics

LIST OF EXPERIMENTS / EXERCISES:

1.	Orifice and Electro Magnetic flow meters and comparison their characteristics
2.	Measurement of flow rate using Turbine Flow Meter and Ultrasonic flow meter comparison their characteristics
3.	a) Calibration of Pressure Gauges using Deadweight Tester b) Measurement of Vacuum Pressure using McLeod Gauge
4.	a) Measurement of torque and angle of the given cantilever beam b) Measurement of pH, Conductivity, Turbidity and TDS in different test samples
5.	a)Measurement of level in Linear Tanks using Ultrasonic level Transmitter b)Measurement of level in Non- Linear Tanks using Differential Pressure Transmitter
6.	a) Calibration of Safety Relief Valves and DPT with HART Communicator b) Measurement of Viscosity using Saybolt Viscometer
7.	Measurement of level and pressure in linear tank using optical sensor
8.	a) Control of kettle Temperature using Temperature switch b) Control of drum pressure using Pressure switch c) Control of flow process system using Flow switch
9.	Measurement of non-electrical parameters of a person
10.	Measurement of Bio-potential parameters of a person

Total:30

REFERENCES/ MANUAL /SOFTWARE:

1.	Industrial instrumentation Laboratory Manual

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	measure the various industrial process parameter using appropriate sensing meters	Applying (K3), Precision (S3)
CO2	calibrate the various industrial instruments	Applying (K3), Precision (S3)
CO3	measure the electrical and non electrical human physiological parameters	Applying (K3), Precision (S3)

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	2	1	3		2			1	3			3	3
CO2	3	3	2	3	1	2	2		1	3			3	3
CO3	3	2	1	3		2			1	3			3	3

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

- PROFESSIONAL SKILLS TRAINING - I								
(Common to All BE/ BTech Engineering and Technology branches)								
Programme & Branch	**All BE/ BTech Engineering and Technology branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**4**	EC	0	0	80	2

Preamble	This subject is to enhance the employability skills and to develop career competency	
Unit – I	**Soft Skills – I :**	**20**
Soft skills and its importance: Pleasure and pains of transition from an academic environment to work environment-Need for change- Fear, stress and competition in the professional world-Importance of positive attitude- Self motivation and continuous knowledge upgradation-Self-confidence. Professional grooming and practices: Basics of corporate culture-Key pillars of business etiquette- Basics of etiquette-Introductions and greetings-Rules of the handshake, earning respect, business manners-Telephone etiquette- Body Language.		
Unit – II	**Quantitative Aptitude and Logical Reasoning – I:**	**30**
Problem solving level I: Number System-LCM &HCF-Divisibility test-Surds and indices-Logarithms- Ratio-proportions and variation-Partnership-Time speed and distance-Data interpretation-data representation. Logical reasoning: Family tree-Deductions-Logical connectives-Binary logic Linear arrangements- Circular and complex arrangement		
Unit – III	**Written Communication & Verbal Aptitude**	**30**
Writing Skills: Writing strategies and formats Importance of Résumés Writing a Cover letter -Responding to Job Advertisements Professional e-mail Writing Responding to e-mails and business letters Technical Report writing Interpretation of Technical Data (Transcoding) Writing One-page Essays. Verbal Aptitude Synonyms Antonyms Homonyms One word substitution Idioms and Phrases Paired words Analogies Spelling test Cloze test using suitable verb forms using appropriate articles and prepositions; Spotting Errors Sentence Correction and Formation Grammar Based questions (Transformation : Active-Passive & Direct-Indirect); Rearranging Jumbled Sentences & Jumbled paragraphs, Identifying Facts, Inferences and Judgements statements		
		Total:45

TEXT BOOK:

1.	Edgar Thorpe and Showick Thorpe, "Objective English for Competitive Examination", 6th Edition, Pearson India Education Services Pvt Ltd, 2017.

REFERENCES:

1.	Stephen Bailey, "Academic Writing: A practical guide for students", Routledge, New York, 2011.
2.	Meenakshi Raman and Sangeeta Sharma. "Technical Communication- Principles and Practice". 4th Edition, Oxford University Press, New Delhi, 2022.

COURSE OUTCOMES: On completion 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 communication skills effectively to understand and deliver information in various written discourses grammatically with accuracy	Applying (K3), Precision (S3)

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	2				3	3		3		3	2		
CO2	3	2				3	3		3		3	2		
CO3		2				3	3		3	3	3	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		50	50				100
CAT3		50	50				100
ESE	NA						100

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

22EIT51 - INDUSTRIAL INSTRUMENTATION II							
Programme & Branch	**B.E. & Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Industrial Instrumentation I**	**5**	**PC**	**3**	**0**	**0**	**3**

Preamble	To impart the knowledge of instruments used for the measurement of flow and level with their principles and also to provide the methods for the measurement of density, viscosity, humidity and moisture.	
Unit – I	**Flow Measurement I:**	**9**
Mechanical Flow Meters – Orifice Flow Meter – Venturi Tubes – Flow Nozzle – Dall Tube – Installation of Head Flow Meters – Pitot Tube – Differential Pressure Transmitters - Quantity Meters -Inferential Flow Meters.		
Unit – II	**Flow Measurement II:**	**9**
Mass Flow Meters – Electrical Flow Meters: Electromagnetic Flow meter –Ultrasonic Flow Meters. Other Types of Flow Meters: Vortex Shedding Flow Meter – Cross correlation flow meter. Solid flow Measurement – Flow Switches – Flow Meter Calibration – Flow Meter Selection.		
Unit – III	**Level Measurement:**	**9**
Float Type Level Measurement – Boiler Drum Level Measurement- Weight based Level Measurement – Air purge system – Electrical Methods: Resistance Tapes – Capacitance Probes – Radiometric Level Detection and Measurement –Ultrasonic Sensors – Level Switches.		
Unit – IV	**Density and Viscosity:**	**9**
Measurement of Density: Displacement and Float Type Densitometers – Hydrostatic Densitometer – Ultrasonic and sonic densitometers – Radiation densitometers – Thermal Conductivity Density Gauges. Measurement of Viscosity: Capillary Viscometers – Efflux Cup Viscometers – Float Viscometers.		
Unit – V	**Humidity and Moisture:**	**9**
Measurement of Humidity: Dry and Wet bulb Psychrometers - Hair Hygrometers – Dew point Hygrometers – Electrolytic Hygrometers. Measurement of Moisture in Gases and Liquids: Capacitance Hygrometer - Piezoelectric Hygrometer - Infrared Absorption Hygrometer – Measurement of Moisture in Solids.		
		Total:45

TEXT BOOK:

1.	Krishnaswamy K., & Vijayachitra S., "Industrial Instrumentation", 2nd Edition, New Age International Publishers, New Delhi, 2019.

REFERENCES:

1.	Singh S. K., 'Industrial Instrumentation and Control', 3rd Edition, McGraw Hill Education India, New Delhi, 2017.
2.	Patranabis D., 'Principles of Industrial Instrumentation', 3rd Edition, McGraw Hill Education India, New Delhi, 2017.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	determine the flow rate using various types of mechanical flow meters	Applying (K3)
CO2	examine the flow through mass type flow meter, electrical type flow meter and infer about calibration and selection of flow meter.	Applying(K3)
CO3	determine the fluid level using various types of level measuring instruments	Applying(K3)
CO4	illustrate the construction and working of density and viscosity measuring instruments	Understanding(K2)
CO5	interpret the construction and working of humidity and moisture measuring instruments	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	2	1	1	1			2				1	3	3
CO2	3	2	1	1	1			2				1	3	3
CO3	3	2	1	1	1			2				1	3	3
CO4	3	1						1					2	2
CO5	3	1						1					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)

22EIT52 - PROCESS CONTROL

Programme & Branch	**B.E. & Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Control Systems**	**5**	**PC**	**3**	**0**	**0**	**3**

Preamble	This Course enhances the students to apply the concepts of process modeling with transfer function approach and empirical approach. The controller designs, tuning and final control elements with multi-loop control are discussed.	
Unit – I	**Process Modeling and Characteristics:**	**9**
Need for automatic process Control - Process control terminology - Mathematical modeling of process: First order level, thermal and pressure process - Second order interacting and non-interacting systems: Liquid level process - Processes with inverse response: Boiler drum level control. Process Characteristics: Continuous and Batch process - Self regulation: CSTR with cooling jacket - Servo and Regulatory operations.		
Unit – II	**Empirical Modeling:**	**9**
Model development using Linear or non-linear regression: Model building procedure-Linear regression-Non-linear regression. Graphical fitting of first-order and second-order models using step tests: Graphical techniques for second- order models-Regression of Step Response data- Approximation of Higher-Order Systems.		
Unit – III	**Controller Characteristics and Tuning:**	**9**
Controller modes: Two position mode, Floating mode, proportional, integral and derivative modes, P+I, P+D, P+I+D modes- Electronic PID controller- Evaluation criteria-Controller Tuning: Process reaction curve method- Ziegler-Nichols method- Damped oscillation method-Frequency response method of tuning.		
Unit – IV	**Final Control Elements:**	**9**
Signal conversions: I/P converter - Actuators: Electric and Pneumatic type -Valve positioner – Characteristics of control valves - Valve bodies - Control valve sizing - Cavitations and Flashing - Selection of control valves.		
Unit – V	**Multi-loop Control:**	**9**
Feed Forward control - Cascade control - Ratio control - Selective control systems - Split-Range control - Inferential control - Introduction to multivariable control. Case studies: Boiler, Reactor, Distillation Column.		
		Total:45

TEXT BOOK:

1.	Krishnaswamy K.," Process Control", 2nd Edition(Reprint), New Age International (P) Ltd., Publishers, New Delhi, 2015 for Unit 1,3,4 and 5.
2.	Dale E. Seborg, Duncan A. Mellichamp, Thomas F. Edgar, and Francis J. Doyle, “Process Dynamics and Control”, 4th Edition, John Wiley and Sons, USA, 2016 for Unit 2.

REFERENCES:

1.	Surekha Bhanot, “Process Control: Principles and Applications”, 4th Edition, Oxford University Press, United Kingdom, 2017.
2.	Wayne Bequette. B, “Process Control: Modeling, Design, and Simulation”,2nd Edition, Prentice Hall of India, New Delhi 2013.
3.	George Stephanopoulos, “Chemical Process Control - An Introduction to Theory and Practice”, 2nd Edition, Prentice Hall of India, New Delhi, 2016.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	develop mathematical modeling for various processes	Applying (K3)
CO2	determine the real time models using empirical modeling	Applying (K3)
CO3	determine the controller gains and tuning methods for various applications	Applying (K3)
CO4	explain the control valve accessories and its operational characteristics	Understanding (K2)
CO5	apply the concepts of multi-loop control to various applications	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	2	1	1	1			2				1	3	3
CO2	3	2	1	1	1			2				1	3	3
CO3	3	2	1	1	1			2				1	3	3
CO4	3	1						2				1	2	2
CO5	3	2	1	1	1			2				1	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	10	30	60				100
CAT2	10	30	60				100
CAT3	10	40	50				100
ESE	10	30	60				100

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

22EIT53 - DIGITAL SIGNAL PROCESSING							
Programme & Branch	**B.E. & Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**5**	**PC**	**3**	**1**	**0**	**4**

Preamble	To impart the fundamental knowledge and applications of Digital Signal Processing.	
Unit – I	**Continuous and Discrete Time Signals:**	**9+3**
Introduction-Classification- Analog to Digital conversion- Sampling – Aliasing - Signal representation: step, ramp, parabolic, sinusoidal and exponential-Periodical signals-Odd and Even signals-Energy and Power signals - Signal transformations-Trigonometric form of Fourier series of periodical signals in continuous and discrete domain.		
Unit – II	**Continuous and Discrete Time Systems:**	**9+3**
Classification of systems: static and dynamic -time variant and invariant – linear and nonlinear - stable and unstable- causal and non causal-recursive and non recursive. Relation between Laplace and Z transform-Response analysis of linear systems with impulse and step input in continuous and discrete domain using Laplace and Z transform-Linear and Circular convolution		
Unit – III	**Transforms:**	**9+3**
Fourier transform of aperiodical signals in continuous and discrete domain- Parseval's theorem-Discrete Time Fourier Transform-Discrete Fourier Transform –Fast Fourier Transform – Decimation in Time FFT algorithm – Decimation in Frequency FFT algorithm – IDFT using FFT.		
Unit – IV	**FIR and IIR Filters:**	**9+3**
FIR Filter :Need, advantages and disadvantages of digital filters- Design of FIR filter (Low Pass Filter only) using windowing techniques (Rectangular, Hanning and Hamming) – Location of zeros of FIR filter - Linear phase realization of FIR filter IIR Filter : Design of analog IIR filter (Low Pass Filter only) –Mapping techniques from s domain to z domain : Impulse invariant, Bilinear Transformation --Design of digital IIR filter using Bilinear Transformation technique –Comparison of FIR and IIR filters-Direct form realization of IIR filter.		
Unit – V	**Finite Word Length Effect and Digital Signal Processor:**	**9+3**
Finite Word Length Effect: Introduction-Digital representation of numbers-Binary number system-Fixed point number representation – Floating point number representation-Fixed point quantization errors-Overflow-Limit cycle oscillations-Coefficient quantization- Coefficient quantization of FIR filters. Digital Signal Processor: Architecture of Digital Signal Processor-Selection of Digital Signal Processor-Addressing modes-On Chip peripherals – TMS320C6748 DSP development kit - Integrated development environment.		
		Lecture:45, Tutorial:15, Total:60

TEXT BOOK:

1.	Esakkirajan S., Veerakumar T., and Badri N Subudhi, "Digital Signal Processing",1st Edition, Tata McGraw hill, New Delhi,2021

REFERENCES:

1.	John G. Proakis & Dimitris G. Manolakis., "Digital Signal Processing: Principles, Algorithms and Applications", 4th Edition, Pearson Prentice Hall, New Delhi, 2014.
2.	Rodger Ziemer, William Tranter & D. Fannin, "Signals and Systems: Continuous and Discrete**",** 4th Edition, Pearson, New Delhi, 1998.
3.	Salivahanan S. "Digital Signal Processing", 4th Edition, Tata McGraw Hill , New Delhi, 2020.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	examine continuous and discrete time signals	Applying (K3)
CO2	examine continuous and discrete time systems	Applying (K3)
CO3	apply Fourier transform to determine the frequency response of LTI discrete system	Applying (K3)
CO4	design and realize FIR and IIR filters	Applying (K3)
CO5	examine the effect of word length and role of DSP Processor	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	2	1	1	1					2		1	3	3
CO2	3	2	1	1	1					2		1	3	3
CO3	3	2	1	1	1					2		1	3	3
CO4	3	2	1	1	1					2		1	3	3
CO5	3	2	1	1	1					2		1	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	5	20	75				100
CAT2	5	20	75				100
CAT3	5	20	75				100
ESE	5	15	80				100

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

22EIT54- VLSI SYSTEMS							
Programme & Branch	**B.E. & Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Digital Logic Circuits**	**5**	**PC**	**3**	**0**	**0**	**3**

Preamble	To impart the knowledge on MOS transistor characteristics, fabrication, programming in Verilog Hardware Description Language and testing of ICs.	
Unit – I	**MOS Transistor Theory:**	**9**
MOS Transistor Theory: NMOS enhancement transistor – PMOS enhancement transistor – Threshold voltage – Body effect.MOS transistor switches. Basic D.C. equations – Second order effects: Threshold voltage – Body effect – Sub threshold region –Channel length modulation – Mobility variation – Fowler- Nordheim tunneling – Drain punch through – Hot electron effect.		
Unit – II	**CMOS Logic and Circuit Design**:	**9**
CMOS Logic: Inverter – Combinational logic – NAND gate – NOR gate – Compound gates –Multiplexers – Memory – Latches and registers. Complementary CMOS inverter - DC characteristics – βn/βp ratio, Noise margin. Switching characteristics: Fall time – Rise time – Delay time. Power dissipation for CMOS logic: Static dissipation – Dynamic dissipation – Short circuit dissipation. Layout design rules and Stick diagram for inverter, NAND and NOR.		
Unit – III	**CMOS Fabrication Technology:**	**9**
Basic CMOS technology: N-Well CMOS process – P-Well process – Twin tub process – Silicon on Insulator. Latchup: Physical origin of latchup – Latchup triggering – Latchup prevention – Internal latchup prevention techniques –I/O latchup prevention. FPGA: Programmable Logic – Programmable Logic structures – Programmable Interconnect – Xilinx Programmable Gate Arrays – Design flow.		
Unit – IV	**Verilog HDL:**	**9**
Typical design flow, Basic concepts: Lexical conventions – Data types, Modules and Ports, Gate level modeling, Dataflow modeling: Continuous assignment, Behavioral modeling: Structured procedure – Procedural assignments. Switch level modeling: MOS switches – CMOS switches – Bidirectional switches. Implementation of logic using Verilog HDL: Half Adder, Full Adder, Ripple Carry Adder, Multiplexer, D-Flip-Flop.		
Unit – V	**CMOS Testing and Verification:**	**9**
Introduction: Logic Verification, Debugging, Manufacturing Test- Manufacturing test principles: Fault Models , Observability, Controllability , Repeatability , Survivability , Fault Coverage Automatic Test Pattern Generation (ATPG). Design strategies for test: Built in Self Test (BIST).		
		Total:45

TEXT BOOK:

1.	Neil Weste, & David Harris, “CMOS VLSI Design-A circuits & System Perspective” , 4th Edition, Pearson education, New Delhi,2022 for Units 1,2,3 and 5.
2.	Palnitkar Samir, " Verilog HDL: Guide to Digital Design and synthesis", 2nd Edition, Pearson Education, New Delhi, 2021 for Unit 4.

REFERENCES:

1.	Pucknell, Douglas A.,& Eshragian K., “Basic VLSI Design”, 3rd Edition, PHI Learning, New Delhi,2012.
2.	Wayne wolf , “FPGA Based System Design”, Prentice Hall of India, CDR Edition, New Delhi,2004
3.	Sung Mo Kang, Yousf Leblebici & Chulwoo Kim, “CMOS Digital Integrated circuits, Analysis and Design”4th edition, McGraw Hill Education, New Delhi, 2019.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	examine the characteristics and the second order effects in designing MOSFET	Applying (K3)
CO2	discuss the CMOS logics and its characteristic for different logics	Applying (K3)
CO3	discuss the various fabrication techniques for chip development	Applying (K3)
CO4	develop programming for VLSI systems using Verilog Hardware Description Language	Applying (K3)
CO5	explain the testing process involved in chip design.	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	2	1	1	1					1			3	3
CO2	3	2	1	1	1					1			3	3
CO3	3	2	1	1	1					1			3	3
CO4	3	2	1	1	1					1			3	3
CO5	3	1								1			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	30	20	50				100
CAT2	10	45	45				100
CAT3	10	45	45				100
ESE	10	40	50				100

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

<table>
<tr><td colspan="8">22EIT55 – INDUSTRIAL PROCESS CONTROL</td></tr>
<tr><td>Programme & Branch</td><td>BE & Electronics and Instrumentation Engineering</td><td>Sem.</td><td>Category</td><td>L</td><td>T</td><td>P</td><td>Credit</td></tr>
<tr><td>Prerequisites</td><td>Control Systems</td><td>5</td><td>PC</td><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>Preamble</td><td colspan="7">This Course enhances the students to apply the concepts of process modeling with transfer function approach and empirical approach. The controller designs, tuning and final control elements with multi-loop control are discussed.</td></tr>
<tr><td>Unit – I</td><td colspan="6">Process Modeling and Characteristics:</td><td>9+3</td></tr>
<tr><td colspan="8">Need for automatic process Control - Process control terminology - Mathematical modeling of process: First order level, thermal and pressure process - Second order interacting and non-interacting systems: Liquid level process - Processes with inverse response: Boiler drum level control. Process Characteristics: Continuous and Batch process - Self regulation: CSTR with cooling jacket - Servo and Regulatory operations.</td></tr>
<tr><td>Unit – II</td><td colspan="6">Empirical Modeling:</td><td>9+3</td></tr>
<tr><td colspan="8">Model development using Linear or non-linear regression: Model building procedure-Linear regression-Non-linear regression. Graphical fitting of first-order and second-order models using step tests: Graphical techniques for second- order models-Regression of Step Response data- Approximation of Higher-Order Systems.</td></tr>
<tr><td>Unit – III</td><td colspan="6">Controller Characteristics and Tuning:</td><td>9+3</td></tr>
<tr><td colspan="8">Controller modes: Two position mode, Floating mode, proportional, integral and derivative modes, P+I, P+D, P+I+D modes-Electronic PID controller- Evaluation criteria-Controller Tuning: Process reaction curve method- Ziegler-Nichols method- Damped oscillation method-Frequency response method of tuning.</td></tr>
<tr><td>Unit – IV</td><td colspan="6">Final Control Elements:</td><td>9+3</td></tr>
<tr><td colspan="8">Signal conversions: I/P converter - Actuators: Electric and Pneumatic type -Valve positioner – Characteristics of control valves - Valve bodies - Control valve sizing - Cavitations and Flashing - Selection of control valves.</td></tr>
<tr><td>Unit – V</td><td colspan="6">Multi-loop Control:</td><td>9+3</td></tr>
<tr><td colspan="8">Feed Forward control - Cascade control - Ratio control - Selective control systems - Split-Range control - Inferential control - Introduction to multivariable control. Case studies: Boiler, Reactor, Distillation Column.</td></tr>
<tr><td colspan="8" align="right">Lecture:45, Tutorial:15,Total:60</td></tr>
</table>

TEXT BOOK:	
1.	Krishnaswamy K.," Process Control", 2nd Edition(Reprint), New Age International (P) Ltd., Publishers, New Delhi, 2015 for Unit 1,3,4 and 5.
2.	Dale E. Seborg, Duncan A. Mellichamp, Thomas F. Edgar, and Francis J. Doyle, “Process Dynamics and Control”, 4th Edition, John Wiley and Sons, USA, 2016 for Unit 2.

REFERENCES:	
1.	Surekha Bhanot, “Process Control: Principles and Applications”, 4th Edition, Oxford University Press, United Kingdom, 2017.
2.	Wayne Bequette. B, “Process Control: Modeling, Design, and Simulation”,2nd Edition, Prentice Hall of India, New Delhi 2013.
3.	George Stephanopoulos, “Chemical Process Control - An Introduction to Theory and Practice”, 2nd Edition, Prentice Hall of India, New Delhi, 2016.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	develop mathematical modeling for various processes	Applying (K3)
CO2	determine the real time models using empirical modeling	Applying (K3)
CO3	determine the controller gains and tuning methods for various applications	Applying (K3)
CO4	explain the control valve accessories and its operational characteristics	Understanding (K2)
CO5	apply the concepts of multi-loop control to various applications	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	2	1	1	1			2				1	3	3
CO2	3	2	1	1	1			2				1	3	3
CO3	3	2	1	1	1			2				1	3	3
CO4	3	1						2				1	2	2
CO5	3	2	1	1	1			2				1	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	10	30	60				100
CAT2	10	30	60				100
CAT3	10	40	50				100
ESE	10	30	60				100

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

22EIT56 – MICROPROCESSOR AND MICROCONTROLLER								
Programme & Branch	**BE & Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
Prerequisites	**Digital Logic Circuits**	**5**	**PC**	**3**	**1**	**0**	**4**

Preamble	To get acquaintance with the architecture of 8085 processor and 8051 microcontroller, apply the embedded programming concepts for interfacing peripherals with the controller and to implement the applications of microcontrollers.	
Unit – I	**8085 Microprocessor:**	**9+3**
Introduction to 8085 Microprocessor-Architecture-Pin configuration-Interrupts–Instruction Set –Addressing Modes–Timing Diagrams–Memory Interfacing –Simple Assembly Language Programs for arithmetic operations.		
Unit – II	**8051 Microcontroller:**	**9+3**
Introduction to 8051 Microcontroller- Architecture- Memory Organization- Special function registers – Program Counter – PSW register –Stack - Instruction set-Addressing modes.		
Unit – III	**8051 Programming:**	**9+3**
I/O Ports – Timer (Mode 1) / Counter– Serial Communication - Interrupt (Timer, Serial communication) – Programming in Embedded C: I/O port programming- Timer programming-Counter programming-Serial port programming-Interrupt programming.		
Unit – IV	**Peripheral Interfacing with 8051:**	**9+3**
Programming in Embedded C: Keypad- LCD – Sensors- A/D and D/A converters- DC Motor -Stepper motor – Servo motor.		
Unit – V	**Applications of Microcontrollers(Block Diagram Approach):**	**9+3**
Smart Card reader, Automated Meter Reading System, Washing machine, Speedometer, Healthcare monitoring systems, 3D Printers, Smart Home automation system.		
		Lecture:45, Tutorial:15,Total:60

TEXT BOOK:

1.	Senthil Kumar N., Saravanan M., Jeevananthan S., "Microprocessors and Microcontrollers", 2nd Edition, Oxford University Press, New Delhi, 2016.

REFERENCES:

1.	Gaonkar R.S, "Microprocessor Architecture, Programming, and Applications with the 8085", 6th Edition, Prentice Hall of India, New Delhi, 2013.
2.	Soumitra Kumar Mandal, "Microprocessors and Microcontrollers Architecture Programming and System Design 8085,8086 and 8051", 8th Edition, McGraw Hill Education (India) Pvt. Ltd., New Delhi,2013.
3.	Muhammad Ali Mazidi, Janice GillispieMazidi, Rolin D. McKinlay , "The 8051 Microcontroller and Embedded Systems Using Assembly and C", 2nd Edition, Pearson Education, New Delhi ,2013.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	apply assembly language program of 8085 microprocessor	Applying (K3)
CO2	summarize the basic concepts of 8051 microcontroller	Understanding (K2)
CO3	write embedded c programs for 8051	Applying (K3)
CO4	interface peripheral devices with 8051 microcontroller	Applying (K3)
CO5	interpret the applications of microcontroller	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	2								2		1	2	2
CO2	3	2								2		1	2	2
CO3	3	3	1	1	1					2		1	3	3
CO4	3	3	1	1	1					2		1	3	3
CO5	3	2								2		1	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	40	40				100
CAT2	20	30	50				100
CAT3	20	30	50				100
ESE	10	40	50				100

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

22EIL52 - PROCESS CONTROL LABORATORY

Programme & Branch	B.E. & Electronics and Instrumentation Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	**Nil**	**5**	**PC**	**0**	**0**	**2**	**1**

Preamble	This laboratory gives a practical exposure to the students to analyze the characteristics of level, temperature, pressure and flow processes. Selected multi-loop control systems and characteristics of control valve are experimented.

LIST OF EXPERIMENTS / EXERCISES:

1.	Empirical modeling of non-interacting and interacting second order system
2.	Closed loop analysis of flow process with servo and regulatory control
3.	Closed loop analysis of temperature process with servo and regulatory control
4.	Closed loop analysis of pressure process with servo and regulatory control
5.	Tuning of controller parameters for temperature process
6.	Response of ratio control for the pressure process
7.	Response of feed forward control of liquid level system
8.	Response of Cascade control of Continuous Stirred Tank Reactor
9.	Characteristics of control valves (Quick opening valve, Linear valve, Equal percentage valve)
10.	Empirical modeling of single conical tank system
	Total:30

REFERENCES/ MANUAL /SOFTWARE:

1.	Laboratory Manual

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	analyze the response of different control schemes in process applications	Analyzing (K4), Precision (S3)
CO2	analyze the controller parameters for optimal control of temperature process	Analyzing (K4), Precision (S3)
CO3	demonstrate the characteristics of pneumatic control valve	Analyzing (K4), Precision (S3)

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	3	2	3	1	2		1	2	3		1	3	3
CO2	3	3	2	3	1	2		1	2	3		1	3	3
CO3	3	3	2	3	1	2		1	2	3		1	3	3

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

22EIL53 - PROCESS CONTROL AND MACHINES LABORATORY							
Programme & Branch	**BE & Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**5**	**PC**	**0**	**0**	**2**	**1**

Preamble	This laboratory gives a practical exposure to the students to analyze the characteristics of level, temperature, pressure and flow processes. Selected multi-loop control systems and characteristics of control valve are experimented. Also it give practical exposure to learn the characteristics of AC and DC machines.

LIST OF EXPERIMENTS / EXERCISES:

1.	Empirical modeling of non-interacting and interacting second order system
2.	Closed loop analysis of flow process with servo and regulatory control
3.	Tuning and closed loop analysis of temperature process with servo and regulatory control
4.	Response of ratio control for the pressure process and response of feed forward control of liquid level system
5.	Characteristics of control valves (Quick opening valve, Linear valve, Equal percentage valve)
6.	Load test on DC series motor
7.	Speed control of DC shunt motor
8.	Load test on squirrel cage induction motor
9.	Predetermination of efficiency and regulation on single phase transformer
10.	Load test on three phase alternator
	Total:30

REFERENCES/ MANUAL /SOFTWARE:

1.	Laboratory Manual

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	analyze the response of different control schemes temperature tuning in process applications	Analyzing (K4), Precision (S3)
CO2	demonstrate the characteristics of pneumatic control valve	Analyzing (K4), Precision (S3)
CO3	demonstrate the performance characteristics of DC and AC machines	Analyzing (K4), Precision (S3)

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	3	2	3	1	2		1	2	3		1	3	3
CO2	3	3	2	3	1	2		1	2	3		1	3	3
CO3	3	3	2	3	1	2		1	2	3		1	3	3

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

22GEL51 - PROFESSIONAL SKILLS TRAINING - II								
(Common to All BE/ BTech Engineering and Technology branches)								
Programme & Branch	**All BE/ BTech Engineering and Technology branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**	
Prerequisites	**Nil**	**5**	**EC**	**0**	**0**	**80**	**2**	

Preamble	This subject is to enhance the employability skills and to develop career competency	
Unit – I	**Soft Skills – II :**	**20**
Group discussions: Advantages of group discussions-Structured GD- Team work: Value of team work in organizations- Definition of a team, why team-Elements of leadership, disadvantages of a team, stages of team formation- Group development activities. Facing an interview: Foundation in core subject- industry orientation / knowledge about the company- professional personality- Communication skills-Activities before Interview, upon entering interview room, during the interview and at the end Mock interviews.		
Unit – II	**Quantitative Aptitude and Logical Reasoning – II:**	**30**
Problem solving level II: Money related problems-Mixtures-Symbol base problem-Clocks and calendars-Simple-linear-quadratic and polynomial equations-Special, equations-Inequalities-Sequence and series-Set theory-Permutations and combinations-Probability-Statistics-Data sufficiency- Geometry-Trigonometry-Heights and distances-Co-ordinate geometry-Mensuration. Logical reasoning: Conditionality and grouping-Sequencing and scheduling- Selections-Networks:-Codes; Cubes-Venn diagram in logical reasoning- Quant based reasoning-Flaw detection- Puzzles-Cryptarithms.		
Unit – III	**Reading & Speaking Skills**	**30**
Reading: Reading comprehension– Effective Reading strategies – Descriptive, Inferential, & Argumentative reading passages – Identifying and locating factual information within a text – global reading/skimming for general understanding – selective comprehension / scanning for specific information – detailed comprehension / intensive reading – understanding the development of an argument – identifying the writer's attitude and opinions – Reading news articles in business magazines, newspapers – Reading notices and book reviews –Interpreting graphic data & Advertisements. Speaking: Mock Interviews –Self-Introduction – Sharing of Real Time Experience; Conversational Practices –Role Play – Short Talks / TED Talks –Extempore; Giving a Presentation on Various Topics – Technical / Non-Technical Topics – Project Review Presentation – Oratory and Effective Public Speaking; Pair Discussion – Group Discussion – The process of Group Discussion – Strategies to be adopted – Skills Assessed – Telephonic Conversations & Skills – Negotiating Skills.		
		Total:45

TEXT BOOK:

1.	Edgar Thorpe and Showick Thorpe, "Objective English for Competitive Examination", 6th Edition, Pearson India Education Services Pvt Ltd, 2017.

REFERENCES:

1.	Aruna Koneru, "Professional Speaking Skills," Oxford University Press India, New Delhi, 2015.
2.	Thorpe, Showick and Edgar Thorpe, "Winning at Interviews," 5th edition, Pearson Education, India, 2013.
3.	Rizvi, Ashraf M, "Effective Technical Communication," 2nd Edition, McGraw Hill Education India, 2017.

COURSE OUTCOMES: On completion 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	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	0	0	0	3	3	0	3	0	3	2		
CO2	3	2	0	0	0	3	3	0	3	0	3	**2**		
CO3		2	0	0	0	3	3	0	3	3	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	20	40	40				100
CAT2		50	50				100
CAT3		50	50				100
ESE	NA						

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

22EIT61 - INDUSTRIAL AUTOMATION USING PLC, SCADA AND DCS

Programme & Branch	**BE & Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Process Control**	**6**	**PC**	**3**	**0**	**0**	**3**

Preamble	Industrial automation is the use of control devices such as PLC/DCS/SCADA etc. to control industrial processes without manual intervention. This course discusses the logic and control systems with its hardware and software modules for implementing monitoring and control systems	
Unit – I	**Programmable Logic Controllers (PLCs):**	**9**
Programmable Logic Controllers - Parts of a PLC - Principles of operation - PLC size and application – Discrete I/O modules – Analog I/O modules – Human Machine Interfaces(HMIs). Basics of PLC Programming: Program scan – PLC programming languages. Programming timers: On-Delay timer instruction – Off-Delay timer instruction – Retentive timer		
Unit – II	**PLC Programming and Applications:**	**9**
Programming counters: Counter instructions – Up counter – Down counter – Cascading counters – Combining counter and timer functions - Program control instructions: Master control reset instruction – Jump instruction - Subroutine Functions. Data manipulation instructions: Data manipulation – Data compare instructions. Sequencer Instructions. Process control and Data Acquisition systems: Closed loop container filling process - ON/OFF liquid heating system- PLC control of a PID loop.		
Unit – III	**Distributed Control Systems:**	**9**
Evolution of Distributed Control Systems: Emergence of the Distributed Control System architecture. Local control unit architecture: Basic elements of a microprocessor based controller – Functional blocks: An introduction. Security design issues for the local control unit: Redundant controller designs.		
Unit – IV	**DCS Operator Interfaces and Applications:**	**9**
Operator interfaces: Introduction – Low level operator interface – High level operator interface: Architectural alternatives, Hardware elements in the operator interface, Operator displays. DCS applications: Power Plants- Cement plants – Pulp and Paper plants		
Unit – V	**SCADA:**	**9**
Introduction – Elements of a SCADA System - Archtecture – Real-time system – Remote terminal unit (RTUs) – Master terminal units (MTUs). Applications: SCADA Monitoring and Control for Gas Lift System – Stamping System – Nonlinear Level control system		
		Total:45

TEXT BOOK:

1.	Frank D. Petruzella, “Programmable Logic Controllers", 5th Edition, Tata McGraw Hill, New Delhi, 2019.

REFERENCES:

1.	Michael P.Lukas, “Distributed Control System”, Van Nostrand Reinhold Co., Canada 1986.
2.	John W.Webb, Ronald A.Reis. “Programmable Logic Controllers: Principles and Applications”, 5th Edition, PHI Learning Pvt. Ltd., New Delhi, 2013.
3.	Stuart A. Boyer, “SCADA: Supervisory Control and Data Acquisition”, 4th Edition, ISA Press, USA, 2009.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	explain the hardware components and I/O modules and operation of Programmable Logic Controllers	Applying (K3)
CO2	apply PLC counter, control and data manipulation instructions and develop applications	Applying (K3)
CO3	describe the architecture of Distributed Control Systems	Understanding (K2)
CO4	choose the operator Interfaces and displays in DCS and develop applications	Applying (K3)
CO5	apply SCADA for select applications	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	2	1	1	1			1		1			3	3
CO2	3	2	1	1	1			1		1			3	3
CO3	3	1						1		1			2	2
CO4	3	2	1	1	1			1		1			3	3
CO5	3	2	1	1	1			1		1			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	10	60	30				100
CAT2	10	60	30				100
CAT3	10	20	70				100
ESE	10	40	50				100

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

22EIT62 - INDUSTRY 4.0 WITH INDUSTRIAL IoT							
Programme & Branch	**B.E. & Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**6**	**PC**	**3**	**0**	**0**	**3**

Preamble	To transform the industrial processes through the integration of modern technologies such as sensors, communication, and computational processing	
Unit – I	**Introduction to Industrial IoT and Industry 4.0:**	**9**
Introduction - IoT Background and History, IIoT key technologies, IoT and IIoT similarities and differences – Innovations and the IIoT – Intelligent devices – Key opportunities and benefits: Digital and human workforce – Industrial Internet use-cases - Industry 4.0: Characteristics and design principles.		
Unit – II	**IIoT Architectures:**	**9**
IIoT Reference Architecture – Industrial Internet Architecture Framework – Five Functional domains – Three tier architecture topology – Connectivity: Key system characteristics, Connectivity security and functional characteristics – Functions of communication layer – Overview of Predictive Maintenance Architecture.		
Unit – III	**IIoT WAN Technologies and Protocols:**	**9**
Need of Protocols – Legacy Industrial protocols – Modern Communication protocols: Industrial Ethernet, Encapsulated Field Bus, Standard Ethernet. IIoT device Low-Power WAN optimized technologies for M2M: SigFox, LoRaWAN, nWave, Dash7, Ingenue RPMA, Low Power Wi-Fi, LTE Category-M, Weightless, Millimeter Radio.		
Unit – IV	**Industrial IoT Security and Governance:**	**9**
Introduction – Security threats and vulnerabilities of IoT – Industrial challenges – Evolution of Cyber attacks: cyber attacks and solutions – Strategic principles of cyber security – cyber security measures - Industrial IoT security architecture: IIoT architecture patterns – four Tier IIoT security model- Management risks with IIoT.		
Unit – V	**Industrial IoT Analytics and Applications:**	**9**
Software Defined Networks: Difference between SDN and NFV – Cloud and Fog - Big Data and Analytics in IIoT. Recent Technological components of Robots: Industrial Robotic applications – Industrial application of AR: Maintenance, assembly, operation and training.		
		Total:45

TEXT BOOK:

1.	Alasdair Gilchrist, “Industry 4.0: The Industrial Internet of Things”, 1st Edition, Apress Media, NewYork, 2016.

REFERENCES:

1.	Alp Ustundag and EmreCevikcan, “Industry 4.0: Managing the Digital Transformation”, Springer series in Advanced Manufacturing, Switzerland, 2018.
2.	DimitriosSerpanos and Marilyn Wolf, “Internet-of-Things (IoT) Systems, Architectures, Algorithms, Methodologies”, Springer International Publishing AG, Switzerland, 2018.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	explore the basics of industrial internet of things	Understanding (K2)
CO2	interpret the concepts of various architectures and components	Understanding (K2)
CO3	design and implement protocols and sensors for IIoT	Applying (K3)
CO4	impart the knowledge of IIoT security layers	Understanding (K2)
CO5	apply IIoT in real time Industrial applications	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					1	1
CO2	3	1						1					2	2
CO3	3	2	1	1	1			1					3	3
CO4	3	1						1					2	2
CO5	3	2	1	1	1			1					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	85					100
CAT2	10	50	40				100
CAT3	5	35	60				100
ESE	10	50	40				100

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

22EIL61 - PLC AND DCS LABORATORY							
Programme & Branch	**B.E. & Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Industrial Automation using PLC and DCS**	**6**	**PC**	**0**	**0**	**2**	**1**

Preamble	The PLC and DCS laboratory is a crucial component, where students are trained in the design, implementation, and maintenance of industrial control systems using Programmable Logic Controllers (PLCs) and Distributed Control Systems (DCS). Through hands-on experience, students will learn to program, simulate and troubleshoot these systems, preparing them for careers in the automation and control industry.

LIST OF EXPERIMENTS / EXERCISES:

1.	Implementation of a simple on/off control of a traffic light system using PLC.
2.	Control of speed and direction of a motor using PLC and SCADA
3.	Counting and sorting objects on a conveyor belt using PLC and HMI
4.	Control of the timing of a filling process operation using PLC.
5.	Implementation of a sequential control of a process using PLC.
6.	Implementation of pressure and flow control system using DCS.
7.	Implementation of an alarm and notification system for a process using DCS.
8.	Implementation of a cascade control level system using DCS.
9.	Implementation of Packaging Line Control using Factory I/O software
10.	Development of simple logic circuits with digital inputs and outputs using Phoenix Contact PLC.

Total:30

REFERENCES/ MANUAL /SOFTWARE:

1.	Laboratory Manual
2.	Next-Gen PLC Training - Factory I/O (factoryio.com)
3.	PLCnext Technology | PHOENIX CONT https://www.phoenixcontact.com/en-pc/industries/plcnext-technology ACT

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	develop Industrial automation applications using PLC	Applying (K3) Precision (S3)
CO2	develop Industrial automation applications using DCS	Applying (K3) Precision (S3)
CO3	develop advanced industrial automation application using factory I/O and Phoenix Contact	Applying (K3) Precision (S3)

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	3	2	3	2	2		1	2	3		1	3	3
CO2	3	3	2	3	2	2		1	2	3		1	3	3
CO3	3	3	2	3	2	2		1	2	3		1	3	3

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

22EIL62 - VIRTUAL INSTRUMENTATION AND INDUSTRIAL IoT LABORATORY							
Programme & Branch	**B.E. & Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**6**	**PC**	**0**	**0**	**2**	**1**

Preamble	To impart the practical knowledge on LabVIEW programming and industrial Internet of Things concept.

LIST OF EXPERIMENTS / EXERCISES:

1.	Programming with basic functions
2.	Programming with FOR Loop, While Loop, Local and Global variables
3.	Programming with Array, Cluster and Structures
4.	Data acquisition and analysis using DAQ.
5.	Data acquisition and analysis using NI-ELVIS.
6.	Monitoring data from Wireless Temperature Transmitter using LoRA and IoT 2040
7.	Monitoring and Controlling of PLC from cloud platform through IoT 2040
8.	Interfacing and transfer of data from LoRa nodes to LoRa Gateway
9.	Interfacing Factory I/O and PLCnext with LoRa Gateway using MQTT
10.	Emergency Start / Stop of Industrial Machines using LoRa IoT sensors
	Total:30

REFERENCES/ MANUAL /SOFTWARE:

1.	LabVIEW Software user Manual.
2.	Siemens S7 1200 PLC and IoT 2040 User Manual
3.	PLCnext User Manual

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	create LabVIEW programs for real time applications	Applying (K3)
CO2	develop Industrial automation applications using PLC and IoT gateway	Applying (K3)
CO3	develop advanced industrial automation application using factory I/O and Phoenix PLCnext	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	3	2	3	2	2		1	2	3		1	3	3
CO2	3	3	2	3	2	2		1	2	3		1	3	3
CO3	3	3	2	3	2	2		1	2	3		1	3	3

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

22EIP61 - PROJECT WORK I								
Programme & Branch	**B.E. & Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**6**	**EC**	**0**	**0**	**8**	**4**

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	formulate a problem with proper objectives to meet the need of the Society and Industry after detailed literature review	Creating (K6) Characterization (A5) Articulation (S4)
CO2	design the Model considering all mathematical calculations meeting required standards prescribe by professional bodies	Creating (K6) Characterization (A5) Articulation (S4)
CO3	select proper instruments for the designed model and develop the model with proper project and finance management and demonstrate the proper working of the model	Evaluating (K5) Characterization (A5) Articulation (S4)
CO4	articulate the project report and presentations with neat presentation incorporating all parameters	Evaluating (K5) Characterization (A5) Articulation (S4)
CO5	contribute individually and in team for the development and final working of the project	Evaluating (K5) Characterization (A5) Articulation (S4)

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	3	3	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	2	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	2	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	2	3	3	3	3	3	3	3	3	3

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

22EIP62 - PROJECT WORK I								
Programme & Branch	**B.E. & Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**6**	**EC**	**0**	**0**	**10**	**5**

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	formulate a problem with proper objectives to meet the need of the Society and Industry after detailed literature review	Creating (K6) Characterization (A5) Articulation (S4)
CO2	design the Model considering all mathematical calculations meeting required standards prescribe by professional bodies	Creating (K6) Characterization (A5) Articulation (S4)
CO3	select proper instruments for the designed model and develop the model with proper project and finance management and demonstrate the proper working of the model	Evaluating (K5) Characterization (A5) Articulation (S4)
CO4	articulate the project report and presentations with neat presentation incorporating all parameters	Evaluating (K5) Characterization (A5) Articulation (S4)
CO5	contribute individually and in team for the development and final working of the project	Evaluating (K5) Characterization (A5) Articulation (S4)

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	3	3	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	2	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	2	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	2	3	3	3	3	3	3	3	3	3

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

22GET31- UNIVERSAL HUMAN VALUES							
(Common to All Engineering and Technology Branches)							
Programme & Branch	**All BE/BTech Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**3/6**	**HS**	**2**	**0**	**0**	**2**

Preamble	To make the student to know what they 'really want to be' in their life and profession, understand the meaning of happiness and prosperity for a human being. Also to facilitate the students to understanding of harmony at all the levels of human living, and live accordingly	
Unit – I	**Introduction:**	**6**
Need and Basic Guidelines of Value Education – Content and Process of Value Education – Self Exploration – purpose of self-Exploration – Content and Process of Self exploration – Natural Acceptance – Realization and Understanding – Basic Human Aspirations – Continuous Happiness and Prosperity – Exploring Happiness and Prosperity – Basic Requirement for Fulfillment of Human Aspirations – Relationships – Physical Facilities – Right Understanding.		
Unit – II	**Harmony in the Self and Body:**	**6**
Human Being and Body – Understanding Myself as Co–existence of Self ('I') and Body, Needs of the Self and Body, Activities in the Self and Body, Self ('I') as the Conscious Entity, the Body as the Material Entity – Exercise – Body as an Instrument– Harmony in the Self ('I) – Understanding Myself – Harmony with Body.		
Unit – III	**Harmony in the Family and Society:**	**6**
Harmony in the Family – Justice – Feelings (Values) in Human Relationships – Relationship from Family to Society – Identification of Human Goal – Five dimensions of Human Endeavour.		
Unit – IV	**Harmony in Nature and Existence:**	**6**
Order of Nature – Interconnectedness – Understanding the Four order – Innateness – Natural Characteristic – Basic Activity – Conformance – Introduction to Space – Co–existence of units of Space – Limited and unlimited – Active and No–activity – Existence is Co–existence.		
Unit – V	**Implications of the above Holistic Understanding of Harmony on Professional Ethics:**	**6**
Values in different dimensions of Human Living – Definitiveness of Ethical Human Conduct –Implications of Value based Living – Identification of Comprehensive Human Goal – Humanistic Education – Universal Human Order – Competence and Issues in Professional Ethics.		
		Total:30

TEXT BOOK:	
1.	Gaur R.R., Sangal R., Bagaria G.P., "A Foundation Course in Human Values and Professional Ethics", 1st Edition, Excell Books Pvt. Ltd., New Delhi, 2016.
REFERENCES:	
1.	Ivan Illich, "Energy & Equity", The Trinity Press, USA, 1974.
2.	Schumacher E.F., "Small is Beautiful: a study of economics as if people mattered", Britain, 1973.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (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	distinguish between ethical and unethical practices, and extend ethical and moral practices for a better living	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	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 – 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	NA						100

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

22GCT71 - ENGINEERING ECONOMICS AND MANAGEMENT								
(Common to All BE/BTech branches)								
Programme & Branch	**All BE/BTech branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**7**	**HS**	**3**	**0**	**0**	**3**

Preamble	The aim of the course is to create fundamental knowledge on management by introducing concepts like economics, national income, marketing, operations management, accounting principles etc.	
Unit – I	**Micro Economics**	**9**
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	**Macro Economics, Business Ownership and Management concepts**	**9**
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	**Marketing Management**	**9**
Marketing - Core Concepts of Marketing - Four P‘s of Marketing - New Product Development – Intellectual Property Rights (IPR), Product Life Cycle - Pricing Strategies and Decisions.		
Unit – IV	**Operations Management**	**9**
Operations Management - Resources - Types of Production System - Site Selection, Plant Layout, Steps in Production Planning and Control - Inventory - EOQ Determination.		
Unit – V	**Financial Management**	**9**
Accounting Principles – Financial Statements and its Uses – Depreciation - Straight Line and Diminishing Balance Method – Break Even Analysis – Capital Budgeting - Significance –Traditional and Discounted Cash Flow Methods.		
		Total:45

TEXT BOOK:

1.	Compiled by Department of Management Studies, Kongu Engineering College, "Economics and Management for Engineers", 1st Edition, McGraw Hill Education, Noida, 2013.

REFERENCES:

1.	Geetika, Piyali Ghosh and Purba Roy Choudhury, “Managerial Economics”, 3rd Edition, McGraw-Hill, New Delhi, 2018.
2.	William J. Stevenson, “Operations Management”, 14th Edition, McGraw-Hill Education, 2021.
3.	William G. Nickels, James M. McHugh, Susan M. McHugh, “Understanding Business”, 12th Edition, McGraw-Hill Education, New York, 2019.

COURSE OUTCOMES: On completion 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	PO7	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		

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	40	40				100
CAT3	20	40	40				100
ESE	20	40	40				100

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

22EIT71 - DIGITAL SIGNAL PROCESSING							
Programme & Branch	**BE & Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**7**	**PC**	**3**	**0**	**0**	**3**

Preamble	To impart the fundamental knowledge and applications of Digital Signal Processing.	
Unit – I	**Discrete Time Signals and Systems:**	**9**
Motivation – Sampling and Quantization of signal – Discrete time (DT) sequences and its representation: Singularity functions, Exponential and Sine – Operations on DT sequence: Shifting, Scaling and Folding – LTI system and Its Properties: Linearity, Causality, and Stability – Linear and circular convolution - Correlation.		
Unit – II	**Fourier transform:**	**9**
Discrete Time Fourier Transform – Discrete Fourier Transform – Relationship between DTFT and DFT – Fast Fourier Transform and Its Significance – Decimation in Time FFT algorithm – Decimation in Frequency FFT algorithm – IDFT using FFT – Parseval's theorem.		
Unit – III	**FIR Filters:**	**9**
Introduction - Need, advantages and disadvantages of digital filters – Theoretical Design of FIR filter: FIR filter design using windowing techniques (Rectangular, Bartlett, Hanning and Hamming) – Frequency Sampling Method of FIR filter design – Design of FIR filter using Rabiner Method – Linear Phase Characteristics – Stabilities.		
Unit – IV	**IIR Filters:**	**9**
IIR Filter: Design of analog IIR filter – Mapping techniques from s domain to z domain: Impulse invariant, Bilinear Transformation – Theoretical Design of IIR filter: Butterworth Filter Design of digital IIR filter – Chebyshev Filter Design of Digital IIR filter– Frequency Transformation – Comparison of FIR and IIR filters – Stabilities.		
Unit – V	**Digital Signal Processor:**	**9**
Digital Signal Processor: Architecture of Digital Signal Processor – Selection of Digital Signal Processor – Addressing modes – On Chip peripherals – TMS320C6748 DSP development kit – Integrated development environment.		
		Total:45

TEXT BOOK:

1.	Esakkirajan S., Veerakumar T., and Badri N Subudhi, "Digital Signal Processing",1st Edition, Tata McGraw hill, New Delhi,2021

REFERENCES:

1.	John G. Proakis & Dimitris G. Manolakis., "Digital Signal Processing: Principles, Algorithms and Applications", 4thEdition, Pearson Prentice Hall, New Delhi, 2014.
2.	Rodger Ziemer, William Tranter& D. Fannin, "Signals and Systems: Continuous and Discrete", 4thEdition, Pearson, New Delhi, 1998.
3.	Salivahanan S. "Digital Signal Processing", 4thEdition, Tata McGraw Hill, New Delhi, 2020.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	summarize discrete time signals and discrete time systems	Understand (K2)
CO2	apply Fourier transform to determine the frequency response of LTI discrete system	Applying (K3)
CO3	describe the design procedures of FIR filter	Understand (K2)
CO4	explain the design procedures of IIR filter	Understand (K2)
CO5	elaborate the DSP Processor used in signal processing applications	Understand (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	2	1	1	1					2		1	3	3
CO2	3	2	1	1	1					2		1	3	3
CO3	3	2	1	1	1					2		1	3	3
CO4	3	2	1	1	1					2		1	3	3
CO5	3	2	1	1	1					2		1	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	30	60	10				100
CAT2	30	40	30				100
CAT3	40	60					100
ESE	20	64	16				100

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

22EIP71 - PROJECT WORK II PHASE I							
Programme & Branch	**B.E. & Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**7**	**EC**	**0**	**0**	**10**	**5**

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	formulate a problem with proper objectives to meet the need of the Society and Industry after detailed literature review	Creating (K6) Articulation (S4)
CO2	design the Model considering all mathematical calculations meeting required standards prescribe by professional bodies	Creating (K6) Articulation (S4)
CO3	select proper instruments for the designed model and develop the model with proper project and finance management and demonstrate the proper working of the model	Evaluating (K5) Articulation (S4)
CO4	articulate the project report and presentations with neat presentation incorporating all parameters	Evaluating (K5) Articulation (S4)
CO5	contribute individually and in team for the development and final working of the project	Evaluating (K5) Articulation (S4)

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	3	3	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	2	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	2	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	2	3	3	3	3	3	3	3	3	3

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

22EIP81 - PROJECT WORK II PHASE II							
Programme & Branch	**B.E. & Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**8**	**EC**	**0**	**0**	**8**	**4**

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	formulate a problem with proper objectives to meet the need of the Society and Industry after detailed literature review	Creating (K6) Articulation (S4)
CO2	design the Model considering all mathematical calculations meeting required standards prescribe by professional bodies	Creating (K6) Articulation (S4)
CO3	select proper instruments for the designed model and develop the model with proper project and finance management and demonstrate the proper working of the model	Evaluating (K5) Articulation (S4)
CO4	articulate the project report and presentations with neat presentation incorporating all parameters	Evaluating (K5) Articulation (S4)
CO5	contribute individually and in team for the development and final working of the project	Evaluating (K5) Articulation (S4)

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	3	3	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	2	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	2	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	2	3	3	3	3	3	3	3	3	3

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

<table>
<tr><td colspan="9">22EIE01 - BIOMEDICAL INSTRUMENTATION</td></tr>
<tr><td>Programme & Branch</td><td>B.E. & Electronics and Instrumentation Engineering</td><td>Sem.</td><td>Category</td><td>L</td><td>T</td><td>P</td><td colspan="2">Credit</td></tr>
<tr><td>Prerequisites</td><td>Nil</td><td>5</td><td>PE</td><td>3</td><td>0</td><td>0</td><td colspan="2">3</td></tr>
<tr><td>Preamble</td><td colspan="8">To impart the knowledge of some human anatomy and measuring bio potentials using bio electrodes with specific instruments which is most commonly used in hospitals. Also understand the fundamental concept of various biomedical imaging techniques and learn the advanced physiological assistive medical devices.</td></tr>
<tr><td>Unit – I</td><td colspan="6">Human Physiological Systems:</td><td colspan="2">9</td></tr>
<tr><td colspan="9">Cell and its structure-Resting and action potentials - Skeletal system - Circulatory system – Respiratory System - Components of the Bio medical instrumentation system. Bio Potential Electrodes: Micro electrode - depth and needle electrode - surface electrodes.</td></tr>
<tr><td>Unit – II</td><td colspan="6">Biomedical Electrical Signal Measurement:</td><td colspan="2">9</td></tr>
<tr><td colspan="9">ECG – Einthoven’s triangle – 3 lead ECG system, EEG - 10- 20 electrode system, EMG, ERG and EOG: Origin and characteristics - Lead systems, recording methods and typical waveforms.</td></tr>
<tr><td>Unit – III</td><td colspan="6">Biomedical Non-Electrical Signal Measurement:</td><td colspan="2">9</td></tr>
<tr><td colspan="9">Digital stethoscope - Phonocardiography (PCG) - Blood pressure Measurement: Sphygmomanometer, MEMS based catheter tip pressure sensor, ultrasonic blood pressure monitor – Spirometer – Capnography - Blood pH measurement - Measurement of blood pCO2 - Blood pO2 measurement - Pulse oximeter - Lung volumes, respiration.</td></tr>
<tr><td>Unit – IV</td><td colspan="6">Biomedical Imaging Systems:</td><td colspan="2">9</td></tr>
<tr><td colspan="9">X-ray machine - Computer tomography - Ultrasonic imaging systems - Magnetic resonance imaging - PET - SPECT -FMRI – Magnetic Particle Imaging.</td></tr>
<tr><td>Unit – V</td><td colspan="6">Physiological Assist Devices:</td><td colspan="2">9</td></tr>
<tr><td colspan="9">Ventricular asynchronous pacemaker - AC Defibrillator- Heart lung machine - Kidney machine - Audiometer – Biothesiometry Vibroscreen - Ophthalmoscope –Biotelemetry – Telemedicine.</td></tr>
<tr><td colspan="9" align="right">Total:45</td></tr>
<tr><td colspan="9">TEXT BOOK:</td></tr>
<tr><td>1.</td><td colspan="8">Khandpur R.S," Handbook of Biomedical Instrumentation", 2nd Edition, Tata McGraw-Hill ,New Delhi , 2017.</td></tr>
<tr><td colspan="9">REFERENCES:</td></tr>
<tr><td>1.</td><td colspan="8">John G. Webster, “Medical Instrumentation Application and Design”, 4th Edition, John Wiley and Sons, NewYork, 2015.</td></tr>
<tr><td>2.</td><td colspan="8">Andrew G. Webb, “Principles of Biomedical Instrumentation” 1st Edition, Cambridge University Press, United Kingdom, 2018</td></tr>
<tr><td>3.</td><td colspan="8">Arumugam. M, “Bio-Medical Instrumentation”, 2nd Edition, Anuradha Agencies, Kumbakonam, 2014.</td></tr>
</table>

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	interpret the basic principles and phenomena of Biomedical Engineering	Understanding (K2)
CO2	record the bioelectric potentials using bio potential electrode through bio signal recording devices	Applying (K3)
CO3	measure biomedical signal parameters through medical instruments	Applying (K3)
CO4	summarize the basic principles in medical imaging techniques	Understanding (K2)
CO5	illustrate the physiological assist devices	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				2		1					2	2
CO2	3	2	1	1	1	2		1					3	3
CO3	3	2	1	1	1	2		1					3	3
CO4	3	1				2		1					2	2
CO5	3	2	1	1	1	2		1					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	20	40	40				100
CAT2	10	40	50				100
CAT3	10	40	50				100
ESE	10	40	50				100

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

22EIE02 - INSTRUMENTATION SYSTEM DESIGN							
Programme & Branch	**B.E. & Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Industrial instrumentation**	**5**	**PE**	**3**	**0**	**0**	**3**

Preamble	To design controllers and signal conditioning circuits for instrumentation systems.	
Unit - I	**Design of Analog Signal Conditioning:**	**9**
Analog Signal Conditioning: Analog Data Representation - Principles Of Analog Signal Conditioning-divider circuits- Guidelines for Analog Signal Conditioning Design - Analog Signal Conditioning Design for various industrial parameters.		
Unit - II	**Design Digital Signal Conditioning:**	**9**
Digital Signal Conditioning : Introduction – Converters: Comparator, Digital to Analog Converters, Analog to Digital Converters - Data-Acquisition Systems: Different types of DAS		
Unit - III	**Design Of Final Control Elements:**	**9**
Introduction - Final Control Operation - Signal Conversions: Analog Electrical Signals, Digital Electrical Signals–Design Actuators: Electrical Actuators -Control Elements: Electrical, Fluid Valves.		
Unit - IV	**Design Of Analog Controllers:**	**9**
Introduction – continuous controller modes -General Features of analog controller –Design of Electronic Controllers: Error Detector, Single Mode, and Composite Mode.		
Unit - V	**Computer-Based Control:**	**9**
Introduction - Digital Applications: Alarms, Two-Position Control - Computer-Based Controller: Hardware Configurations, - Other Computer Applications: Data Logging, Supervisory Control - Control System Networks: Development, General Characteristics,		
		Total:45

TEXT BOOK:

1. Curtis D. Johnson, “Process Control Instrumentation Technology”, 8th Edition, Pearson Education Limited, London, 2015

REFERENCES:

1. Dale E Seborg ,”Process Dynamics and Control”, 3rd Edition, Wiley India, New Delhi, 2016.
2. Surekha Bhanot, "Process Control: Principles and Applications", 4thEdition, Oxford University Press, United Kingdom, 2017.
3. Daniel H Sheingold, "Transducer Interfacing Handbook", 1st Edition, Analog devices Inc, America, 1980.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	narrate the role of signal conditioning circuits in instrumentation	Understanding (K2)
CO2	develop signal transmitter circuits for various process parameter	Applying (K3)
CO3	design final control elements and actuators	Applying (K3)
CO4	design controllers for various applications	Applying (K3)
CO5	describe the role of computer based control systems	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											2	2
CO2	3	2	1	1	1								3	3
CO3	3	2	1	1	1								3	3
CO4	3	2	1	1	1								3	3
CO5	3	1											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	5	25	70				100
CAT2	5	25	70				100
CAT3	5	25	70				100
ESE	5	25	70				100

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

22EIE03 - SOFT COMPUTING TECHNIQUES							
Programme & Branch	**B.E. & Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**5**	**PE**	**3**	**0**	**0**	**3**

Preamble	Emphasis of this course will be on Artificial Neural Networks, Fuzzy Logic, Meta-heuristic techniques like Genetic Algorithms and Neuro fuzzy Systems and their applications to different computational problems.	
Unit – I	**Introduction to Optimization Techniques:**	**9**
Introduction – Hard Computing – Soft computing – Hybrid Computing. Optimization and Some Traditional Methods: Introduction to Optimization – Traditional methods of Optimization. Overview of Non-Traditional Optimization methods: Simulated Annealing – Particle Swarm optimization.		
Unit – II	**Fundamentals of Neural Networks :**	9
Evolution of Neural Networks – Basic models of Artificial Neural Network- Important Terminologies of ANNs - Linear Separability-Perceptron Networks – Adaptive Linear Neuron – Supervised Learning Network: Back Propagation Network - Radial Basis Function network.		
Unit – III	**Unsupervised Learning Networks and Fuzzy Logic Systems:**	9
Unsupervised Learning Networks: Associative Memory Network: Hopfield Networks – Discrete Hopfield Network. Unsupervised Learning Networks: Kohonen Self Organizing Map. **Fuzzy Logic Systems:** Introduction to fuzzy logic –Classical sets (Crisp sets) - Fuzzy sets. Classical Relation and Fuzzy Relation: Introduction –Membership functions: Introduction – Features of the Membership Functions.		
Unit – IV	**Fuzzy Inference Systems:**	9
Fuzzification – Methods of Membership Value Assignments. Defuzzification: Introduction - Lambda-Cuts for fuzzy sets and fuzzy relations, Defuzzification methods. Fuzzy Rule Base and Approximate Reasoning: Aggregation of Fuzzy Rules – Fuzzy Reasoning – Fuzzy Inference systems (FIS): – Methods of FIS.		
Unit – V	**Neuro-Fuzzy System and Genetic Algorithm:**	9
Neuro-Fuzzy System: Characteristics of Neuro–Fuzzy Hybrids – Adaptive Neuro - Fuzzy Inference System (ANFIS). Genetic Algorithm: Introduction – Biological Background – Traditional Optimization and Search Techniques - Basic Terminologies in GA – Operators in GA – Problem solving using Genetic Algorithm: Maximizing a Function.		
		Total:45

TEXT BOOK:

1.	Dr.S.N.Sivanandam & Dr.S.N.Deepa, “Principles of Soft Computing”, 3rd Edition, Wiley, New Delhi, 2018.

REFERENCES:

1.	Dilip K.Pratihar ,”Soft computing fundamentals and Applications,”Narosa Publishing House Pvt. Ltd.,2015.
2.	Timothy J. Ross, “Fuzzy Logic with Engineering Applications”, 3rd Edition, Wiley, New Delhi, 2010.
3.	David E. Goldberg, “Genetic algorithms in search, optimization, and machine learning”, 3rd Edition, Addison Wesley Longman Publishing Co, 2013.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	explain the fundamentals and the concepts of optimization techniques	Understanding(K2)
CO2	develop the various neural network algorithms for classification and function approximation and clustering	Applying(K3)
CO3	explain the fundamental concepts of fuzzy logic systems	Understanding(K2)
CO4	design the controller using Fuzzy Inference System	Applying (K3)
CO5	apply Genetic Algorithm and Neuro-Fuzzy concepts for specific applications	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											2	2
CO2	3	2	1	1	1								3	3
CO3	3	1											2	2
CO4	3	2	1	1	1								3	3
CO5	3	2	1	1	1								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	20	40	40				100
CAT2	20	30	50				100
CAT3	10	40	40				100
ESE	20	30	50				100

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

<table>
<tr><td colspan="8">22EIE04 – ANALYTICAL INSTRUMENTATION</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td>Programme & Branch</td><td>B.E. & Electronics and Instrumentation Engineering</td><td>Sem.</td><td>Category</td><td>L</td><td>T</td><td>P</td><td>Credit</td></tr>
<tr><td>Prerequisites</td><td>Transducers Engineering</td><td>5</td><td>PE</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td>Preamble</td><td colspan="7">Analytical Instrumentation provides qualitative and quantitative techniques for analysis in chemical, pharmaceutical, clinical, oil refineries and in pollution monitoring and control. The conventional and modern analytical techniques along with their principle, instrumentation and applications are included in the course.</td></tr>
<tr><td>Unit – I</td><td colspan="6">Colorimeters and Spectrophotometers:</td><td>9</td></tr>
<tr><td colspan="8">The Electromagnetic Spectrum–Laws relating to absorption of radiation–Ultraviolet and Visible Absorption Spectroscopy–Spectrophotometers: IR spectroscopy: Basic components of IR Spectrophotometers – Types of IR Spectrophotometers– FTIR spectrophotometers – Flame Photometers: Principle of Flame Photometers and Construction Details of Flame Photometers –Atomic Absorption Spectroscopy.</td></tr>
<tr><td>Unit – II</td><td colspan="6">Chromatography and pH Measurement:</td><td>9</td></tr>
<tr><td colspan="8">Basic definitions – Gas chromatography – Liquid chromatography –Types of Liquid Chromatography – High Pressure Liquid Chromatography (HPLC). pH Meters: Principle of pH Measurement – Electrodes for pH measurement: Hydrogen electrodes – Glass electrodes – Reference electrodes – Combination electrode – Selective-ION Electrodes – Ammonia Electrode –Fluoride Electrode.</td></tr>
<tr><td>Unit – III</td><td colspan="6">Industrial Gas Analyzers:</td><td>9</td></tr>
<tr><td colspan="8">Types of gas analyzers – Paramagnetic oxygen analyzer –Electrochemical Methods- Infrared gas analyzers – Thermal conductivity analyzers – Analyzers based on Gas density ––Method based on Ionization of gases.</td></tr>
<tr><td>Unit – IV</td><td colspan="6">Radio Chemical Techniques:</td><td>9</td></tr>
<tr><td colspan="8">Fundamentals of radiochemical methods – Radiation detectors: Ionization chamber – Geiger-Muller counter – Proportional counter – Scintillation counter – Semiconductor detectors – X-ray spectrophotometer – Mass Spectrometers: Basic Mass Spectrometer-Principle of Operation – Types of Mass Spectrometers: Magnetic deflection mass spectrometer and the Time-of-flight mass spectrometer. NMR Spectrometer: Principle and construction details.</td></tr>
<tr><td>Unit – V</td><td colspan="6">Applications of Analytical Instrumentation:</td><td>9</td></tr>
<tr><td colspan="8">Scanning Electron Microscope, Scanning Probe Microscopes and Particle size analyzers. Air Pollution Monitoring Instruments: CO analyzer, SO2analyzer, Ozone analyzer. Water Pollution Monitoring Instruments: Dissolved oxygen, oxidation-reduction potential, Turbidity meter.</td></tr>
<tr><td colspan="8" align="right">Total:45</td></tr>
</table>

TEXT BOOK:	
1.	Khandpur R.S., “Handbook of Analytical Instruments” 3rd Edition, McGraw-Hill Education India Pvt. Ltd, New Delhi , 2015.
REFERENCES:	
1.	Ewing G.W., “Instrumental Methods of Chemical Analysis”, 6th Edition, McGraw-Hill, New York, 2007.
2.	Douglas A. Skoog, F. James Holler, Stanley R. Crouh, “Principles of Instrumental Analysis”, 7th Edition, Thomson Brooks Cole, San Francisco, 2020.
3.	Bela G. Liptak, “Analytical Instrumentation”, 2nd Edition, New York: McGraw-Hill Book Co., 2018.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	summarize on analytical instruments which utilize electromagnetic spectrum as source	Understanding (K2)
CO2	explain the chromatographic methods and electrodes used in pH measurement	Understanding (K2)
CO3	make use of analyzers for measuring industrial gases and liquids	Applying (K3)
CO4	interpret the sample data with radiochemical techniques	Understanding (K2)
CO5	apply analytical techniques for industrial requirements	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											2	2
CO2	3	1											2	2
CO3	3	2	1	1	1								3	3
CO4	3	1											2	2
CO5	3	2	1	1	1								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	30	70					100
CAT2	10	50	40				100
CAT3	10	50	40				100
ESE	20	50	30				100

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

22EIE05 - INDUSTRIAL ELECTRONICS AND DRIVES							
Programme & Branch	**B.E. & Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**5**	**PE**	**3**	**0**	**0**	**3**

Preamble	To impart the knowledge on Power semiconductor devices and their characteristics, Controlled rectifiers, Choppers, DC drives, Variable Frequency Drives and to understand the specific applications of different drives.	
Unit – I	**Introduction to Power semiconductor devices**	**9**
Classification of power semiconductors – Control characteristics of power devices – Types of power electronic circuits – Elements in the design of power electronics equipment – Thyristor: Operating principle – Behaviour under biased condition – Gate triggering – Commutation methods.		
Unit – II	**Controlled rectifiers**	**9**
Principle of phase controlled converter operation– Single phase half controlled rectifier - Single phase full converter – - Single phase half controlled Bridge converter - Three phase fully controlled Bridge Rectifiers – Three phase dual converters – Three phase semi converters – Inverting mode of a converter - Effect of source and load inductances.		
Unit – III	**Choppers and Inverters**	**9**
Principle of DC chopper - Step up and Step down Choppers – Classification of choppers - Quadrants of operation – Switching mode Regulators - Buck, Boost and Buck-Boost Regulators. Introduction to Inverters: Principle of Operation- Single phase bridge inverters.		
Unit – IV	**DC Drives and AC Drives**	**9**
Basic characteristics of DC motors – Operating modes – Single phase semi converter and dual converter drives- Three phase half wave and full converter drives – Control modes - Power control, Regenerative brake control, Rheostatic brake control, Combined regenerative and rheostatic brake control. Introduction to AC drives: Introduction to Variable Frequency Drives.		
Unit – V	**Drives for specific applications**	**9**
Drive considerations for textile mills – Steel rolling mills – Cranes and Hoist Drives – Cement mills – Sugar mills- Paper mills.		
		Total:45

TEXT BOOK:

1.	Rashid, M. H.,"Power Electronics –Circuits, Devices and Applications", 4th Edition ,Pearson Education, New Delhi, 2017. Unit 1,2,3 and 4
2.	Vedam Subrahmanyam, "Electric Drives-Concepts and Applications", 2nd Edition, McGraw Hill Education (India) Private Limited, New Delhi, 2017 for Unit 5.

REFERENCES:

1.	Moorthi V.R., "Power Electronics - Devices, Circuits and Industrial Applications", Oxford university press, New Delhi, 1st edition, 2012.
2.	Gopal K. Dubey, "Fundamentals of Electrical Drives", Narosa Publishing House, Reprint, New Delhi, -2019

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	interpret the power electronic devices for industrial drives	Understanding(K2)
CO2	describe the various controlled devices	Understanding(K2)
CO3	interpret the different types of choppers, inverters and their working	Understanding(K2)
CO4	develop the operating and control modes of DC drives and learn about variable frequency AC drives	Applying (K3)
CO5	select suitable DC drives and simple AC drives for industrial applications	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											2	2
CO2	3	1											2	2
CO3	3	1											2	2
CO4	3	2	1	1	1								3	3
CO5	3	2	1	1	1								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	85					100
CAT2	15	85					100
CAT3	10	45	45				100
ESE	5	70	25				100

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

22EIE06 - ADVANCED CONTROL TECHNIQUES

Programme & Branch	**B.E. & Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Control Systems**	**5**	**PE**	**3**	**0**	**0**	**3**

Preamble	To understand and analyse the performance of linear and nonlinear system in state space domain with and without controllers.	
Unit – I	**State Space Analysis in Continuous domain:**	**9**
Review of state variable representation and state variable models in continuous systems. Conversion from transfer function to various state space model – Conversion of state space to transfer function-Non-uniqueness of state model – Eigen values and eigen vectors – State transition matrix and its properties. Solutions of state equations — Free and forced responses.		
Unit – II	**State Feedback Controllers and Observers:**	**9**
Controllability and observability – Relation between transfer function and state model – Effect of sampling time on controllability and observability - State feedback controllers. State estimators: Full and reduced order observer. Steady state error in state model-PI feedback controller- Deadbeat Observers- Dead beat Control.		
Unit – III	**Phase Plane Analysis:**	**9**
Behaviour of non-linear systems, jump resonance, sub-harmonic oscillation- Singular points Phase plane analysis: Linear and nonlinear systems – Construction of phase portraits using isoclines- Limit cycle analysis.		
Unit – IV	**Describing function Analysis:**	**9**
Typical non-linearities Describing Function of nonlinearities –Review of Nyquist criterion for linear system –Nyquist stability criteria for nonlinear system–Limit cycle oscillations- Accuracy of Describing Function method.		
Unit – V	**Lyapunov Stability Analysis:**	**9**
Stability in the sense of Lyapunov – Second method of Lyapunov – Lyapunov stability analysis of linear time invariant systems and non linear system- Krasovski's theorem- Variable gradient method of generating Lyapunov functions. Lyapunov analysis for non autonomous systems.		
		Total:45

TEXT BOOK:

1.	Gopal M. "Digital Control and State Variable Methods", 4^{th} Edition, Tata McGraw-Hill, New Delhi,2008 for Unit-1, 2 & 3

REFERENCES:

1.	Slotine and Li , "Applied Nonlinear Control", 2^{nd} Edition, Prentice Hall Publishers, USA, 1991 for Unit-4 & 5.
2.	Khalil, Hasan K., "Nonlinear Systems", 2^{nd} edition, Prentice Hall, NewJercy, 2002.
3.	Richard C.Dorf& Robert H.Bishop, "Modern Control Systems"12^{th} Edition, Pearson Publication, NewJercy, 2013.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	analyse the time domain unctional tics of continuos systems in state space domain	Analyse(K4)
CO2	Design state feedback controllers and observers	Applying (K3)
CO3	Apply the concepts in the design of state feedback controllers and observers	Analyse(K4)
CO4	Analyse the unction of nonlinear systems using describing function method	Analyse(K4)
CO5	Analyse the stability of linear and nonlinear systems using Lyapunov stability method	Analyse(K4)

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	3	2	2	2					1			3	3
CO2	3	2	1	1	1					1			3	3
CO3	3	3	2	2	2					1			3	3
CO4	3	3	2	2	2					1			3	3
CO5	3	3	2	2	2					1			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	10	40	40	10			100
CAT2	10	40	40	10			100
CAT3	10	40	40	10			100
ESE	10	40	40	10			100

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

22EIE07 - SCADA AND ITS APPLICATIONS								
Programme & Branch	**BE & Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Process Control**	**6**	**PE**	**3**	**0**	**0**	**3**
Preamble	To develop and implement the SCADA in Industrial Automation						
Unit - I	**Introduction to SCADA and Architectures:**						**9**
Inductive Automation by Ignition SCADA: Introduction - Basic Architecture - Scale Out Architecture - Hub and Spoke Architecture - Edge Architectures - IIoT Architecture - Redundancy Architecture - Cloud Based Architecture - AWS Outposts Architecture - Security Architecture							
Unit - II	**Modules in SCADA:**						**9**
Core Modules: Vision Module - Perspective Module – OPC/UA Module: Driver Module – Allen-Bradley Ethernet – Modbus – TCP IP – Siemens – Connecting and configuration to S7 1200 devices – Tag Historian Module – Web Dev module							
Unit - III	**Ignition Platform:**						**9**
Gateway – Home - status – configuration – Gateway backup and restore – Ignition exchange – Database connections: Installing database – connecting to database MySQL							
Unit - IV	**SCADA Security and Tags:**						**9**
Gateway general security settings – classic authentication security – Identity provider authentication security – service security. Tags: Tag browser – Types – user defined tags – Alarm – configuring and scheduling.							
Unit - V	**Applications:**						**9**
Traffic light controls – Lift / Elevator Controls – Water and Sewage Treatment Plants – Building Automation management – Mass Transit and Railway Application – Manufacturing sorting Systems							
							Total:45

TEXT BOOK:

1. Ignition 8.1 User Manual – Inductive Automation

REFERENCES:

1. Stuart A. Boyer, “SCADA: Supervisory Control and Data Acquisition”, 4th Edition, ISA Press, USA, 2009
2. Ronald L. Krutz, “Securing SCADA System”, Wiley Publications, 2007.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	gain knowledge on the basic components of SCADA	Understanding (K2)
CO2	interpret various modules in SCADA	Applying (K3)
CO3	develop ignition platform gateway and connecting to database	Applying (K3)
CO4	impart the knowledge of SCADA security and tags	Applying (K3)
CO5	apply SCADA in specified industrial applications	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											2	2
CO2	3	2	1	1	1								3	3
CO3	3	2	1	1	1								3	3
CO4	3	2	1	1	1								3	3
CO5	3	2	1	1	1								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	10	60	30				100
CAT2	10	30	60				100
CAT3	10	30	60				100
ESE	10	30	60				100

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

22EIE08 VIRTUAL INSTRUMENTATION

Programme & Branch	B.E. & Electronics and Instrumentation Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	**Nil**	**6**	**PE**	**3**	**0**	**0**	**3**

Preamble	Virtual instrumentation is a powerful concept for control, measuring, testing and analysis of real time problems. This course aims at giving an adequate exposure and practice in LabVIEW programming and DAQ system to overcome the limitations of classical methods.	
Unit – I	**Introduction to Virtual Instrumentation:**	**9**
Virtual Instrumentation- Programming Requirements- Drawbacks of Recent Approaches- Virtual Instruments Versus Traditional Instruments- Advantages of VI- Creating Virtual Instruments Using LabVIEW- Virtual Instrumentation in the Engineering Process- Graphical Programming and Textual Programming- Advantages of LabVIEW- LabVIEW Environment- Dataflow Programming- G Programming.		
Unit – II	**Basic Tools, Loops and Graphs:**	**9**
Front Panel-Block Diagram Tools and Palettes- Repetition and Loops: FOR Loop, While Loop, Shift Registers, Tunnels, Feedback Nodes, Local and Global Variables – Arrays-Clusters-Waveform Charts-Waveform Graphs-XY Graphs-Intensity Graphs and Charts-Digital Waveform Graph-3D Graphs.		
Unit – III	**Programming with Structures:**	**9**
Structures: Case Structure, Sequence Structures, Customizing Structures, Timed Structures, Formula Nodes, Event Structure, MathScript-Strings-File I/O-State Machine.		
Unit – IV	**Data Acquisition:**	**9**
Interface Buses: RS 232, RS422, RS485, GPIB and USB. Hardware Aspects: Signal Grounding-Signal Conditioning-Digital I/O Techniques-Data Acquisition in LabVIEW-Hardware Installation and Configuration-Components of DAQ-DAQ Signal Accessory-DAQ Assistant-DAQ Hardware- DAQ Software.		
Unit – V	**Tools and Applications:**	**9**
Signal processing and Analysis Tools-Control System Design and Simulation Tools-Signal, Voltage and Current measurement using general purpose DAQ Card-Bio-Medical Signal Acquisition using NI-ELVIS –Temperature Measurement.		
		Total:45

TEXT BOOK:

1.	S.Sumathi , P.Surekha, “LabVIEW based Advanced Instrumentation Systems”, 1st Edition, Springer Berlin, Heidelberg, 2007.

REFERENCES:

1.	Jovitha Jerome, “Virtual Instrumentation Using LabVIEW”, 3rd Edition, PHI Learning Pvt. Ltd., New Delhi, 2012.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	explain the Virtual Instrumentation concepts	Applying (K2)
CO2	apply structured programming concepts in developing LabVIEW programs	Applying (K3)
CO3	build LabVIEW programs using structures, nodes and state machine concepts	Applying (K3)
CO4	utilize DAQ System to solve real time problems	Applying (K3)
CO5	apply knowledge on various tools in practical works	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	2											2	2
CO2	3	2	1	1	1								3	3
CO3	3	2	1	1	1								3	3
CO4	3	2	1	1	1								3	3
CO5	3	2	1	1	1								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	20	50	30				100
CAT2	15	40	45				100
CAT3	15	60	30				100
ESE	20	40	40				100

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

22EIE09 DIGITAL IMAGE PROCESSING							
Programme & Branch	**B.E. & Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Digital Signal Processing**	**6**	**PE**	**3**	**0**	**0**	**3**

Preamble	To impart the fundamental knowledge and applications of Digital Image Processing.	
Unit – I	**Introduction to Image Processing:**	**9**
Overview to Image Processing – Nature of Image Processing – Image Processing and Related Fields – Digital Image Representation – Types of Images – Fundamental Steps in Image Processing. Digital Image Processing Operations: Basic Relationships and Distance Metrics – Classification of Image Processing Operations – Arithmetic Operations: Image Addition, Image Subtraction, Image Multiplication, Image Division – Logical Operations: AND/NAND, OR/NOR, XOR/XNOR, NOT.		
Unit – II	**Image Transform:**	**9**
Need for Image Transforms – 2D Discrete Fourier transform – 2D Discrete Cosine Transform – Haar Transform – SVD Transforms.		
Unit – III	**Image Enhancement:**	**9**
Image Quality and Need for Image Enhancement – Image Enhancement Point Operations – Linear and Non-linear Functions – Piecewise Linear Functions: Intensity Slicing, Bit-plane Slicing – Histogram Equalization – Spatial Filtering Concepts: Design of Discrete Gaussian Mask, Order-statistics Filters (Median, Maximum, Minimum) – Image Smoothing in Frequency Domain – Image Sharpening in Frequency Domain.		
Unit – IV	**Image Segmentation:**	**9**
Introduction – Classification of Image Segmentation Algorithms – Detection of Discontinuities – Edge Detection: Stages in Edge Detection, Types of Edge Detectors –Edge Detectors: Roberts Operator, Prewitt Operator, Sobel Operator – Canny Edge Detection – Principle of Thresholding: Histogram and Thresholding, Global Thresholding Algorithms – Principle of Region-growing.		
Unit – V	**Image Processing Applications:**	**9**
Theory and Case study: Image Registration – Image Fusion – Image Mosaicking – Digital Watermarking.		
		Total:45

TEXT BOOK:

1.	Sridhar S. "Digital Image Processing", 2nd Edition, Oxford University Press, India, 2016

REFERENCES:

1.	Jayaraman S, Veerakumar T, Esakkirajan S. "Digital Image Processing". 1st Edition, Tata McGraw Hill, New Delhi, 2009**.**
2.	Tamal Bose. "Digital Signal and Image Processing", 1st Edition, Wiley, USA, 2003.
3.	Rafael C. Gonzalez and Richard E. Woods. "Digital Image Processing". Pearson, 4th edition, New Delhi, 2018.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	perform the basic operations of image processing	Applying (K3)
CO2	apply various 2D transforms for images	Applying (K3)
CO3	implement image enhancement techniques to improve the image quality	Applying (K3)
CO4	apply various algorithms for image segmentation	Applying (K3)
CO5	construct case study on image processing applications	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	2	1	1	1			1		1			3	3
CO2	3	2	1	1	1			1		1			3	3
CO3	3	2	1	1	1			1		1			3	3
CO4	3	2	1	1	1			1		1			3	3
CO5	3	1						1		1			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	10	35	55	-	-	-	100
CAT2	10	35	55	-	-	-	100
CAT3	15	40	45	-	-	-	100
ESE	10	35	55	-	-	-	100

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

22EIE10 – POWER PLANT INSTRUMENTATION							
Programme & Branch	**B.E. & Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**6**	**PE**	**3**	**0**	**0**	**3**

Preamble	To provide an overview of various methods of power generation and the basic concepts and practical aspects of Instrumentation and Control in Thermal Power Plant and Nuclear Power plant.	
Unit – I	**Overview of Power Generation:**	**9**
Brief survey of Conventional and non-conventional methods of power generation – Nonconventional: Wind power – Solar power – Geothermal Power – Biomass Power. Conventional: Hydropower – Steam Power – Comparison of various power plants – Piping and Instrumentation diagram – Cogeneration of Power – Control rooms		
Unit – II	**Instrumentation and Control in Water Circuit:**	**9**
Water circuit – Boiler Feed water circulation – Measurements in water circuit: Water and Steam flow measurement – Drum water level measurement – Controls in water circuit: Boiler Drum Level Control – Superheated Steam temperature control – Impurities in water and Steam: Impurities in Raw water – Effect of impurities – Measurement of impurities.		
Unit – III	**Instrumentation and Control in Air-Fuel Circuit:**	**9**
Air-Fuel circuit – Measurements in air-fuel circuit – Controls in Air- Fuel circuit: Combustion control – Furnace draft control. Analytical Measurement: Oxygen measurement in Flue gas – Measurement of Carbon Dioxide in Flue gas – Combustibles Analyser ($CO+H_2$) – Infrared Flue Gas Analysers – Smoke detector – Dust monitor – Chromatography		
Unit – IV	**Power Plant Management and Turbine Monitoring and Control:**	**9**
Master control – Boiler Efficiency – Maintenance of Measuring Instruments – Interlocks for Boiler operation – SCADA – Application of DCS in Power Plants. Classification of turbines–Turbine Steam inlet system – Turbine Measurements: Process parameters – Turbine control system: Safety control systems – Process control systems –Lubrication for Turbo-Alternator – Turbo-Alternator Cooling System.		
Unit – V	**Instrumentation and Control in Nuclear Power Plant:**	**9**
Nuclear Power Plant components – Sensors and measurement system – Reactor control: Pressurized Water Reactor (PWR) – Boiler Water Reactor (BWR) – Liquid Metal Cooled Reactor (LMCR) – Digital architectures in nuclear power plants – Radiation protection and monitoring – Case study: Three mile island – Chernobyl nuclear power plant – Fukushima nuclear power plant.		
		Total:45

TEXT BOOK:

1.	Krishnaswamy K. & Ponni Bala M., “Power Plant Instrumentation”, 2nd Edition, PHI Learning Pvt. Ltd, New Delhi, 2013.

REFERENCES:

1.	SwapanBasu, Ajay Debnath., “Power Plant Instrumentation and Control Handbook”, United States, 1st Edition, Academic Press Publications, 2014.
2.	Philip Kiameh, “Power Plant Instrumentation and Controls”, 1st Edition, McGraw-Hill Professional, New Delhi, 2014.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	interpret the knowledge about the basics of power plants and various methods of power generation	Understanding (K2)
CO2	build the instrumentation and control techniques involved in water circuit of thermal power plant	Applying (K3)
CO3	recognize various measurement and control techniques applied to air- fuel circuit of thermal power plant	Understanding (K2)
CO4	apply DCS, SCADA, interlock circuits and turbine controls in thermal power plant	Applying (K3)
CO5	develop the concepts of different reactor controlled methods, safety and radiation measures in nuclear power plants	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					1			1			2	2
CO2	3	2	1	1	1		1			1			3	3
CO3	3	1					1			1			2	2
CO4	3	2	1	1	1		1			1			3	3
CO5	3	2	1	1	1		1			1			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	10	50	40				**100**
CAT2	10	40	50				**100**
CAT3	10	40	50				**100**
ESE	10	40	50				**100**

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

22EIE11 - EMBEDDED SYSTEMS								
Programme & Branch	**B.E. & Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Microcontroller and its Applications / Microprocessor and Microcontroller**	**6**	**PE**	**3**	**0**	**0**	**3**

Preamble	To impart the fundamental knowledge and programming concepts of Microcontroller and Embedded systems.	
Unit – I	**Introduction to PIC18 Microcontrollers:**	**9**
Architecture of PIC 18 - Pin Description – Memory Organization: Program Memory – Data Memory: Register Organization – Oscillator and Reset Circuits – Addressing Modes – Introduction to Instruction sets and C Programming.		
Unit – II	**PIC 18 Programming:**	**9**
Assembly Language/ C Programming to Interface I/O Ports – Timers – Counters – Capture/Compare Mode – PWM.		
Unit – III	**Interfacing Peripherals with PIC18 Microcontroller:**	**9**
Interfacing and Assembly Language/ C Programming of ADC – DAC – Temperature Sensor – LCD – Keyboard – Motor Control: DC motor and Stepper motor.		
Unit – IV	**Embedded Systems and Interfacing with Arduino**	**9**
Classification of Embedded Systems – Structural units in Embedded processor – Physical device – Arduino Interfaces, Hardware requirement for Arduino, Connecting remotely over the network using VNC, GPIO Basics, Controlling GPIO Outputs Using a Web Interface, – Programming, APIs / Packages- Quark SOC processor, programming, Arduino Boards using GPIO		
Unit – V	**RTOS Concepts and case study:**	**9**
Introduction to RTOS – Types of RTOSs – Tasks – Process – Task scheduling – Task Communication – Priority Inversion Problem. Case Study: Automatic Chocolate Vending Machine – Smart Card Reader – Mobile phone software for Key inputs.		
		Total:45

TEXT BOOK:

1.	Danny Causey, Muhammad Ali Mazidi, Rolin McKinlay, “PIC Microcontroller and Embedded Systems using Assembly and C for PIC 18”, 2nd Edition, Pearson Education Micro Digital Ed, 2017.

REFERENCES:

1.	Rajkamal, “Embedded Systems Architecture, Programming and Design”, 3rd Edition, Tata McGraw Hill, 2015.
2.	Shibu. K.V, “Introduction to Embedded Systems”, 2nd Edition, Tata McGraw Hill, 2009.
3.	Vijay Madisetti and Arshdeep Bahga, Internet of Things (A Hands-on-Approach), 1st Edition, VPT, 2016

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	understand the basic concepts of PIC microcontroller	Understanding (K2)
CO2	acquire adequate knowledge in the interfacing concepts of PIC Microcontroller	Applying (K3)
CO3	apply the programming skills to interface peripherals with PIC Microcontroller	Applying (K3)
CO4	infer knowledge in basics of embedded systems and Interface analog/digital sensors with Arduino	Understanding (K2)
CO5	explain the applications of embedded system using RTOS	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		1			2	2
CO2	3	2	1	1	1			1		1			3	3
CO3	3	2	1	1	1			1		1			3	3
CO4	3							1		1			2	2
CO5	3							1		1			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	10	65	25				100
CAT2	10	30	60				100
CAT3	15	85					100
ESE	5	60	35				100

* ±3% may be varied (CAT 1, 2 & 3 – 60 marks & ESE – 100 marks)

22EIE12 – CONTROL SYSTEM COMPONENTS							
Programme & Branch	**B.E. & Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Control Systems**	**6**	**PE**	**3**	**0**	**0**	**3**

Preamble	To emphasize the engineering principles and fundamental characteristics of components and to explain their functions in composite systems	
Unit – I	**Mechanical Components:**	**9**
Control system parameters- CAM: Components- Classification-CAM profile-CAM as a mechanical function generator-3D CAM. Gears: Types – Gears for load matching- Backlash in gears-Manufacture of gears. Gyroscope: Gyroscopic effect- Construction-Precession and velocity of precession-Generalised equations- Application.		
Unit – II	**Electromechanical Components:**	**9**
Potentiometer: Types – Applications –Selection. Synchros: Construction and operation – Characteristics – Application – Synchro pair as error detector. Relays: Classification –Relay circuits – Construction-Characteristics of electromechanical and reed relays – Relay problems and remedies.		
Unit – III	**Actuators: Servomotors:**	**9**
Theory of operation and transfer function of DC servomotors and AC servomotors. Stepper motor: Types – Construction and working – Driver circuits – Applications. **Tachogenerators:** Characteristic requirements – EMF equation – Commutation and armature reaction problem- AC induction tachogenerators-Working – Sources of errors- Applications		
Unit – IV	**Amplifiers and Modulators:**	**9**
Rotating amplifiers: Types – Amplidyne generator- Working principle –transfer function. Magnetic amplifiers: Series connected – Parallel connected- Magnetic amplifiers with feedback. Servo amplifiers: Features – AC and DC servo amplifiers – Performance characteristics. Modulators and demodulators: Amplitude modulation theory- Half and full wave balanced modulator- Amplitude modulator circuit.		
Unit – V	**Hydraulic systems:**	**9**
Components – Classifications- Hydraulic pumps – Hydraulic transmission lines- Hydraulic power supply. Hydraulic valves: Spool type-Nozzle valve- Flapper valve- Pulsed operation of control valves. **Pneumatic systems**: Pneumatic power supply – Compressor efficiency – Accessories for air compressor- Flow control. Pneumatic control valves: Operating mechanism – Direction control valves-P,PI and PID pneumatic control valves.		
		Total:45

TEXT BOOK:	
1.	Desai M.D., “Control System Components”, 1st Edition, PHI learning Pvt. Ltd, New Delhi, 2008.
REFERENCES:	
1.	Gibson J.E. & Tuteur F.B. “Control System Components”, 1st Edition, McGraw Hill, Newyork, 2013.
2.	Andrew W. G. &. William H.B, “Applied Instrumentation in the Process Industries”, 2nd Edition, Gulf Professional, Houston,1979.
3.	Liptak. B.G, “Instrument Engineers’ Handbook”, 4th Edition, CRC Press, USA, 2011.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest level)**
CO1	recognize the working and applications of mechanical components used for measuring angular displacement	Applying (K3)
CO2	distinguish the working and applications of electric mechanical components used for measuring angular displacement	Applying (K3)
CO3	identify the suitable actuators used for closed loop control system applications	Applying (K3)
CO4	recognize the working and applications of amplifiers used for composite systems	Applying(K3)
CO5	realize the working and applications of pneumatic and hydraulic components used in control applications	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	2	1	1	1					1			3	3
CO2	3	2	1	1	1					1			3	3
CO3	3	2	1	1	1					1			3	3
CO4	3	2	1	1	1					1			3	3
CO5	3	2	1	1	1					1			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	30	30	40				100
CAT2	30	30	40				100
CAT3	30	30	40				100
ESE	20	20	60				100

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

22EIE13 - FIBER OPTICS AND LASER INSTRUMENTS							
Programme & Branch	**B.E. & Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	7	**PE**	**3**	**0**	**0**	**3**

Preamble	The course will enable the students to learn about basic concepts and properties of optical fibers and lasers. The course will provide students with adequate knowledge about industrial application of optical fibers and lasers, holography and medical applications of lasers.	
Unit – I	**Optical Fibers and their Properties:**	**9**
Ray theory transmission – Optical fibers – Preparation of optical fibers: Liquid-phase (melting) techniques, Vapor–phase deposition techniques – Transmission characteristics of optical Fibers: Attenuation, Material Absorption losses in silica glass fibers, Linear scattering losses, Dispersion, Chromatic dispersion, Intermodal dispersion, Overall fiber dispersion – Optical fiber connection: Fiber splices, Fiber connectors.		
Unit – II	**Industrial Applications of Optical Fibers:**	**9**
Fiber optic sensor fundamentals – Intensity-modulated sensors – Phase-modulated sensors – Displacement sensors – Strain sensors – Temperature sensors – Pressure sensors – Magnetic and electric field sensors – Rotation rate sensors(Gyroscopes).		
Unit – III	**Laser Fundamentals:**	**9**
Laser rate equations: Introduction, The two-level system, The three-level laser system, The four-level laser system – Pulsed operation of lasers: Q-switching, Mode locking – Properties of lasers: Laser beam characteristics – Laser safety: Physiological effects, Laser safety practices and standards.		
Unit – IV	**Industrial Applications of Lasers:**	**9**
Introduction – Applications in material processing: Laser welding, hole drilling, laser cutting – Laser tracking –Lidar – Precision length measurement – Laser interferometry: Homodyne and heterodyne interferometry – Velocity measurement – Lasers in information storage, Bar code scanner – Applications for surface treatment: Hardening, glazing, laser alloying, laser cladding.		
Unit – V	**Hologram and Medical Applications:**	**9**
Principles of holography: Formation of holograms, The holographic process, Hologram types and efficiency – Applications of holography: Holographic interferometry – Light and matter: Reflection and refraction, Absorption, Scattering – Interaction mechanisms – Medical applications of lasers: Lasers in ophthalmology, Lasers in neurosurgery, Lasers in angioplasty and cardiology, Lasers in dermatology.		
		Total:45

TEXT BOOK:

1.	John.M. Senior, "Optical Fibre Communication – Principles and Practice", 3rd Edition, Pearson Education India, New Delhi, 2014 for Unit 1.
2.	David A. Krohn, Trevor W. MacDougall, & Alexis Mendez, "Fiber Optic Sensors: Fundamentals and Applications", 4th Edition, SPIE Press, Bellingham, 2015 for Unit 2.
3.	Thyagarajan K, Ajoy Ghatak, "Lasers: Fundamentals and Applications' 2nd Edition, Springer Science & Business Media, New York, 2011 for Units 3, 4 & 5.

REFERENCES:

1.	John F. Ready, "Industrial Applications of Lasers", 2nd Edition, Academic Press, San Diego, 1997.
2.	Markolf H. Niemz, "Laser Tissue Interaction: Fundamentals and Applications", 4th Edition, Springer Science and Business Media, Switzerland, 2019.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	infer about the basics of optical fibres	Understanding(K2)
CO2	use fibre optic sensors for various industrial applications	Applying(K3)
CO3	interpret the working of various types of laser sources	Understanding(K2)
CO4	apply the laser based instrumentation systems for various applications in industries apply the laser based instrumentation systems for various applications in industries	Applying(K3)
CO5	predict the applications of lasers in medical field and holography	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											2	2
CO2	3	2	1	1	1								3	3
CO3	3	1											2	2
CO4	3	2	1	1	1								3	3
CO5	3	2	1	1	1								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	30	40	30				100
CAT2	30	40	30				100
CAT3	30	40	30				100
ESE	30	40	30				100

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

22EIE14 - WIRELESS INSTRUMENTATION

Programme & Branch	B.E. & Electronics and Instrumentation Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	**Nil**	**7**	**PE**	**3**	**0**	**0**	**3**

Preamble	To impart knowledge on wireless technology for instrumentation, wireless components and its applications. To provide adequate technical information on power sources, wireless protocols and network implementation

Unit – I **Wireless Instrumentation Technology:** **9**

Introduction – Instruments and Instrumentation: Measurement systems – Multiplexing structures – Wireless instruments and communication protocols – RF interfaces and examples – Networks of wireless instruments – Sensor node components: Computing subsystem – Communication subsystem – Power subsystems – Sensing subsystems.

Unit – II **Powering Autonomous sensors:** **9**

Autonomous sensors – Ambient energy sources and transducers – Energy storage units – Power considerations of wireless instruments – Energy harvesting: Solar and wind energy harvesting, RF energy harvesting, Energy harvesting from vibration, Thermal energy harvesting – Energy management techniques – Calculation for battery selection – Understanding RSSI and LQI values.

Unit – III **Wireless Systems/Standards for Automation:** **9**

Wireless HART: Protocol stack – Network components – Addressing control – Coexistence techniques. ISA100.11a: Introduction – Scope – Working group of ISA 100 – Features – Sensor classes – System configuration and architecture of ISA 100.11a – Comparison between ISA100.11a and WHART protocol stacks.

Unit – IV **Design of Wireless Devices and LoRa:** **9**

Wireless sensor and instrument network design – Wireless integrated network sensors – Plug-and-play sensors and networks – Industrial wireless networks and automation.
Introduction – Communication Methods – Difference between LoRa and LoRaWAN – LoRaWAN architecture – LoRaWAN classes.

Unit – V **Wireless Sensor and Instrument Applications:** **9**

Application specific wireless sensors and instruments – Commercial wireless sensors and instruments – Industrial wireless sensor and instrument networks – Wireless human health monitoring and environmental applications – Radio frequency identification – Consumer products and other applications – Applications in Transportation and Agriculture.

Total:45

TEXT BOOK:

1. John G. Webster, Halit Eren, “Measurement, Instrumentation, and Sensors Handbook”, 2nd Edition, CRC Press - Taylor & Francis Group, LLC, Boca Raton, Florida, 2017

REFERENCES:

1. Subhas Chandra Mukhopadhyay, “Smart Sensors, Measurement and Instrumentation”, 2nd Edition , Springer Science & Business Media, Heidelberg, Germany, 2013
2. Sunit Kumar Sen, “Fieldbus and Networking in Process Automation”, 1st Edition, Taylor & Francis Group, LLC, London, 2017
3. Halit Eren, “Wireless Sensors and Instruments: Networks, Design, and Applications”, 1st Edition, CRC Press, 2006

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	identify different instrumentation systems and fundamentals of wireless technology	Understanding (K2)
CO2	indicate the power sources and energy storage units used for autonomous sensors	Understanding (K2)
CO3	recognize the different wireless protocols and network standards for wireless instruments	Understanding (K2)
CO4	illustrate design concepts and procedure for wireless devices and LoRA	Understanding (K2)
CO5	explore the various applications of wireless sensor and instrument systems and networks	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	2											2	2
CO2	3	2											2	2
CO3	3	2	1	1	1								2	2
CO4	3	2											2	2
CO5	3	2	1	1	1								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	15	85					100
CAT2	15	85					100
CAT3	15	85					100
ESE	10	90					100

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

22EIE15 INSTRUMENTATION TECHNIQUES IN AGRICULTURE

Programme & Branch	B.E. & Electronics and Instrumentation Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	**Transducers Engineering/Sensors and Transducers**	**7**	**PE**	**3**	**0**	**0**	**3**

Preamble	To discuss the sensing and automation technology associated with agriculture.	
Unit – I	**Necessity of Instrumentation:**	**9**
Necessity of instrumentation & control for agriculture and food processing requirement, World Agriculture Scenario, Indian Agriculture sector – A synoptic Review- Areas of Concern. Information, Interpretation and Instruction Systems – Agri Instrumentation. Introduction to Transducers – Characteristics.		
Unit – II	**Agri Transducers**	**9**
Technology Trend – Conventional and Silicon transducers, Capacitive gauges, Silicon Displacement transducer, Silicon Temperature transducer, Silicon Pressure Transducer. Grain Moisture transducers, soil moisture transducers, Humidity transducers, pH transducers, Gas transducers, Intelligent Sensors.		
Unit – III	**Automation in Agriculture**	**9**
Microprocessor based Grain moisture measurement- Introduction, Sensing Mechanism, I/O requirement analysis. Microprocessor based Soil Nutrient Estimation Systems- Soil nutrients and their role, collection of samples, soil nutrient estimation, sensing mechanism. Preparation of soil extract for estimation of N,P,K and S, I/O requirement Analysis. SCADA Based system for Agriculture process monitoring. Case Study : Interfacing of agri sensors with Microcontroller.		
Unit – IV	**Drip Irrigation and Precision Agriculture**	**9**
Introduction-Sensors, Hardware block Schematic, system operation, I/O Requirement Analysis, Hardware Systems. Precision: Introduction, need for precision agriculture. Subsystem and components- GPS, Agri sensors, DAS, Communication System. Precision agriculture status – Working Philosophy.		
Unit – V	**Green House cultivation:**	**9**
Designs and classification of greenhouse- Orientation of Greenhouse / Poly house- Components of green house- Plant growing structures/containers in green house production- Environmental factors influencing greenhouse cultivation- Media preparation and fumigation- Drip irrigation and fertigation systems greenhouse cultivation- Problem management in greenhouse cultivation.		
		Total:45

TEXT BOOK:

1. Krishna Kant , "Microprocessor Based Agri Instrumentation", 1st Edition, PHI Private Limited, New Delhi, 2010.

REFERENCES:

1. Greenhouse Cultivation, Tamilnadu Agritech Portal. http://agritech.tnau.ac.in/horticulture/horti_Greenhouse%20cultivation.html
2. Sidney Walter Reginald Cox, Filby D E , "Instrumentation in Agriculture", Lockwood Publishers, UK, 2011.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	explain the necessity of instrumentation for agriculture	Understanding (K2)
CO2	familiarize with the Soil parameters and tranducers in agricultural instrumentation	Understanding (K2)
CO3	Illustrate the techniques of agriculture using Microprocessor and SCADA	Applying(K3)
CO4	Outline the fundamentals of Drip Irrigation and Precision Agriculture	Understanding (K2)
CO5	Utilize the concepts of instruments in Green house cultivation	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											2	2
CO2	3	1											2	2
CO3	3	2	1	1	1								3	3
CO4	3	1											2	2
CO5	3	1											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	30	70					100
CAT2	20	60	20				100
CAT3	40	60					100
ESE	20	60	20				100

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

22EIE16 - SAFETY IN PROCESS INDUSTRIES							
Programme& Branch	**B.E. & Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**7**	**PE**	**3**	**0**	**0**	**3**

Preamble	This course will provide the required information for safety management, prevention of accidents, hazard identification and control. It also discusses the risk analysis, management safety strategies, procedures and designs.	
Unit – I	**Safety Management:**	**9**
Definitions – Safety Culture – Individual Risk, Societal Risk and Risk Populations – Safety Metrics – Risk Perception, Risk Tolerance/Acceptance and Risk Matrix – Safeguards. Toxicology: How Toxicants Enter Biological Organisms – How Toxicants are Eliminated from Biological Organisms –Effects of Toxicants on Biological Organisms.		
Unit – II	**Fires and Explosions:**	**9**
The Fire Triangle – Distinction between Fires and Explosions – Ignition Energy – Autoignition – Ignition Sources. Explosions: Detonation and Deflagration – Confined Explosions. Concepts to Prevent Fires and Explosions: Inerting: Vacuum Purging, Pressure Purging. Ventilation – Sprinkler Systems.		
Unit – III	**Hazards Identification and Evaluation:**	**9**
Introduction to Hazard Identification – Hazards identification and risk assessment procedure – Process Hazards Checklists – Hazards Surveys – Hazards and Operability Studies – Case study: HAZOP Study Applied to the Exothermic Reactor.		
Unit – IV	**Risk Analysis and Assessment:**	**9**
Review of Probability Theory – Event Trees– Fault Trees – Bow-Tie Diagrams– Quantitative Risk Analysis– Layer of Protection Analysis – Relationship between Fault Trees and Event Trees.		
Unit – V	**Solid Waste Management:**	**9**
Process Safety Strategies – Safe Operating Procedures – Safe Work Practices – Designs for Process Safety – Case study: Static Electricity – Tank Car Loading Explosion – Explosion in a Centrifuge – Duct System Explosion – Conductor in a Solids Storage Bin – Pigment and Filter.		
		Total:45

TEXT BOOK:

1.	Daniel A Crowl, & Joseph F Louvar, “Chemical Process Safety (Fundamentals with Applications)”, 4th Edition, Pearson India, 2020.

REFERENCES:

1.	Amit Gupta, “Industrial Safety and Environment’, 2nd Edition, Laxmi Publication (P) Ltd., India, 2015.
2.	American Institute of Chemical Engineers, “Introduction to Process Safety for Undergraduates and Engineers”, John Wiley & Sons, Inc., Hoboken, New Jersey, 2016.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	outline the fundamentals of safety management and toxicology	Understanding (K2)
CO2	interpret the concepts of fires and explosions and preventing fires and explosions	Understanding (K2)
CO3	summarize the methods of hazard identification/ evaluation	Understanding (K2)
CO4	choose suitable risk analysis and assessment techniques	Applying (K3)
CO5	integrate various safety strategies, procedures, and designs involved in process industries	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				2		1					2	2
CO2	3	1				2		1					2	2
CO3	3	1				2		1					2	2
CO4	3	2	1	1	1	2		1					3	3
CO5	3	2	1	1	1	2		1					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	30	70					100
CAT2	30	70					100
CAT3	20	40	40				100
ESE	20	50	30				100

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

22EIE17 – INSTRUCTION AND CONTROL IN PROCESS INDUSTRIES							
Programme & Branch	**B.E. & Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Industrial Instrumentation, Process Control**	**7**	**PE**	**3**	**0**	**0**	**3**

Preamble	This course provides the concepts of various processes in process Industries such as steel, glass, dairy products, pharmaceutical and fermentation. This course emphasizes the Instrumentation and Control techniques involved in such units.	
Unit – I	**Basics of Process Measurements:**	**9**
Continuous vs. discrete measurement – Continuous vs. Sampled measurement – In-line, On-line and Off-line – Measurement uncertainty – Measurement decision risk –Calibration – Measurement device components – Current loop – Power supply and Wiring – Serial communications – Smart transmitters.		
Unit – II	**Instrumentation and Control in Steel Industries:**	**9**
Process description in diagrammatic and functional block details – Raw materials preparation – Operation of Blast Furnace (BF) – Basic Oxygen Furnace (BOF) – Electric Furnace (EF) – Open Hearth Furnace (OHF) – Gas and water control system in Basic oxygen furnace–Mold level control system in strand casting operation.		
Unit – III	**Instrumentation and Control in Glass Industries:**	**9**
Definition and composition of glass – Glassmaking process – Level measurement: Electrical, Pneumatic, Optical method – Temperature measurement: Radiation pyrometer – Furnace pressure measurement – Flow measurement – Automatic inspection in container and flat glass manufacturing – Control of glass melting furnaces – Electric booster melting controls		
Unit – IV	**Instrumentation and Control in Dairy Industries:**	**9**
Process description in diagrammatic and functional block details – Plate heat exchanger – Single stage and Two stage Homogenizer – Doppler ultrasonic flow meter – Control system in HTST pasteurizer– Temperature control in spray dryer – Automation for Cleaning in Place (CIP) – Refrigeration system – Metal detection system		
Unit – V	**Instrumentation and Control in Pharmaceutical and Fermentation Industries:**	**9**
Description of the penicillin production process – Flow measurement – Level measurement – Pressure measurement – Temperature measurement – Fermentation control system – Continuous fermentation – pH control – Temperature control – Centrifuge purging control.		
		Total:45

TEXT BOOK:

1.	Liptak B.G, "Instrumentation in the Processing Industries", 1st Edition, Chilton Book Company, Boston, 1973. (Digitized 2008).

REFERENCES:

1.	Cecil Smith, "Basic Process Measurements", 1st Edition, John Wiley & Sons, New Jersey, 2009. (E-Book 2011)
2.	Gosta Bylund, "Dairy Processing Hand Book", 3rd Edition, Tetrapak Processing Systems, Sweden, 2015.
3.	Instrumentation and Controls in Dairy Industries – http://ecoursesonline.iasri.res.in/course/view.php?id=82 Refrigeration System – http://ecoursesonline.iasri.res.in/mod/page/view.php?id=124105 Metal Detection System – Dairy Knowledge Portal – https://www.dairyknowledge.in › default › files

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	explain the basics of process measurements in various industries	Understanding (K2)
CO2	build the instrumentation and control techniques involved in iron and steel industry	Applying (K3)
CO3	develop the instrumentation and control systems in glass industry	Applying (K3)
CO4	apply the various instrumentation and control schemes in dairy industry	Applying (K3)
CO5	interpret the knowledge on instruments used in pharmaceutical and fermentation industry	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											2	2
CO2	3	2	1	1	1								3	3
CO3	3	2	1	1	1								3	3
CO4	3	2	1	1	1								3	3
CO5	3	1											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	10	40	50				100
CAT3	10	40	50				100
ESE	10	40	50				100

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

22GEE02 - TOTAL QUALITY MANAGEMENT								
(Common to All BE/BTech branches)								
Programme & Branch	**All BE/BTech branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**7**	**PE**	**3**	**0**	**0**	**3**

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.		
Unit – II	**TQM-Principles and Strategies**	**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	**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 Seven Tools of Quality, Benchmarking - Need - Types and Process, Quality Function Deployment - House of Quality (HOQ) Construction - Case Studies, Introduction to Taguchi's Robust Design - Quality Loss Function - Design of Experiments (DOE), Total Productive Maintenance (TPM) - Uptime Enhancement, Failure Mode and Effect Analysis (FMEA) - Risk Priority Number (RPN) – Process - Case Studies.		
Unit – V	**Quality Systems**	**9**
Need for ISO 9000 and Other Quality Systems - ISO 9000: 2015 Quality System – Elements - Implementation of Quality System - Documentation - Quality Auditing, Introduction to ISO 14000 - IATF 16949 - TL 9000-IEC 17025 - ISO 18000 - ISO 20000 - ISO 22000 - ISO21001. Process of Implementing ISO - Barriers in ISO Implementation.		
		Total:45

TEXT BOOK:

1.	Besterfield Dale H., Besterfield Carol, Besterfield Glen H., Besterfield Mary, Urdhwareshe Hemant, UrdhwaresheRashmi. "Total Quality Management", 5th Edition, Pearson Education, Noida, 2018.

REFERENCES:

1.	Subburaj Ramasamy, "Total Quality Management", McGraw Hill Education, New Delhi, 2017.
2.	James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8th Edition, Cengage Learning, 2012.
3.	David Goetsch & Stanley Davis, "Quality Management for Organizational Excellence: Introduction to Total Quality", 8th Edition,Pearson, 2017.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	demonstrate the evolution of TQM principles	Understanding (K2)
CO2	illustrate the principles and strategies of TQM	Understanding (K2)
CO3	use control charts and identify process capability of a process	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 (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		3
CO2	2	2				1						1		3
CO3	2	2				1						1		3
CO4	2	2				1						1		3
CO5	1	1				1						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	25	45	30				100
CAT2	20	40	40				100
CAT3	25	45	30				100
ESE	20	40	40				100

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

22EIE18 - INSTRUMENTATION IN AIRCRAFT NAVIGATION AND CONTROL							
Programme & Branch	**B.E. & Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**7**	**PE**	**3**	**0**	**0**	**3**

Preamble	To discuss the concepts of aircraft instruments and cockpit layout in modern aircraft and deals with the conventional and advanced flight instruments.	
Unit – I	**Basics of Aircraft and Aircraft Instruments:**	**9**
Introduction – Control Surfaces – Forces – Moments and Angle of Attack – Engines – Avionics – Modern Aircraft System. Aircraft Instruments and their Layout – Aircraft Display Types – Quantitative and Qualitative Display – Instrument Grouping – Basic T Grouping, Glass Cockpits of Modern Aircraft.		
Unit – II	**Air Data Instruments and Directional Systems:**	**9**
Introduction to Air Data Instruments – Pitot pressure and Pitot tube – Types of Air Data Instruments – Pneumatic-type Air Data Instruments – Air Speed Indicator, Air Data Computer – International Standard Atmosphere – Air Data Instruments – Directional Systems: Magnetic Compass – Earth Magnetic Field – Flux Detector Unit.		
Unit – III	**Gyroscopic and Advanced Flight Instruments:**	**9**
Introduction – Types of Gyro – Conventional Mechanical, Vibrating Gyros, RLG, FOG – Basic Mechanical Gyro and its Properties – Directional Gyro and limitations – Gyro Horizon – Turn and Bank Indicator – Turn Coordinator – Standby Attitude Director Indicator Advanced Direction Indicators.		
Unit – IV	**Engine Instruments and Indicators:**	**9**
Introduction – Engine Speed Measurements – Electrical Tacho Generator/Indicator, Servo Type, Non-Contact Type, Optical Tachometer, Hall Effect Sensor – Torque Measurements – Electronic Torque Meter – Pressure Measurements – Engine Pressure Ratio Indicator. Engine Fuel Indicators: Fuel Quantity Indicator.		
Unit – V	**Aircraft Navigation and Safety Warning Systems:**	**9**
Introduction – Radio Navigation Aids – VHF Omni Directional Range System DME/ILS/INS/GPS – Principle of VOR operation – Distance Measuring Equipment, Instrument Landing Systems –Inertial Navigation System: Principle, Gimballed and Strap Down INS – Global Positioning System. Air Data Warning Systems.		
		Total:45

TEXT BOOK:

1.	Nagabhushana S & Sudha L K. “Aircraft Instrumentation and Systems”, 2nd Edition, I.K. International Publishing House Pvt. Ltd., New Delhi, 2013.

REFERENCES:

1.	Federal Aviation Administration (FAA), “Instrument Flying Handbook”, 1st Edition, Aviation Supplies and Academics, Washington, 2013.
2.	Megson T M G., “Aircraft Structures for Engineering Students”, 4th Edition, Elsevier Science and Technology, Great Britain, 2007.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	infer the basics of aircraft and aircraft instruments	Understanding(K2)
CO2	discuss about air data instruments and directional systems	Understanding (K2)
CO3	make use of gyroscopes for advanced flight instruments	Applying(K3)
CO4	outline the fundamentals of engine instruments and indicators	Understanding (K2)
CO5	utilize the concepts of aircraft navigation safety warning systems	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											2	2
CO2	3	1											2	2
CO3	3	2	1	1	1								3	3
CO4	3	1											2	2
CO5	3	1	1	1	1								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	30	70					100
CAT2	30	40	30				100
CAT3	30	40	30				100
ESE	30	40	30				100

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

22EIE19 - INDUSTRIAL DATA COMMUNICATION							
Programme & Branch	**B.E. & Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**7**	**PE**	**3**	**0**	**0**	**3**

Preamble	To educate on the basic concepts of data communication, different industrial communication protocols and wireless communication.	
Unit – I	**Serial communication:**	**9**
Serial Communication: OSI reference model – Protocols – RS-232 overview, RS-232 interface standard (CCITT V.24 interface standard) – Half-duplex operation of the RS-232 interface – Limitations – RS-485 overview – The RS-485 interface standard – RS-485 vs RS-422 – The 20 mA Current loop.		
Unit – II	**Copper Cable and Fiber Optics Cable Communication:**	**9**
Copper cable: Characteristics – Cable selection – Coaxial cables – Twisted-pair cable – Distribution/installation standards – Connector standards. Fibre optics Communication: Fiber-optic cable components – Cable parameter – Types of optical fiber – Basic cable types – Connecting fibers.		
Unit – III	**MODBUS, PROFIBUS PA/DP/FMS and TCP/IP:**	**9**
MODBUS: Modbus Overview – MODBUS protocol structure – Function codes – query response cycle, transmission mode, Message Formatting. PROFIBUS PA/DP/FMS: PROFIBUS protocol stack- The PROFIBUS communication model- Relationship between application process and communication – Communication objects. TCP/IP – TCP/IP overview: Introduction – Internet Layer Protocols (Packet Transport) – Host-to-host layer: end to end reliability. TCP/IP troubleshooting: Introduction – Common problems – Typical network layer problems – Transport layer problems.		
Unit – IV	**HART and Foundation Field Bus:**	**9**
HART: HART Introduction – HART and smart instrumentation – Physical layer, Data link and application layer – HART Commands. Foundation Field Bus: Introduction – The Physical layer and Wiring Rules, The Data link layer, The Application layer, The User layer, Error detection and diagnostics - High-speed Ethernet (HSE)		
Unit – V	**Industrial Ethernet and Wireless Communication**	**9**
Industrial Ethernet: Introduction – 10 Mbps Ethernet – 100 Mbps Ethernet – Gigabit Ethernet – Industrial Ethernet. Wireless communication: Satellite systems – Wireless LANs- Radio and wireless communication : Introduction – components of radio link – radio spectrum and frequency allocation – Radio MODEMs.		
		Total:45

TEXT BOOK:

1.	Deon Reynders, Steve Mackay, Edwin Wright, “Practical Industrial Data Communications”, 1st Edition, Elsevier, 2005.

REFERENCES:

1.	Forouzan, Behrouz A., “Data communication and Networking”, 5th Edition, Tata McGraw-Hill, New Delhi, 2013.
2.	William L.Schweber, “Data Communications”, 1st Edition, Tata McGraw-Hall, 2009.
3.	Steve Mackay, Edwin Wright, Deon Reynders,” Practical Industrial Data Networks: Design, Installation and Troubleshooting”, 1st Edition, Elsevier, 2005.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped** **(Highest Level)**
CO1	Make use of the essentials of the communication system and learn the serial communication interface	Understanding(K2)
CO2	Interpret knowledge about Copper cable and fiber optic cable communication	Understanding(K2)
CO3	Examine the suitability of various communication protocols	Understanding(K2)
CO4	Identify the architecture and applications of HART and Field bus	Applying (K3)
CO5	Examine the concepts of Industrial Ethernet and wireless communications	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				1							2	2
CO2	3	1				1							2	2
CO3	3	1				1							2	2
CO4	3	2	1	1	1	1							3	3
CO5	3	1				1							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	80					100
CAT2	20	80					100
CAT3	20	60	20				100
ESE	20	60	20				100

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

22EIE20 - MEMS AND NANO TECHNOLOGY

Programme & Branch	**B.E. & Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**7**	**PE**	**3**	**0**	**0**	**3**

Preamble	The course aims to impart the knowledge on different materials, principles used for recent MEMS and NEMS fabrication techniques and applications.	
Unit – I	**Microsystems:**	**9**
Overview of microelectronics manufacture and Microsystems technology– Scaling Laws In Miniaturization: Scaling in geometry – Scaling in rigid body dynamics – Scaling in electrostatic and electromagnetic forces – Scaling in Electricity – Scaling in Fluid Mechanic – Scaling in heat transfer – Materials for MEMS and Microsystems.		
Unit – II	**Micro sensors and Actuators**:	**9**
Working principle of Microsystems – Micro actuation techniques – Micro actuators: Micro grippers – Miniature Microphones – Micro motors – Micro pumps – Micro valves – Micro accelerometers – Micro gyroscopes –Application of Microsystems in Automotive and Biomedical Field.		
Unit – III	**Microsystems Fabrication and Manufacturing:**	**9**
Substrates – Single crystal silicon wafer formation – Photolithography – Ion implantation – Diffusion –Oxidation – CVD – PVD – Deposition by epitaxy – Etching. Manufacturing process: Bulk Micromanufacturing – Surface Micromachining – LIGA –SLIGA. Microsystem Design Considerations.		
Unit – IV	**Introduction to Nanotechnology:**	**9**
Carbon Allotropes – CNTs: Structure – Mechanical Properties– Electrical Properties – CNT Electronics – Synthesis – Graphene: Structure – Synthesis– Electrical Properties. Quantum Dots – Synthesis – Optical Properties – Single Electron Transistor – Quantum Dots in Medicine. Nanowires: Metal Nanowires – Semiconductor Nanowires.		
Unit – V	**Fields of Nanotechnology:**	**9**
Scanning Tunneling Microscopy – AFM – Scanning Electron Microscopy– TEM. General Principles of Nano Fabrication – Fluid Flow in Sub micrometer and Nanoscales – Heat Conduction at Nanoscale – Measurement of Thermal Conductivity–Nano Products – Application of Nanoproducts – Challenges in Nanoscale Engineering.		
		Total:45

TEXT BOOK:

1.	Tai-Ran Hsu, “MEMS and Microsystems: Design, Manufacture and Nano Scale Engineering”, 2nd Edition, John Wiley and Sons, New York, 2021.

REFERENCES:

1.	Wesley C. Sanders, “Basic Principles of Nanotechnology”, 1st Edition, CRC Press, Taylor & Francis Group, New York, 2019.
2.	Murty B.S., Shankar P., Baldev Raj, Rath, & James Murday, “Nanoscience and Nanotechnology”, Universities Press (India) Private Limited, Hyderabad, 2013.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	retrieve the concepts of scaling laws	Understand(K2)
CO2	employ sensors and actuators in micro systems	Applying (K3)
CO3	interpret on the rudiments of micro fabrication techniques	Applying (K3)
CO4	interpret the properties of nanostructures and Nano synthesis	Applying (K3)
CO5	use the nano-structured materials for engineering applications	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											2	2
CO2	3	2	1	1	1								3	3
CO3	3	2	1	1	1								3	3
CO4	3	2	1	1	1								3	3
CO5	3	2	1	1	1								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	20	60	20				100
CAT2	30	40	30				100
CAT3	30	40	30				100
ESE	30	40	30				100

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

22EIE21 - OPTIMAL AND ADAPTIVE CONTROL

Programme & Branch	B.E. & Electronics and Instrumentation Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	**Control Systems**	**7**	**PE**	**3**	**0**	**0**	**3**

Preamble	To provide the knowledge about fundamental concepts of optimal and adaptive control techniques.

Unit – I	**Optimal Control Formulation:**	**9**

Matrix properties and definitions – Quadratic forms and definiteness – State space form for continuous systems. Calculus of variations: Fundamental concepts – The unctional of a single function- Optimal Control Formulation: The Performance measure: Performance measures for optimal control problems, selecting a performance measure. Constraints – Variational approach to optimal control problems: Necessary conditions for optimal control.

Unit – II	**Linear Quadratic Optimal Control Systems:**	**9**

Problem formulation – Linear regulator problem –Infinite time linear quadraticator – Meaningful interpretation of Riccati coefficient – Analytical solution of algebraic Riccati equation – Equivalence of open loop and closed loop. Design of LQR: Inverted pendulum, DC motor speed control.

Unit – III	**Dynamic Programming:**	**9**

The Optimal control law –Principle of optimality – Dynamic programming applied to routing problem – Recurrence relation of dynamic programming – Computational procedure for solving optimal control problems- Characteristics of dynamic programming solutions.

Unit – IV	**Self Tuning Regulators:**	**9**

Introduction to adaptive control –classification –Pole placement design, Direct and Indirect self tuning regulators, continuous time self tuners, minimum variance and moving average controllers, stochastic direct and indirect self tuning regulators, linear quadratic self tuning regulators

Unit – V	**Model Reference Adaptive control:**	**9**

The MIT rule- Lyapunov theory – Design of model reference adaptive controller using MIT rule and Lyapunov theory – Relation between MRAS and STR, Introduction to Adaptive back stepping.

Total:45

TEXT BOOK:

1.	Kirk, Donald E. “Optimal Control Theory: An Introduction” 1^{st} Edition, Dover publications, USA, 2004 for Unit -1, 2 & 3
2.	Karl J Astrom and Bjorn Wittenmark, “Adaptive Control”, 2^{nd} Edition, Addison Wesley, USA, 1995 for Unit- 4 & 5

REFERENCES:

1.	Desineni Subburam Naidu, “Optimal Control Systems” 1^{st} Edition, CRC Press, London, 2002.
2.	Rolf Isermann and Macro munchhof, “Identification of dynamic systems an introduction with applications”, 8^{th} Edition, Springer Verlag, Berlin, 2011.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	formulate optimal control problem	Understanding (K2)
CO2	apply the concepts in the design of optimal controller using LQR concepts	Applying (K3)
CO3	determine optimal control solution for discrete systems using dynamic programming	Applying (K3)
CO4	gain knowledge about the model reference adaptive control and self-tuning control systems	Understanding (K2)
CO5	know the Implementation aspects of adaptive control and applications	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											2	2
CO2	3	2	1	1	1								3	3
CO3	3	2	1	1	1								3	3
CO4	3	1											2	2
CO5	3	2	1	1	1								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	20	40	40				100
CAT2	20	40	40				100
CAT3	20	40	40				100
ESE	20	40	40				100

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

22EIE22 – WEARABLE TECHNOLOGY							
Programme & Branch	**B.E. & Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**7**	**PE**	**3**	**0**	**0**	**3**

Preamble	A category of electronic devices that discuss the worn accessories, embedded in clothing, implanted in the user's body. The devices are hands-free gadgets with practical uses, powered by microprocessors and enhanced with the ability to send and receive data via the Internet.	
Unit – I	**Introduction to Wearable Technology:**	**9**
An overview of wearable technology – Brief history – Applications of wearable Technology- Wearable Technology in Medicine and Health Care – Smart Glasses – Conventional Textile Wearable Integration Techniques.		
Unit – II	**Components and Technologies:**	**9**
Introduction to components and technologies – Microprocessors and Microcontrollers – Operating Systems – Sensors – Wireless connectivity unit – Battery technology – Displays and other user interface elements – Microphones and Speakers. Wearable Technologies and Force Myography for Healthcare: Moving Monitoring – Accelerometers – Inertial Measurement Units – Data Gloves – Myography – Force Myography		
Unit – III	**Product Development and Design Considerations:**	**9**
Introduction to Production development process – Engineering analysis – prototyping – Testing and validation – Production – Design considerations –Various factors and requirements – Operational power packing and material – Maintenance.		
Unit – IV	**Security Issues and Privacy Concerns:**	**9**
Security issues – Privacy issues – Potential solutions – Product case examples: Blood Glucose Meters - Blood Pressure Monitors - Weighing and Body Analysis Scale – Pulse Oximeters – Electrocardiogram.		
Unit – V	**Psychological and Social Impact:**	**9**
Psychological effects of wearables – Social implications – Technology acceptance factors – Electromagnetic radiations – Specific absorption rate – Thermal effects. Health Issues: Cancers – Fertility – Vision and sleep disorder – Pain and discomfort – Electromagnetic intolerance and other risks.		
		Total:45

TEXT BOOK:

1.	Haider Raad , "The Wearable Technology Handbook" ,1st Edition, United Scholars Publications, USA, 2017

REFERENCES:

1.	Raymond Kai-Yu Tong, "Wearable Technology in Medicine and Health Care", Academic Press, 1st Edition, United States, 2018.
2.	Fernando Jose Velez and Fardin Derogarian Miyandoab, "Wearable Technologies and Wireless Body Sensor Networks for Healthcare", The Institution of Engineering and Technology, 1st Edition, United Kingdom, 2019.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	infer the recent technology used as wearable devices in medical and health care	Understanding (K2)
CO2	describe the functions, operations of various components and technologies in wearable devices	Understanding (K2)
CO3	analyze the development process and design consideration in wearable products	Applying (K3)
CO4	interpret the security and privacy issues in wearable technology	Understanding (K2)
CO5	explore the psychological and social impact, health concerns in wearable devices	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											2	2
CO2	3	1											2	2
CO3	3	2	1	1	1								3	3
CO4	3	1											2	2
CO5	3	1											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	30	70					100
CAT2	10	40	50				100
CAT3	40	60					100
ESE	10	70	20				100

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

22GEE01 - FUNDAMENTALS OF RESEARCH							
(Common to All BE/BTech branches)							
Programme & Branch	**All BE/BTech branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**7**	**GE**	**3**	**0**	**0**	**3**
Preamble	This course familiarizes the fundamental concepts/techniques adopted in research, problem formulation and also disseminates the process involved in collection, consolidation of published literature and rewriting them in a presentable form using latest tools.						
Unit – I	**Introduction to Research**						**9**
Introduction to Research: Types and Process of Research - Outcomes of Research - Sources of Research Problem - Characteristics of a Good Research Problem - Errors in Selecting a Research Problem - Importance of Keywords.							
Unit – II	**Literature Review**						**9**
Literature Review: Literature Collection - Methods - Analysis - Citation Study - Gap Analysis - Problem Formulation Techniques.							
Unit – III	**Research Methodology**						**9**
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 Limitations.							
Unit – IV	**Journals and Papers**						**9**
Journals and Papers: Journals in Science/Engineering - Indexing and Impact factor of Journals. Plagiarism and Research Ethics. Types of Research Papers - Original Article/Review Paper/Short Communication/Case Study.							
Unit – V	**Reports and Presentations**						**9**
How to Write a Report - Language and Style - Format of Project Report - Title Page - Abstract - Table of Contents - Headings and Sub-Headings - Footnotes - Tables and Figures - Appendix - Bibliography etc - Different Reference Formats. Presentation using PPTs. Research Tools.							
							Total:45

TEXT BOOK:

1.	Walliman, Nicholas. “Research Methods: The basics”. 2nd edition, Routledge, 2017., for Units I, II, III, IV & V

REFERENCES:

1.	Mishra, S.B. and Alok, S. “Handbook of research methodology” Educreation Publishing, 2017
2.	Kumar, Ranjit. “Research Methodology: A step-by-step guide for beginners”. SAGE Publications Limited, 2019.
3.	Nayak, J.K. and Singh, P. “Fundamentals of Research Methodology Problems and Prospects”. SSDN Publishers & Distributors, 2021.

COURSE OUTCOMES: On completion 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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	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 – 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		100

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

22EIE23 - INSTRUMENTATION IN BUILDING AUTOMATION							
Programme& Branch	**B.E. & Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**7**	**PE**	**3**	**0**	**0**	**3**

Preamble	Building Management System is computer-based control system installed in building that controls and monitors the total MEP (Mechanical – Electrical – Plumbing) and security Structure. Itconsist of both Hardware and software. This subject will help the students to understand the various aspects of different systems seen in well-structured building.	
Unit – I	**Introduction and Fire Alarm System:**	**9**
Introduction: Concept and application of Building Management System (BMS) and Automation, requirements and design considerations and its effect on functional efficiency of building automation system, architecture and components of BMS. Fire Alarm: Fundamentals – FAS Components – Fire control panels- Field Components, Panel Components- FAS Architectures- FAS loops – Fire Standards- Concept of IP enabled fire & alarm system, design aspects and components of PA system.		
Unit – II	**Access Control System:**	**9**
Access Control System: Access Components, Access control system Design. CCTV: Camera: Camera Applications, DVR Based system, DVM, Network design, Storage design. Components of CCTV controlling system. CCTV Applications: CCTV Applications. Security Systems Fundamentals: Introduction to Security Systems, Concepts. Security Design: Security system design for – RFID enabled access control with components, Computer system access control – DAC, MAC, RBAC.		
Unit – III	**HVAC system:**	**9**
HVAC system Fundamentals: Introduction to HVAC, HVAC Fundamentals, Basic Processes Human Comfort: Human comfort zones, Effect of Heat, Humidity, Heat loss. Processes: Heating Process & Applications. Cooling Process & Applications, Ventilation Process & Applications, Unitary Systems.		
Unit – IV	**Energy Management System:**	**9**
Energy Management System: ASHRAE Symbols Energy Management: Energy Savings concept & methods, Lighting control, Building Efficiency improvement, Green Building (LEED) Concept & Examples –Energy conservation and Sustainability		
Unit – V	**Building Management System:**	**9**
Building Management System: IBMS (HVAC, Fire & Security) project cycle, Project steps BMS. Verticals: Advantages & Applications of BMS, Examples Integration: IBMS Architecture, Normal & Emergency operation. Advantages of BMS.		
		Total:45

TEXT BOOK:

1.	Jim Sinopoli , "Smart Buildings", 2nd Edition, Butterworth-Heinemann imprint of Elsevier , 2010

REFERENCES:

1.	Shengwei Wang, "Intelligent Buildings and Building Automation", 1st Edition, Spon Press (an imprint of the Taylor & Francis Group), USA,2010.
2.	NJATC, "Building Automation Control Devices and Applications", 1st Edition, American Technical Publishers,Homewood,USA, 2008.
3.	Albert Ting-Pat So, WaiLok Chan, "Intelligent Building Systems", 3rd Edition, Kluwer Academic Publishers, 2012

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	Realize current philosophy, technology, terminology, and practices used in building automation	Understanding (K2)
CO2	Interpret different safety and security standards for building management system	Understanding (K2)
CO3	Understand various hardware and software requirement for given HVAC system	Understanding (K2)
CO4	Evaluate energy management and communication for efficient Building Management System	Applying (K3)
CO5	Use various tools and techniques in BMS for Design of Secure, Safe and Green building	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						1		1			2	2
CO2	3	1						1		1			2	2
CO3	3	1						1		1			2	2
CO4	3	2	1	1	1			1		1			3	3
CO5	3	2	1	1	1			1		1			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	20	80					100
CAT2	20	80					100
CAT3		20	80				100
ESE	15	60	25				100

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

22EIE24 - ELECTRONIC INSTRUMENTATION							
Programme & Branch	**B.E. & Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**7**	**PE**	**3**	**0**	**0**	**3**

Preamble	To provide fundamentals of the Electronic Instruments in the field of Instrumentation Engineering. It discusses the concepts of digital instruments, signal generators, display devices and calibration.	
Unit – I	**Digital Instruments**	**9**
Block diagram of Digital Instrument-Digital Voltmeters: Dual slope Integrating type -Digital Multimeters-True RMS Meter-Digital Frequency meter-Digital Measurement of Time- Universal counter-Decade counter- Generalized Data Acquisition System (DAS).		
Unit – II	**Measuring Instruments**	**9**
Output Power meters-Field strength meter-Stroboscope-Phase meter-Vector Impedance meter: Direct Reading, Commercial vector Impedance meter-Rx meters-Automatic Bridges.		
Unit – III	**Signal Generators**	**9**
Introduction – Fixed Frequency AF Oscillator– Variable AF Oscillator - Basic Standard Signal Generator (Sine Wave)– Modern Laboratory Signal Generator - AF Sine and Square Wave Generator – Function Generator– Square and Pulse Generator (Laboratory Type)- Random Noise Generator- Sweep Generator.		
Unit – IV	**Display Devices**	**9**
Displays-Classification-LED & LCD-LCOS-Bar graph display-Segmental and Dot matrix display-Plasma Display-OLED-FOLED-simple CRO.		
Unit – V	**Instrument Calibration**	**9**
Introduction-Comparison methods- Digital multimeters as standard Instruments-Calibration instruments-Potentiometers-Potentiometer calibration methods-Multifunction calibrators-Multiproduct calibrators-Automated calibration.		
		Total:45

TEXT BOOK:

1.	Kalsi H.S. “Electronic Instrumentation”, 3rd Edition, Tata McGraw Hill, New Delhi, 2019 for Unit 1,2,3,4.
2.	David A Bell, Electronic Instrumentation and Measurements, 2nd Edition, Oxford University Press, New Delhi, 2003 for Unit 5

REFERENCES:

1.	Betty Lincoln, “Digital Electronics”, 1st Edition, Pearson Education, New Delhi, 2014.
2.	R.S.Sedha, “Electronic Measurements And Instrumentation” 1st Edition, S Chand & Company ,2013

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	interpret the fundamentals of digital instruments in various measurements	Understanding (K2)
CO2	employ the functions of measuring instruments	Applying(K3)
CO3	make use of various instruments to generate the waveforms	Applying (K3)
CO4	infer the types of displays used in electronics instruments	Understanding (K2)
CO5	illustrate the calibration methods for standard instruments	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						1					2	2
CO2	3	2	1	1	1			1					3	3
CO3	3	2	1	1	1			1					3	3
CO4	3	1						1					2	2
CO5	3	1						1					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	40	30	30				100
CAT2	50	20	30				100
CAT3	60	40					100
ESE	40	40	20				100

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

22EIE25 - PIPING AND INSTRUMENTATION DIAGRAMS

Programme & Branch	B.E. & Electronics and Instrumentation Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	**Nil**	**7**	**PE**	**3**	**0**	**0**	**3**

Preamble	This course discusses the basic knowledge on Instrumentation standards and to make students familiarize with Instrumentation Symbols, Abbreviations and Identification of Instruments to create Piping and Instrumentation Diagrams for Process Industries	
Unit – I	**Instrument Symbols And Standards:**	**9**
Instrumentation standards: Purpose, Industry codes and standards, Government Regulations – Application to Industries, Application to work activities – Application to classes of Instrumentation and to Instrument functions. **Identification Systems:** Identification System guidelines**:** Instrument Index – Multipoint, Multivariable and Multifunction devices – System Identification – Loop Identification number – Identification Letter Tables		
Unit – II	**Graphic Symbol Systems:**	**9**
Instrument Line symbols – Measurement and control devices – AND/OR function symbols – Discrete devices – Shared continuous devices – Shared On/Off devices – Multipoint, Multifunction, Multivariable devices and loops. Primary elements – Final control elements – Electrical schematic symbols.		
Unit – III	**Fundamentals of P&ID Development:**	**9**
Identification of P&ID and its role in process industries - P&ID Development Activity- Anatomy of a P&ID Sheet – Title Block - Ownership Block - Reference Drawing Block – Revision Block – Comments Block – Main Body of a P&ID. Pipes and Equipments: Fluid Conductors: Pipes, Tubes, and Ducts – Pipe Identifiers – Pipe Symbol – Pipe Tag – Pipe fittings. Manual Valves and Automatic Valves – classification of valves – valve operators – Actuators – Tagging Automatic valves – valve positions. Heat Transfer units: Heat exchanger identifier – Heat exchanger identifier Symbol – Heat exchanger Tag – Heat exchanger P&ID.		
Unit – IV	**Instrumentation and Control System:**	**9**
Fundamentals of Instrumentation and Control - ICSS System Technology - ICSS Elements – Basic Process Control System (BPCS) –Instruments on P&IDs - Instrument Identifier – Signals: Communication Between Instruments – Different Instrument Elements - Simple control loops – Level Control Loops –Pressure Control Loops –Temperature Control Loops – Composition Control Loops – Flow Control Loops.		
Unit – V	**Plant Interlocks and Alarms:**	**9**
Introduction- Safety strategies – Concept of a SIS – SIS extent – Anatomy of a SIS: SIS Element Symbols, SIS Final Elements, SIS Logic – Showing Safety Instrumented Functions on P&IDs – Discrete Control – Alarm System: Anatomy of Alarm systems, Alarm requirements, Alarm system Symbology, Concept of ‘Common Alarm’.		
		Total:45

TEXT BOOK:

1.	Liptak B.G., “Instrumentation Engineers Handbook (Process Measurement & Analysis)”, Volume 3, 4th Edition , Chilton Book Co, CRC Press, United States, 2016. (Unit 1,2)

REFERENCES:

1.	Moe Toghraei, “Piping and Instrumentation Diagram Development”, 1st Edition, Wiley-Blackwell, USA, 2019. Unit (3,4,5)
2.	Ernest E. Ludwig, “Applied Process Design for Chemical and Petrochemical Plants, Vol-I”, 4th Edition, Gulf Publishing Company, Houston, 2007.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	summarize the basics of instrumentation standards and symbols.	Understanding (K2)
CO2	identify the instrument symbols and function symbols for various elements.	Understanding (K2)
CO3	interpret the symbols of pipes and various equipments in process industry and recognize P&ID and its role in process industry.	Understanding (K2)
CO4	implement the control concepts in basic process systems and develop simple control loops	Applying (K3)
CO5	develop the safety interlock systems and alarm systems in process plants and equipments	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						1		2			2	2
CO2	3	1						1		2			2	2
CO3	3	1						1		2			2	2
CO4	3	2	1	1	1			1		2			3	3
CO5	3	2	1	1	1			1		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	40	60					100
CAT2	20	30	50				100
CAT3	20	30	50				100
ESE	20	40	40				100

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

22EIE26 - MACHINE LEARNING AND ITS APPLICATIONS							
Programme & Branch	**B.E. & Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**7**	**PE**	**3**	**0**	**0**	**3**

Preamble	This course is intended to provide the foundation on topics in probability and various statistical methods which form the basis for many other areas in the mathematical sciences including parametric methods and decision theory. As application of machine learning case studies will also be addressed.	
Unit – I	**Machine Learning Basic Concepts:**	**9**
Learning Associations – Classification – Regression – Unsupervised Learning – Reinforcement Learning. Supervised Learning: Learning Multiple Classes - Model Selection and Generalization. Bayesian Decision Theory: Introduction – Classification - Losses and Risks – Discriminant Function.		
Unit – II	**Dimensionality Reduction, Clustering and Decision Trees:**	**9**
Introduction – Subset Selection – Principal Component Analysis – Factor Analysis – Multidimensional Scaling – Linear Discriminate Analysis. Clustering: Introduction – Mixture Densities – K-means Clustering .Decision Trees: Univariate Trees - Pruning – Multivariate Trees.		
Unit – III	**Multilayer Perceptrons:**	**9**
Introduction – The Perceptron - Training a Perceptron – Learning Boolean Function – Multilayer Perceptrons - MLP as a Universal Approximator – Back Propagation Algorithm – Training Procedures - Tuning the Network Size – Bayesian View of Learning – Learning Time: Time Delay Neural Networks – Recurrent Networks.		
Unit – IV	**Local and Graphical Models:**	**9**
Local Models: Introduction – Competitive Learning– Normalized and Competitive Basis Function – Learning Vector Quantization. Graphical Models: Canonical cases for conditional independence – Example of Graphical Models. Reinforcement Learning: Introduction – Elements of Reinforcement Learning – Model Based Learning - Temporal Difference Learning – Generalization.		
Unit – V	**Applications of Machine Learning:**	**9**
Clustering: Analysis for Market Research -Regression: Predicting house prices with regression. Classification: Music Genre Classification – Computer vision.		
		Total:45

TEXT BOOK:

1.	Ethem Alpaydin, “Introduction to Machine Learning “,3rd Edition, The MIT Press, London, England , 2014

REFERENCES:

1.	Luis Pedro Coelho, Willi Richert, “Building Machine Learning Systems with Python” 2nd Edition, Packt Publishing, England, 2015.
2.	Tom M.Mitchelll, “Machine Learning” 1st Edition, McGraw-Hill Education, New York, 1997.
3.	James A Anderson, “An Introduction to Neural Networks”, 1st Edition, MIT Press, UK,1995

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	infer the basic concepts of learning methods involved in machine learning	Understanding (K2)
CO2	explain the fundamentals of dimensionality reduction, clustering and decision trees	Understanding (K2)
CO3	summarize the concepts of neural networks along with its architectures	Applying(K3)
CO4	explain the various models and reinforcement learning techniques	Understanding (K2)
CO5	apply machine learning algorithms for basic clustering, classification and regression 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	3	1											2	2
CO2	3	1											2	2
CO3	3	2	1	1	1								3	3
CO4	3	1											2	2
CO5	3	2	1	1	1								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	20	60	20				100
CAT2	20	30	50				100
CAT3	20	40	40				100
ESE	20	40	40				100

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

<table>
<tr><td colspan="8">22EIE27 – MODEL PREDICTIVE CONTROL</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td>Programme & Branch</td><td>B.E. & Electronics and Instrumentation Engineering</td><td>Sem.</td><td>Category</td><td>L</td><td>T</td><td>P</td><td>Credit</td></tr>
<tr><td>Prerequisites</td><td>Control Systems</td><td>7</td><td>PE</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td>Preamble</td><td colspan="7">To understand the basic principles and algorithm of predictive control and to get acquainted with the fundamental contents of predictive control theory and applications</td></tr>
<tr><td>Unit – I</td><td colspan="6">Need for Predictive Control:</td><td>9</td></tr>
<tr><td colspan="8">Classical control assumptions: PID compensation-lag-lead compensation-classical control analysis. Challenges in classical methods: Controlling systems with non-minimum phase zeros and time delays – impact of delays- control of open loop unstable systems-the potential value of prediction-main components of Model Predictive Control (MPC)</td></tr>
<tr><td>Unit – II</td><td colspan="6">Generation and Development of Predictive Control:</td><td>9</td></tr>
<tr><td colspan="8">Principles of Predictive Control (PC)-prediction model-dynamic matrix control (DMC) based on step response model-DMC algorithm and implementation-DMC in state space framework-general predictive control based on the linear difference equation model – PC based on state space model.</td></tr>
<tr><td>Unit – III</td><td colspan="6">Synthesis of Stable Predictive Control:</td><td>9</td></tr>
<tr><td colspan="8">Fundamental philosophy of qualitative synthesis theory of PC –relationship between MPC and optimal control-synthesis of stable PC – PC with zero terminal constraints – PC with terminal cost functions-general stability conditions of PC- sub-optimality analysis of PC</td></tr>
<tr><td>Unit – IV</td><td colspan="6">Predictive Control of Non-linear Systems:</td><td>9</td></tr>
<tr><td colspan="8">General description of PC for non-linear systems- PC based on input-output linearization – multiple MPC based on fuzzy clustering – neural network PC – PC for Hammersian systems – PC with feed-forward and feedback structure – cascade PC.</td></tr>
<tr><td>Unit – V</td><td colspan="6">Applications of Predictive Control:</td><td>9</td></tr>
<tr><td colspan="8">Industrial applications and software development of PC –role of PC in industrial process optimization – key technologies pf PC implementation – process description and control system configuration –problem formulation and variable selection – plant testing and model identification-application of PC in an automatic train operation system and in solar power plant.</td></tr>
<tr><td colspan="8" align="right">Total:45</td></tr>
</table>

TEXT BOOK:

1.	Yugeng Xi , Dewei Li, "Predictive Control: Fundamentals and Developments", 1st Edition, Wiley Publishers, USA, 2019.

REFERENCES:

1.	Camacho E.F., Bordons C., "Model Predictive control in Process Industry"", 1st Edition, Springer publications, London,1995.
2.	Rossiter J.A., "A First Course in Predictive Control" 2nd Edition, CRC Press, USA, 2018.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	recognize the need for predictive control and to identify the main components	Understanding (K2)
CO2	formulate the predictive control problem and algorithms	Applying (K3)
CO3	apply the concepts of synthesizing stable predictive control	Applying (K3)
CO4	apply the concepts of predictive control in non-linear systems	Applying (K3)
CO5	realize the applications of model predictive control in industries	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											2	2
CO2	3	2	1	1	1								3	3
CO3	3	2	1	1	1								3	3
CO4	3	2	1	1	1								3	3
CO5	3	1											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)

22EIE28 - MULTISENSOR AND DATA FUSION							
Programme & Branch	**B.E. & Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Digital Signal Processing**	**7**	**PE**	**3**	**0**	**0**	**3**

Preamble	To impart the fundamental knowledge and applications of data fusion and implementation of data fusion algorithms	
Unit – I	**Sensor and Data Fusion:**	**9**
Introductions, Sensors and Sensor data. Use of multiple sensors, Fusion applications. The inference hierarchy: Output data. Data fusion model: Architectural concepts and issues – Benefits of data fusion.		
Unit – II	**Data Registration:**	**9**
Introduction – Registration Problem – Review of existing research – Registration using Meta-Heuristics – Wavelet-based registration of Range Images – Registration Assistance/Preprocessing – Registration using Elastic Transformations – Theoretical Bounds.		
Unit – III	**Principles of Image and Spatial Data Fusion:**	**9**
Introduction – Motivation for combining image and spatial data – Defining image and spatial data fusion – Three classic levels of combination for Multisensor Automatic Target – Image data fusion for Enhancement of Imagery data – Spatial data fusion applications – Spatial data fusion GEOINT.		
Unit – IV	**Identity Declaration:**	**9**
Identity declaration and pattern recognition – Future extraction – Parametric Templates – Cluster Analysis Techniques – Adaptive Neural Networks – Physical Models – Knowledge-based Methods – Hybrid Techniques.		
Unit – V	**Implementation of Data Fusion:**	**9**
Introduction – Requirements Analysis and Definition – Sensor Selection and Evaluation – Functional Allocation and Decomposition – Architecture Trade-Offs – Algorithm Selection – Database Definition – HCI design – Software Implementation – Test and Evaluation – Survey on Military Applications.		
		Total:45

TEXT BOOK:

1.	David L. hall, Sonya A.H. McMullen, "Mathematical techniques in Multi sensor data fusion", 2nd Edition, Artech House, Boston, 2004, for units 1, 4 and 5.
2.	Martin E. liggins, David L. Hall and James Llinas, "Handbook of Multi sensor data Fusion: Theory and Practice", 2nd Edition, CRC Press, Boca Raton 2009, for units 2 and 3.

REFERENCES:

1.	Brooks R. R. and Iyengar S. S., "Multisensor Fusion: Fundamentals and Applications with software", 1st Edition, Prentice Hall Inc., New Jersey, 1998.
2.	Jitendra R. Raol, "Data Fusion Mathematics, Theory and Practice", 1st Edition, CRC Press, Boca Raton, 2015.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	describe the basics concepts of sensor and data fusion	Understanding (K2)
CO2	illustrate the data registration for data fusion	Understanding (K2)
CO3	examine the principles of image and spatial data fusion	Understanding (K2)
CO4	explain the various techniques in data fusion	Understanding (K2)
CO5	perform case study on the data fusion algorithm for realtime applications	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						1		1			2	2
CO2	3	1						1		1			2	2
CO3	3	1						1		1			2	2
CO4	3	1						1		1			2	2
CO5	3	2	1	1	1			1		1			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	30	70					**100**
CAT2	30	70					**100**
CAT3	30	40	30				**100**
ESE	15	70	15				**100**

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

22EIE29- DIAGONISTIC AND THERAPEUTIC INSTRUMENTS							
Programme & Branch	**B.E. & Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Bio Medical Instrumentation**	**8**	**PE**	**3**	**0**	**0**	**3**

Preamble	To impart the fundamental knowledge and applications of Digital Signal Processing.	
Unit – I	**Respiratory Measurements Systems:**	**9**
Pulmonary function measurements – Basic spirometer- Ultrasonic spirometer – Fleisch Pneumotachometer – Pulmonary function analyzers – Respiratory gas analyzers-Apnea monitor. Types of ventilators – Ventilator terms – Pressure volume flow diagram – Microprocessor controlled ventilator.		
Unit – II	**Ultrasonic Imaging Systems:**	**9**
Diagnostic ultrasound – Physics of ultrasonic waves – Medical ultrasound – Basic pulse-echo apparatus – Imaging modes – Real-time ultrasonic imaging systems – Duplex scanner – Modern ultrasound imaging systems –Three-dimensional ultrasound imaging systems-Portable ultrasound systems.		
Unit – III	**Arrhythmia and Ambulatory Monitoring Instruments:**	**9**
Cardiac Arrhythmias – Arrhythmia monitor – QRS detection techniques – Ambulatory monitoring instruments – Data recording – Data replay and analysis. Foetal monitoring instruments: Cardiotocograph – Abdominal foetal Electrocardiogram – Foetal Phonocardiogram.		
Unit – IV	**Blood Cell Counters:**	**9**
Types of blood cells – Cell counting: Microscopic method – Automatic optical method – Electrical conductivity method. Anaesthetic system: Need of anaesthesia – Anaesthesia machine. Audiometers: Mechanism of hearing –Measurement of sound – Bekesy audiometery.		
Unit – V	**Surgical and Therapeutic Instruments:**	**9**
Surgical diathermy-Endoscopy basic components-Laparoscope, gastro scope, bronchoscope-Cryogenic techniques and application-Operating microscope-arthroscopy-Modern lithotripter system-laser lithotripsy.		
		Total:45

TEXT BOOK:

1.	Khandpur R.S., “Handbook of Biomedical Instrumentation”, 3rd Edition, Tata McGraw-Hill, New Delhi, 2018.

REFERENCES:

1.	Joseph J. Carr and John M. Brown, “Introduction to Biomedical Equipment Technology”, Pearson Education, 2003.
2.	John G. Webster, “Medical Instrumentation Application and Design”, 4th Edition, John Wiley and Sons, NewYork, 2015.
3.	Leslie Cromwell, “Biomedical Instrumentation and Measurement”, 2nd Edition, Prentice Hall of India, New Delhi, 2007.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	interpret the various measurement techniques related to respiratory system	Understanding(K2)
CO2	employ the ultrasound imaging techniques and its usefulness in diagnosis	Applying (K3)
CO3	identify the various monitoring instruments	Applying (K3)
CO4	explain the mechanisms of special assist devices	Understanding(K2)
CO5	infer the concepts in surgical and therapeutic instruments	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				3							2	2
CO2	3	2	1	1	1	3							3	3
CO3	3	2	1	1	1	3							3	3
CO4	3	1				3							2	2
CO5	3	1				3							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	50	20	30				100
CAT3	40	60					100
ESE	30	50	20				100

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

22EIE30 - INSTRUMENTATION AND CONTROL IN PAPER INDUSTRIES							
Programme & Branch	**B.E. & Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**8**	**PE**	**3**	**0**	**0**	**3**

Preamble	This course discusses the basic knowledge on Instrumentation in paper making process and expose the students to various control strategies employed in paper industries	
Unit – I	**Paper Making Process:**	**9**
Paper making process: Raw materials, pulping and preparation, screening – bleaching, cooking, chemical addition, approach system, paper machine, drying section, calenders, drive, finishing, other after treatment processes, coating.Properties of paper: physical, electrical, optical and chemical properties.		
Unit – II	**Wet End Instrumentation:**	**9**
Conventional measurements at wet end, pressure and vacuum, temperature, liquid density and specific gravity, level, flow, consistency measurement, pH and ORP measurement, freeness measurement.		
Unit – III	**Dry End Instrumentation:**	**9**
Conventional measurements, moisture basis weight, caliper, coat thickness, optical variables, measurement of length and speed. Digester: Rotary and Batch type.		
Unit – IV	**Control Strategies:**	**9**
Machine and cross direction control techniques, control of pressure, vacuum, temperature, liquid density and specific gravity, level, flow, pH, freeness, thickness, consistency, basis weight and moisture.		
Unit – V	**Modernization in Paper Industries:**	**9**
Paper cutting mechanism – packaging mechanism – Computer controls for online basis weight and web moisture in modern mills – Case Studies: Waste water Management, Advances in Pulp Purification, Paper making and Finishing		
		Total:45

TEXT BOOK:

1.	Liptak, B.G., “Instrumentation Engineers Handbook (Measurement)”, CRC Press, 2005.

REFERENCES:

1.	Libby, C. E., “Pulp and Paper Science and Technology (Volume 1, Pulp), (Volume 2, Paper)”, New York McGraw Hill, USA, 1962.
2.	John Lavigne, “Instrumentation Applications for the Pulp and Paper Industry (A Pulp & paper book)”, Backbeat Books, 1979.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	describe the different stages of operation in Paper Industries	Understanding(K2)
CO2	explain the working operation of instruments used in wet end section	Understanding(K2)
CO3	explain the working operation of instruments used in dry end section.	Understanding(K2)
CO4	iidentify the control aspects used in the paper industry	Applying (K3)
CO5	demonstrate about the evolution of computer applications in paper industry	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						1		2			2	2
CO2	3	1						1		2			2	2
CO3	3	1						1		2			2	2
CO4	3	2	1	1	1			1		2			3	3
CO5	3	2	1	1	1			1		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	40	60					100
CAT2	40	60					100
CAT3	40	40	20				100
ESE	40	40	20				100

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

<table>
<tr><td colspan="9">22EIE31 – INSTRUMENTATION AND CONTROL IN PETROCHEMICAL INDUSTRIES</td></tr>
<tr><td>Programme & Branch</td><td>B.E. & Electronics and Instrumentation Engineering</td><td>Sem.</td><td>Category</td><td>L</td><td>T</td><td>P</td><td>Credit</td></tr>
<tr><td>Prerequisites</td><td>Industrial Instrumentation, Process Control</td><td>8</td><td>PE</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Preamble</td><td colspan="7">This course provides the concepts of petroleum processing and various measurement and control techniques applied to reactors, crystallizers, distillation columns, safety and regulations</td></tr>
<tr><td>Unit – I</td><td colspan="6">Petroleum Processing:</td><td>9</td></tr>
<tr><td colspan="8">Petroleum Exploration – Composition of petroleum – Drilling – Recovery techniques – Oil and Gas separation: Well completion methods – Feed stocks of Petrochemicals – Separation of Gases into individual constituents – Separation of liquids.</td></tr>
<tr><td>Unit – II</td><td colspan="6">Operations in Petroleum Industry:</td><td>9</td></tr>
<tr><td colspan="8">Crude oil distillation – Refining of crude oil –Thermal conversion processes: Thermal cracking – Catalytic conversion processes: Catalytic cracking –Catalytic reforming – Hydro cracking – Catalytic alkylation – Catalytic Isomerisation – Catalytic polymerization.</td></tr>
<tr><td>Unit – III</td><td colspan="6">Control of Reactors and Crystallizers:</td><td>9</td></tr>
<tr><td colspan="8">Reactors: Basic operation and fundamentals – Temperature control – Once through cooling – Recirculated cooling – Cascade control –Split range controls with multiple coolants – Crystallizers: Control basis – Cooling crystallizers – Classifying crystallizers – Evaporator crystallizers – Vacuum crystallizers – Reaction crystallizers.</td></tr>
<tr><td>Unit – IV</td><td colspan="6">Control of Distillation Columns:</td><td>9</td></tr>
<tr><td colspan="8">Distillation equipment –Column variables –Control configurations –Product Quality Control – Direct control: Feedback control –Feed forward control – Cascade control - Inferring composition from Temperature – Column pressure control –Feed control: Feed flow rate control - Temperature control.</td></tr>
<tr><td>Unit – V</td><td colspan="6">Safety and ATEX Terminology & Regulations:</td><td>9</td></tr>
<tr><td colspan="8">Introduction - Intrinsic Safety - Certification of Intrinsic Safety – NEC Definition of Hazardous Locations - IEC Definition of Hazardous Locations – Introduction to ATEX Terminology & Regulations: EC Directives - Directive 94/9/EC – ATEX 95 – Directive 1999/92/EC – ATEX 137 - North America - International IECEx Scheme - IECEx Scheme Objective – IECEx International Certification Scheme.</td></tr>
<tr><td colspan="8" align="right">Total:45</td></tr>
<tr><td colspan="8">TEXT BOOK:</td></tr>
<tr><td>1.</td><td colspan="7">Robert A. Meyers, “Handbook of Petroleum Refining Processes”,4th Edition, McGraw-Hill, New York,2016 for Unit-1,2</td></tr>
<tr><td>2.</td><td colspan="7">Liptak B.G, “Instrumentation in the Processing Industries”, 1st Edition, Chilton Book Company, Boston, 1973.
(Digitized 2008) for Unit-3,4</td></tr>
<tr><td>3.</td><td colspan="7">https://tools.niehs.nih.gov/wetp/public/Course_download2.cfm?tranid=2497
https://osha.europa.eu/en/legislation/directives/21 for Unit-5</td></tr>
<tr><td colspan="8">REFERENCES:</td></tr>
<tr><td>1.</td><td colspan="7">Dr. Ram Prasad, “Petroleum Refining Technology”, 1st Edition, Khanna Publishers, New Delhi, 2008.</td></tr>
</table>

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	explain the basics of petroleum exploration and processing in petroleum industry	Understanding (K2)
CO2	illustrate the operations of petroleum refining process in petroleum industry	Understanding (K2)
CO3	build the instrumentation and control techniques involved in reactors and crystallizers	Applying (K3)
CO4	apply the various instrumentation and control schemes in distillation columns	Applying (K3)
CO5	describe the standards on Electrical, Intrinsic safety systems and ATEX terminology and regulations	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											2	2
CO2	3	1											2	2
CO3	3	2	1	1	1								3	3
CO4	3	2	1	1	1								3	3
CO5	3	1											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	40	60					**100**
CAT2	10	40	50				**100**
CAT3	10	40	50				**100**
ESE	20	40	40				**100**

* ±3% may be varied (CAT 1, 2 & 3 – 60 marks & ESE – 100 marks)

22EIE32 – VHDL PROGRAMMING AND ITS APPLICATIONS							
Programme & Branch	**B.E. & Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**8**	**PE**	**3**	**0**	**0**	**3**

Preamble	To impart knowledge about different modeling in VHDL programming and synthesize complex digital circuits at several level of abstractions.	
Unit – I	**VHDL Fundamentals:**	**9**
History of Hardware Description Languages – HDL Abstraction – The Modern Digital Design Flow – VHDL Constructs – Data Types – Libraries and Packages – The Entity – The Architecture – Modeling Concurrent Functionality in VHDL – Concurrent Signal Assignments – Concurrent Signal Assignments with Logical Operators –Conditional Signal Assignments.		
Unit – II	**Dataflow Modeling**:	**9**
Concurrent Signal Assignment Statement – Concurrent versus Sequential Signal Assignment – Delta Delay – Conditional Signal Assignment Statement – Block Statement – Concurrent Assertion Statement – Value of a signal.		
Unit – III	**Structural Modeling:**	**9**
Components: Component Declarations – Component Instantiation – Packaging Components – Configuring Component Instances: Basic Configuration Declarations – Configuring Multiple Levels of Hierarchy – Direct Instantiation of Configured Entities –Port Maps in Configurations.		
Unit – IV	**Behavioral Modeling**	**9**
If Statements: Conditional Variable Assignments – Case Statements: Selected Variable Assignments – Null Statements – Loop Statements: Exit Statements – Next Statements – While Loops – For Loops – Summary of Loop Statements.		
Unit – V	**Applications of VHDL in Digital System Design:**	**9**
Combinational Logic Circuits: Adders, Multiplexer, Decoders and Encoders. **Sequential logic Circuits**: Flip flops, – ALU –– Counters – Shift registers.		
		Total:45

TEXT BOOK:

1.	Peter J Ashenden, “The Designer’s Guide of VHD”L, 3rd Edition, Morgan Kaufmann publisher, USA, 2008.

REFERENCES:

1.	Brock J LaMeres, “Introduction to Logic Circuits & Logic Design with VHDL”, 2nd Edition, Springer Publisher, Switzerland, 2019.
2.	Bhasker J, “VHDL Primer”, 3rd Edition, Pearson Education, New Delhi, 2008.
3.	Sung Mo Kang, Yousf Leblebici & Chulwoo Kim, “CMOS Digital Integrated Circuits, Analysis and Design”, 4th Edition, McGraw Hill Education, New Delhi, 2019.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	understand the significance of VHDL	Understanding (K2)
CO2	apply the concepts for creating dataflow modeling	Applying(K3)
CO3	design the logic circuits using structural modeling	Applying(K3)
CO4	develop the digital circuits using behavioral modeling	Applying(K3)
CO5	design and synthesize the various applications of digital circuits using VHDL programming	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								1			2	2
CO2	3	2	1	1	1					1			3	3
CO3	3	2	1	1	1					1			3	3
CO4	3	2	1	1	1					1			3	3
CO5	3	2	1	1	1					1			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	30	70					100
CAT2	10	30	60				100
CAT3	10	30	60				100
ESE	10	40	50				100

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

22EIE33 COMPUTER CONTROL OF PROCESSES							
Programme & Branch	**B.E. & Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Process Control**	**8**	**PE**	**3**	**0**	**0**	**3**

Preamble	To provide knowledge, and understanding required to effectively analyze and design computer-controlled systems.	
Unit – I	**Computer Aided Process Control:**	**9**
Introduction- Role of computers in process control – Classification of computer aided process control system – batch and sequential control processes – supervisory computer control processes – Direct Digital Control processes-Computer aided process control architecture- Centralized computer control systems – Distributed computer control systems – Hierarchical computer control systems-Man Machine Interface-Economics of computer aided process control-Process related interfaces – Types of computer control process software.		
Unit – II	**Sampled Data Control Systems:**	**9**
Conventional control Vs Computer control– Mathematical representation of the sampling Process– Sampling frequency considerations – Selection of optimum sampling period – Zero Order Hold-First order hold –Pulse transfer function- Complex series representation of the sampler – Development of the Pulse transfer Function – Modified z Transform-stability analysis: Asymptotic stability - BIBO stability – Internal stability- Jury's stability analysis.		
Unit – III	**Design of Controllers for Linear Systems:**	**9**
Digital equivalent of conventional PID controller – implementation of discrete PID algorithm-controller design for process with difficult dynamics: Non-minimum phase systems – time delay systems- Smith Predictor algorithm –Inverse response systems-Inverse response compensator-Open loop unstable systems		
Unit – IV	**Pole Placement Design:**	**9**
State space approach-concepts of controllability, observability, reachability and delectability-regulation by state feedback-observers-output feedback –the servo problem. Polynomial approach): simple design problem – The Diophantine equation – Design procedure –Design of controller for double integrator, Harmonic oscillator and flexible robotic arm.		
Unit – V	**Controller Design for Nonlinear Systems:**	**9**
Linearization and the classical approach-Adaptive control principles: Scheduled adaptive control –Model reference adaptive control-Self tuning adaptive control-Variable transformations. Model based control: Direct synthesis control –First order systems – Higherorder systems –Time delay systems-Inverse response systems-Internal model control.		
		Total:45

TEXT BOOK:

1.	Karl Astrom J , & JornWittenmar B, "Computer Controlled Systems: Theory and Design", 3rd Edition, Prentice Hall Publishers,1997 for Unit 1, 2 and 4.
2.	Babatunte A. Ogunnaike & W. Harmon Ray, "Process Dynamics Modeling and Control ",1st Edition, Public Oxford UniversityPress, Newyork, 1994 for Unit 3 and 5.

REFERENCES:

1.	Singh S.K., "Computer aided Process control", 1st Edition, Prentice Hall India Pvt. Ltd, India, 2004.
2.	Deshpande, P.B. & Ash, R.H., "Computer Process Control",1st Edition, ISA Publications,USA,1995.
3.	Curtis D. Johnson, "Process Control Instrumentation Technology", 8th Edition, Pearson Education Limited, London, 2015.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	recognize the impact of computers in process control	Understanding (K2)
CO2	analyze the performance of discrete time systems	Analyzing (K4)
CO3	apply the concepts in the design of basic digital controllers and analyze the stability of the closed loop discrete systems	Applying (K3)
CO4	apply the concepts in designing controllers for linear and nonlinear systems.	Applying (K3)
CO5	apply the concepts of pole placement design for control applications	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											2	2
CO2	3	3	2	2	2								3	3
CO3	3	2	1	1	1								3	3
CO4	3	2	1	1	1								3	3
CO5	3	2	1	1	1								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	30	30	40				100
CAT2	10	40	30	20			100
CAT3	10	30	60				100
ESE	20	20	40	20			100

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

22EIE34 - DIGITAL TWINS								
Programme & Branch	**B.E. & Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	Nil	**8**	**PE**	**3**	**0**	**0**	**3**

Preamble	This course is designed to impart students with introduction to foundation of digital twins in a pragmatic way for cyber –physical fusion, as emerging approach to support engineering design.

Unit – I	**Introduction to Digital Twin Driven Smart Design:**	**9**
Development of Product design and Prospect forecast-Digital Twin and its Applications- History, Concept, Applications of Digital twins-Five Dimension digital twin of a Product-physical, virtual, Digital twin data, Services and connections.-Framework for Digital twin driven smart product design-Case study: Bicycle and Landing gear.		
Unit – II	**Digital Twin Driven Conceptual Design**	**9**
Conceptual design methodology foundation of digital twin: Design theory-general, Axiomatic, systematic, Function-Behaviour-structure ontology, Digital twin based conceptual design: function modeling, concept generation, concept evaluation, contradiction resolution, constraint management, complexity management, collaborative conceptual design, digital twin based design affordance. Case study: robot vacuum cleaner (functional formulation, concept generation, constraint management, contradiction solving).		
Unit – III	**Digital Twin Driven Energy-aware Green Design**	**9**
Iterative optimization of energy consumption-energy consumption digital thread-product –life cycle, green design (in material selection, disassembly, supply chain and its potential applications). Energy aware five-dimension digital twin,		
Unit – IV	**Application and Case Study**	**9**
Digital twin driven factory design: framework, functions at different stages and modular approach-case study: digital twin driven factory design of a paper cup factory, digital twin driven factory design of a nylon factory.		
Unit – V	**Digital Twin Driven Process Design Evaluation**	**9**
Process design- process design evaluation- Digital Twin driven process design evaluation-framework for Digital Twin driven process design evaluation-Reconfigurable process plan creation-Digital twin data generation-process plan evaluation based on digital twin data-case study: digital engine connecting rod model description-real time data collection and management-verification of process design evaluation.		
		Total:45

TEXT BOOK:

1.	Fei Tao, Ang Liu, Tianliang Hu, "Digital Twin Driven Smart Design", Academic Press, Elsevier, United Kingdom, 2020.

REFERENCES:

1.	Pethuru Raj, Preeta Evangeline,"The Digital Twin Paradigm for Smarter Systems and Environments: The industry use cases" , 1st Edition, Academic press, Elseiver , 2020
2.	Shyam Varan Nath, Pieter van Schalkwyk," Building Industrial Digital Twins: Design, Develop and Deploy Digital Twin Solutions for Real World Industry using Azure Digital Twins", Packt Publishing, 2021.
3.	Xinya Song, "Machine Learning Assisted Digital Twins for event identification in electrical power system", 1st Edition, Technische Universitate Limenau/Universities, Bibliotheck, 2022

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	understand digital twin product design framework from a holistic perspective and discusses the related key processes and technologies.	Understanding (K2)
CO2	gain envisions a Digital twin driven conceptual design in terms of functional modeling, concept generation, evaluation and contradiction resolution at basic levels.	Applying (K3)
CO3	discuss and relate digital twin (DT) to green design; proposes and emphasize DT model to energy conservation(EC) digital thread and discusses the way DT could promote green design for energy saving.	Understanding (K2)
CO4	discuss the practical application of DT driven smart design and present case study about paper cup and nylon factory.	Applying(K3)
CO5	present a DT based process design evaluation and exemplify the machining process of diesel engine connecting rod.	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					1	2	1		1		2	2
CO2	2	2	1	1	1		1	2	1		1		3	3
CO3	2	1					1	2	1		1		2	2
CO4	3	2	1	1	1		2	2	1		2		3	3
CO5	3	2	1	1	1		2	2	1		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	20	60	20				100
CAT2	20	70	10				100
CAT3	20	60	20				100
ESE	20	60	20				100

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

22EIO01 - MEASUREMENTS AND INSTRUMENTATION
(Offered by Department of Electronics and Instrumentation Engineering)

Programme & Branch	**All BE/Btech branches except Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**5**	**OE**	**3**	**1**	**0**	**4**

Preamble	This course imparts the knowledge of measuring instruments for measuring electrical and electronic parameters. Measurements and Instrumentation course gives overview of various measurements like PMMC,MI, power, Energy, recorders and various methods of measurements using AC bridges and transducers.	
Unit – I	**Electrical Meters:**	**9+3**
Deflecting, controlling and damping forces in indicating instruments – Principle and operation: D'Arsonval Galvanometers-Torque Equation- Permanent Magnet Moving Coil instruments -Moving iron instruments -Dynamometer type Wattmeter- Single Phase induction type Energy meters.		
Unit – II	**DC Null Methods:**	**9+3**
Measurement of Resistances: Classification of Resistances –Measurement of Medium Resistances: Wheatstone Bridge Measurement of low resistance: Kelvin Double Bridge– Measurement of high resistance: Megger – Earth resistance measurement. Potentiometers: Basic Potentiometer circuit-Laboratory Type (Crompton's) potentiometer-Applications: calibration of ammeter, voltmeter, wattmeter using potentiometer, measurement of unknown resistance using DC potentiometer.		
Unit – III	**Methods of Measurements using AC bridges** :	**9+3**
Introduction to A.C. bridges-Sources and detectors-General Equation for bridge balance-General form of an AC bridge Measurement of Self Inductance: Maxwell's inductance Bridge and Anderson's bridge. Measurement of Capacitance: Schering bridge. Measurement of Mutual Inductance: uses of Mutual Inductance in bridge circuits, Heaviside mutual inductance bridge. Measurement of frequency: Wien's bridge.		
Unit – IV	**Display Devices and Recorders:**	**9+3**
Segmental Displays: Seven segment display-Dot Matrices-Rear Projection Display-Nixie Tube- Light Emitting Diode-Liquid Crystal Diode-X-Y Recorders-Magnetic Tape Recorders-Digital tape recorders		
Unit – V	**Transducers:**	**9+3**
Classification of Transducers-Primary and Secondary –Passive and Active- Analog and Digital-Inverse Transducers. Resistive Transducers: Strain Gauges-Theory of Strain Gauge- Thermistor: Construction of Thermistor. Thermocouple: Construction of Thermocouple. Linear Variable Differential Transformers (LVDT): Construction – Advantages and Disadvantages.		
		Lecture:45, Tutorial :15, Total:60

TEXT BOOK:

1.	Sawhney A.K., "A Course in Electronic Measurements and Instrumentation", 2nd Edition, Dhanpat Rai & Co. Pvt. Ltd., New Delhi, 2015.

REFERENCES:

1.	Joseph J.Carr, "Elements of Electronic Instrumentation and Measurement", 3rd Edition, Pearson Education Pvt Ltd, New Delhi, 2008.
2.	Oliver B.M., & Cage, J.M., "Electronic Measurements and Instrumentation", 3rd Edition, McGraw-Hill, New York, 1975.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	explain the working of various electrical meters	Understanding (K2)
CO2	employ the DC null methods for measurement of resistance	Applying (K3)
CO3	make use of the AC bridges for measurement of Capacitance	Applying (K3)
CO4	interpret the concepts of storage and display devices in instruments	Understanding (K2)
CO5	select appropriate Transducer for different applications	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	2	1	1	1								3	3
CO2	3	2	1	1	1								3	3
CO3	3	2	1	1	1								3	3
CO4	3	2	1	1	1								3	3
CO5	3	1											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	40	30	30				100
CAT2	30	30	40				100
CAT3	40	60					100
ESE	40	40	20				100

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

2EIO02 - BIOMEDICAL INSTRUMENTATION AND APPLICATIONS
(Offered by Department of Electronics and Instrumentation Engineering)

Programme & Branch	All BE/Btech branches except Electronics and Instrumentation Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	**Nil**	**5**	**OE**	**3**	**1**	**0**	**4**

Preamble	To impart the knowledge of some human anatomy and measuring bio potentials using bio electrodes with specific instruments which is most commonly used in hospitals. Also understand the fundamental concept of various biomedical imaging techniques and learn the advanced physiological assistive medical devices	
Unit – I	**Human Physiological Systems:**	**9+3**
Cell and its structure – Resting and action potentials – Different systems of human body: Circulatory system – Respiratory system – nervous system – Components of the Bio medical instrument system – strain gauge as pressure transducer – photoelectric type resistive transducer – piezoelectric ultrasonic transducer.		
Unit – II	**Bio Potential Electrodes:**	**9+3**
Micro electrode-depth and needle electrode-surface electrodes. Biomedical Electrical signal measurement: ECG, EEG, EMG, EOG and ERG: Lead systems, recording methods and typical waveforms.		
Unit – III	**Biomedical Non Electrical Signal Measurement:**	**9+3**
Phonocardiography – GSR- Blood pressure Measurement: Sphygmomanometer, MEMS based catheter tip pressure sensor, ultrasonic blood pressure monitor. Spirometer – Blood pH measurement – Ear oximeter – Pulse oximeter – Lung volumes, respiration and cardiac rate.		
Unit – IV	**Biomedical Imaging Systems:**	**9+3**
X-ray machine – Computer tomography – Thermography – Ultrasonic imaging systems – Magnetic resonance imaging – PET – SPECT – FMRI – Magnetic Particle Imaging.		
Unit – V	**Physiological Assist Devices:**	**9+3**
Ventricular asynchronous pacemaker – AC Defibrillator – Heart lung machine – Kidney machine – Audiometer – Biothesiometry-Vibroscreen – Biotelemetry – Telemedicine.		
		Lecture:45, Tutorial :15, Total:60

TEXT BOOK:

1.	Khandpur R.S," Handbook of Biomedical Instrumentation", 2nd Edition, Tata McGraw-Hill , New Delhi ,2017.

REFERENCES:

1.	John G. Webster, "Medical Instrumentation Application and Design", 4th Edition, John Wiley and Sons, NewYork, 2015.
2.	Andrew G. Webb, "Principles of Biomedical Instrumentation" 1st Edition, Cambridge University Press, United Kingdom, 2018
3.	Arumugam. M, "Bio-Medical Instrumentation", 2nd Edition, Anuradha Agencies, Kumbakonam, 2014.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	interpret the basic principles and phenomena of Biomedical Engineering	Understanding (K2)
CO2	record the bioelectric potentials using bio potential electrode through bio signal recording devices	Applying (K3)
CO3	measure biomedical signal parameters through medical instruments	Applying (K3)
CO4	summarize the basic principles in medical imaging techniques	Understanding (K2)
CO5	illustrate the physiological assist devices	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				2		1					2	2
CO2	3	2	1	1	1	2		1					3	3
CO3	3	2	1	1	1	2		1					3	3
CO4	3	1				2		1					2	2
CO5	3	2	1	1	1	2		1					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	20	40	40				100
CAT2	10	40	50				100
CAT3	10	40	50				100
ESE	10	40	50				100

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

22EIO03 - INDUSTRIAL AUTOMATION (Offered by Department of Electronics and Instrumentation Engineering)							
Programme & Branch	**All BE/Btech branches except Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**5**	**OE**	**3**	**1**	**0**	**4**

Preamble	To provide solution towards better control action for various process applications	
Unit – I	**Introduction To Industrial Automation:**	**9+3**
Automation – Industrial Automation vs. Industrial Information Technology – Role of automation in industry – Types of production systems – Types of Automation Systems – The Functional Elements of Industrial Automation – Industrial Sensors and Instrument Systems – Industrial Actuator Systems – Industrial Control Systems – The Architecture of Elements: The Automation Pyramid.		
Unit – II	**Programmable Logic Controllers (PLCs) An Overview:**	**9+3**
Parts of a PLC –Principle of operation. PLC Hardware Components: Discrete I/O Modules- Analog I/O modules – The Central Processing Unit (CPU) – Programming Terminal Devices. Converting Relay Schematics into PLC Ladder Programs. Programming Timers: Timer Instructions – Types of timers – On-Delay Timer Instruction – Off-Delay Timer Instruction – Retentive Timer.		
Unit – III	**Advanced PLC Programming:**	**9+3**
Programming Counters: Counter Instructions – Up-Counter – Down counter – Cascading Counters – Program Control Instructions: Master Control Reset Instruction – Subroutine Functions. Data Manipulation Instructions: Data Compare Instructions. Math Instructions: Addition Instruction – Subtraction Instruction – Multiplication Instruction – Division Instruction.		
Unit – IV	**Process Control, Network Systems, and SCADA:**	**9+3**
Types of Processes – Structure of Control Systems – On/Off Control – PID Control – Motion Control – Data Communications – Supervisory Control and Data Acquisition (SCADA) – Human Machine Interfaces (HMIs) – Introduction to DCS		
Unit – V	**Internet of Things – An Overview:**	**9+3**
Introduction – Internet of Things Definition Evaluation – IoT Architectures – IoT Data Management and Analytics – Communication Protocols – Internet of Things Applications – Security – Identity Management and Authentication – Privacy – Standardization and Regulatory Limitations.		
		Lecture:45, Tutorial:15, Total:60

TEXT BOOK:

1.	Frank D. Petruzella, “Programmable Logic Controllers”, 5th Edition, Tata McGraw Hill Education Private Limited, India, 2019 for Unit 1,2,3,4.
2.	Rajkumar Buyya & Amir Vahid Dastjerdi, "Internet of Things Principles and Paradigms", 1st Edition, Morgan Kaufmann (Imprint of Elsevier), USA, 2016 for Unit 5

REFERENCES:

1.	https://nptel.ac.in/content/storage2/courses/108105063/pdf/L-01(SM)(IA&C)%20((EE)NPTEL).pdf
2.	https://nptel.ac.in/content/storage2/courses/108105063/pdf/L-02(SM)(IA&C)%20((EE)NPTEL).pdf

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	explain the concepts about basics of automation system	Understanding (K2)
CO2	develop programming with PLC	Applying (K3)
CO3	analyze theory of operation in advanced PLC and SCADA	Applying (K3)
CO4	interpret the architectural interfaces and operation about DCS	Understanding (K2)
CO5	illustrate the advanced technologies, opportunities, challenges to bring out industry 4.0	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											2	2
CO2	3	2	1	1	1								3	3
CO3	3	2	1	1	1								3	3
CO4	3	1											2	2
CO5	3	1											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	10	40	50				100
CAT3	30	70	-				100
ESE	10	50	40				100

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

22EIO04 -PLC PROGRAMMING WITH HIGH LEVEL LANGUAGES (Offered by Department of Electronics and Instrumentation Engineering)							
Programme & Branch	**All BE/BTech branches except Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**6**	**OE**	**3**	**1**	**0**	**4**

Preamble	To develop PLC programs using high-level languages, troubleshoot and debug PLC programs	
Unit - I	**Programmable Logic Controllers (PLCs) An Overview:**	**9+3**
Introduction - Parts of a PLC - Principle of operation - PLC Hardware Components: The I/O Section - Discrete I/O Modules- Analog I/O modules - Special I/O modules - I/O Specifications – The Central Processing Unit (CPU) – Programming Devices.		
Unit - II	**Basics of PLC Programming:**	**9+3**
Program Scan – PLC Programming Languages –Instruction Addressing – Branch Instructions – NO and NC Instructions – Modes of Operations. Seal-In Circuits – Latching – Simple PLC ladder programming.		
Unit - III	**Programming Timers and Counters:**	**9+3**
Timers: On-Delay Timer Instruction – Off-Delay Timer Instruction – Retentive Timer – basic applications. Counters: Counter Instructions – Up-Counter – Down-Counter –Combining Counter and Timer Functions - basic applications.		
Unit - IV	**PLC Programming with high level languages:**	**9+3**
Review of Python syntax and data structures - Python scripts with Node-RED - communication between Node-RED and PLCs - Reading and writing data to PLC registers -IoT devices with Node-RED.		
Unit - V	**Advanced PLC Programming for Basic Applications:**	**9+3**
PLC programming with C++ - Database creation with MySQL - Automatic Door opening and closing –One way traffic light control - Motor Start-Stop Operation control- Elevator Control - Water Tank Level Control		
		Lecture:45, Tutorial:15, Total:60

TEXT BOOK:

1.	Frank D. Petruzella, "Programmable Logic Controllers", 5th Edition, Tata McGraw Hill Education Private Limited, New Delhi, 2019.

REFERENCES:

1.	John W. Webb & Ronald A. Reis, "Programmable Logic Controllers: Principles and Application", 5th Edition, Pearson Education India, India, 2015.
2.	http://instrumentation tools.com/learn-programmable-logic-controller-plc/

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped** **(Highest Level)**
CO1	describe the basic components of PLC	Understanding (K2)
CO2	interpret various programming logics and languages of PLC	Applying (K3)
CO3	develop PLC programs with times and counters	Applying (K3)
CO4	develop PLC programs with high level languages	Applying (K3)
CO5	create database for data storage and develop select applications	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											2	2
CO2	3	2	1	1	1								3	3
CO3	3	2	1	1	1								3	3
CO4	3	2	1	1	1								3	3
CO5	3	2	1	1	1								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	10	60	30				100
CAT2	10	30	60				100
CAT3	10	30	60				100
ESE	10	30	60				100

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

22EIO05 - VIRTUAL INSTRUMENTATION (Offered by Department of Electronics and Instrumentation Engineering)							
Programme & Branch	**All BE/BTech branches except Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**6**	**OE**	**3**	**1**	**0**	**4**

Preamble	Virtual instrumentation is a powerful concept for control, measuring, testing and analysis of real time problems. This course aims at giving an adequate exposure and practice in LabVIEW programming and DAQ system to overcome the limitations of classical methods.	
Unit – I	**Introduction to Virtual Instrumentation:**	**9+3**
Virtual Instrumentation- Programming Requirements- Drawbacks of Recent Approaches- Virtual Instruments Versus Traditional Instruments- Advantages of VI- Creating Virtual Instruments Using LabVIEW- Virtual Instrumentation in the Engineering Process- Graphical Programming and Textual Programming- Advantages of LabVIEW- LabVIEW Environment- Dataflow Programming- G Programming.		
Unit – II	**Basic Tools, Loops and Graphs:**	**9+3**
Front Panel-Block Diagram Tools and Palettes- Repetition and Loops: FOR Loop, While Loop, Shift Registers, Tunnels, Feedback Nodes, Local and Global Variables – Arrays-Clusters-Waveform Charts-Waveform Graphs-XY Graphs-Intensity Graphs and Charts-Digital Waveform Graph-3D Graphs.		
Unit – III	**Programming with Structures:**	**9+3**
Structures: Case Structure, Sequence Structures, Customizing Structures, Timed Structures, Formula Nodes, Event Structure, MathScript-Strings-File I/O-State Machine.		
Unit – IV	**Data Acquisition:**	**9+3**
Interface Buses: RS 232, RS422, RS485, GPIB and USB. Hardware Aspects: Signal Grounding-Signal Conditioning-Digital I/O Techniques-Data Acquisition in LabVIEW-Hardware Installation and Configuration-Components of DAQ-DAQ Signal Accessory-DAQ Assistant-DAQ Hardware- DAQ Software.		
Unit – V	**Tools and Applications:**	**9+3**
Signal processing and Analysis Tools-Control System Design and Simulation Tools-Signal, Voltage and Current measurement using general purpose DAQ Card-Bio-Medical Signal Acquisition using NI-ELVIS –Temperature Measurement.		
		Lecture:45, Tutorial:15, Total:60

TEXT BOOK:

1. S.Sumathi , P.Surekha, "LabVIEW based Advanced Instrumentation Systems", 1st Edition, Springer Berlin, Heidelberg, 2007.

REFERENCES:

1. Jovitha Jerome, "Virtual Instrumentation Using LabVIEW", 3rd Edition, PHI Learning Pvt. Ltd., New Delhi, 2012.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	explain the Virtual Instrumentation concepts	Understanding (K2)
CO2	apply structured programming concepts in developing LabVIEW programs	Applying (K3)
CO3	build LabVIEW programs using structures, nodes and state machine concepts	Applying (K3)
CO4	utilize DAQ System to solve real time problems	Applying (K3)
CO5	apply knowledge on various tools in practical works	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											2	2
CO2	3	2	1	1	1								3	3
CO3	3	2	1	1	1								3	3
CO4	3	2	1	1	1								3	3
CO5	3	2	1	1	1								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	20	50	30				100
CAT2	15	40	45				100
CAT3	15	60	30				100
ESE	20	40	40				100

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

<table>
<tr><td colspan="8">22EIO06 - INTRODUCTION TO DISTRIBUTED CONTROL SYSTEMS
(Offered by Department of Electronics and Instrumentation Engineering)</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td>Programme & Branch</td><td>All BE/BTech branches except Electronics and Instrumentation Engineering</td><td>Sem.</td><td>Category</td><td>L</td><td>T</td><td>P</td><td>Credit</td></tr>
<tr><td>Prerequisites</td><td>Nil</td><td>7</td><td>OE</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td>Preamble</td><td colspan="7">This course provides the basic concepts in Control Systems and gives an introduction to distributed control systems, its interfaces, displays and applications.</td></tr>
<tr><td>Unit - I</td><td colspan="6">Control Systems:</td><td>9</td></tr>
<tr><td colspan="8">Control System: Definition, Open loop and closed loop control system, Open loop and closed loop systems-P, PI, PD and PID controller-Signal conversions: I/P converter - Actuators: Electric and Pneumatic type-Sensors</td></tr>
<tr><td>Unit - II</td><td colspan="6">Distributed Control Systems:</td><td>9</td></tr>
<tr><td colspan="8">Evolution of Distributed Control Systems: Traditional Control System Developments – Computer-based Control System Developments – Resulting System Architecture - Emergence of the Distributed Control System architecture: Hybrid System Architecture, Central Computer System Architecture – Generalized Distributed Control System Architecture</td></tr>
<tr><td>Unit - III</td><td colspan="6">Microprocessor based Controller:</td><td>9</td></tr>
<tr><td colspan="8">Basic elements of a microprocessor based controller – Functional blocks: An introduction – Comparison of Architectures - Security design issues for the local control unit: Redundant controller designs.</td></tr>
<tr><td>Unit - IV</td><td colspan="6">DCS Operator Interfaces:</td><td>9</td></tr>
<tr><td colspan="8">Operator interfaces: Introduction – Low level operator interface – High level operator interface: Architectural alternatives, Hardware elements in the operator interface, Operator displays. Engineering interfaces: Engineering interface requirements.</td></tr>
<tr><td>Unit - V</td><td colspan="6">DCS issues and Applications:</td><td>9</td></tr>
<tr><td colspan="8">Power Plants - Water and waste water treatment plants - Cement plants – Pulp and Paper plants – Glass –making Plants – Oil and Gas Fields.</td></tr>
<tr><td colspan="8" align="right">Total:45</td></tr>
<tr><td colspan="8">TEXT BOOK:</td></tr>
<tr><td>1.</td><td colspan="7">Michael P. Lukas, "Distributed Control System", Van Nostrand Reinhold Co., Canada, 2019</td></tr>
<tr><td colspan="8">REFERENCES:</td></tr>
<tr><td>1.</td><td colspan="7">Norman S. Nise, "Control Systems Engineering", 7th Edition, Wiley-India Publishers, New Delhi, 2017.</td></tr>
<tr><td>2.</td><td colspan="7">D. Popovic and V.P.Bhatkar,’ Distributed computer control for industrial Automation’ Marcel Dekker, Inc., Newyork, 1990.</td></tr>
<tr><td>3.</td><td colspan="7">Nagrath I.J.,& Gopal M., —Control Systems Engineeringǁ, 6th Edition, New Age International Pvt. Ltd., New Delhi,2017.</td></tr>
<tr><td colspan="8"></td></tr>
</table>

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped** **(Highest Level)**
CO1	provide basic concepts in Control Systems	Understanding (K2)
CO2	describe the architecture of Distributed Control Systems	Understanding (K2)
CO3	give adequate information with respect to interfaces used in DCS	Applying (K3)
CO4	choose the operator Interfaces and displays in DCS	Applying (K3)
CO5	apply DCS for select applications	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						1		2			2	2
CO2	3	1						1		2			2	2
CO3	3	2						1		1			3	3
CO4	3	2	1	1	1			1		1			3	3
CO5	3	2	1	1	1			1		1			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	30	70					100
CAT2	20	40	40				100
CAT3	20	30	50				100
ESE	20	40	40				100

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

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22EIO07 - INSTRUMENTATION IN AIRCRAFT NAVIGATION AND CONTROL
(Offered by Department of Electronics and Instrumentation Engineering)

Programme & Branch	All BE/BTech branches except Electronics and Instrumentation Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	**Nil**	**7**	**OE**	**3**	**0**	**0**	**3**

Preamble	To discuss the concepts of aircraft instruments and cockpit layout in modern aircraft and deals with the conventional and advanced flight instruments.	
Unit – I	**Basics of Aircraft and Aircraft Instruments:**	**9**
Introduction – Control Surfaces – Forces – Moments and Angle of Attack – Engines – Avionics – Modern Aircraft System. Aircraft Instruments and their Layout – Aircraft Display Types – Quantitative and Qualitative Display – Instrument Grouping – Basic T Grouping, Glass Cockpits of Modern Aircraft.		
Unit – II	**Air Data Instruments and Directional Systems:**	**9**
Introduction to Air Data Instruments – Pitot pressure and Pitot tube – Types of Air Data Instruments – Pneumatic-type Air Data Instruments – Air Speed Indicator, Air Data Computer – International Standard Atmosphere – Air Data Instruments – Directional Systems: Magnetic Compass – Earth Magnetic Field – Flux Detector Unit.		
Unit – III	**Gyroscopic and Advanced Flight Instruments:**	**9**
Introduction – Types of Gyro – Conventional Mechanical, Vibrating Gyros, RLG, FOG – Basic Mechanical Gyro and its Properties – Directional Gyro and limitations – Gyro Horizon – Turn and Bank Indicator – Turn Coordinator – Standby Attitude Director Indicator Advanced Direction Indicators.		
Unit – IV	**Engine Instruments and Indicators:**	**9**
Introduction – Engine Speed Measurements – Electrical Tacho Generator/Indicator, Servo Type, Non-Contact Type, Optical Tachometer, Hall Effect Sensor – Torque Measurements – Electronic Torque Meter – Pressure Measurements – Engine Pressure Ratio Indicator. Engine Fuel Indicators: Fuel Quantity Indicator.		
Unit – V	**Aircraft Navigation and Safety Warning Systems:**	**9**
Introduction – Radio Navigation Aids – VHF Omni Directional Range System DME/ILS/INS/GPS – Principle of VOR operation – Distance Measuring Equipment, Instrument Landing Systems –Inertial Navigation System: Principle, Gimballed and Strap Down INS – Global Positioning System. Air Data Warning Systems.		
		Total:45

TEXT BOOK:

1.	Nagabhushana S & Sudha L K. “Aircraft Instrumentation and Systems”, 2nd Edition, I.K. International Publishing House Pvt. Ltd., New Delhi, 2013.

REFERENCES:

1.	Federal Aviation Administration (FAA), “Instrument Flying Handbook”, 1st Edition, Aviation Supplies and Academics, Washington, 2013.
2.	Megson T M G., “Aircraft Structures for Engineering Students”, 4th Edition, Elsevier Science and Technology, Great Britain, 2007.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	infer the basics of aircraft and aircraft instruments	Understanding(K2)
CO2	discuss about air data instruments and directional systems	Understanding (K2)
CO3	make use of gyroscopes for advanced flight instruments	Applying(K3)
CO4	outline the fundamentals of engine instruments and indicators	Understanding (K2)
CO5	utilize the concepts of aircraft navigation safety warning systems	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											2	2
CO2	3	1											2	2
CO3	3	2	1	1	1								3	3
CO4	3	1											2	2
CO5	3	1	1	1	1								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	30	70					100
CAT2	30	40	30				100
CAT3	30	40	30				100
ESE	30	40	30				100

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

22EIO08 - INDUSTRY 4.0 WITH INDUSTRIAL IoT
(Offered by Department of Electronics and Instrumentation Engineering)

Programme & Branch	All BE/BTech branches except Electronics and Instrumentation Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	**Nil**	**7**	**OE**	**3**	**0**	**0**	**3**

Preamble	To transform the industrial processes through the integration of modern technologies such as sensors, communication, and computational processing.	
Unit – I	**Introduction to Industrial IoT and Industry 4.0:**	**9**
Introduction - IoT Background and History, IIoT key technologies, IoT and IIoT similarities and differences – Innovations and the IIoT – Intelligent devices – Key opportunities and benefits: Digital and human workforce – Industrial Internet use-cases - Industry 4.0: Characteristics and design principles.		
Unit – II	**IIoT Architectures:**	**9**
IIoT Reference Architecture – Industrial Internet Architecture Framework – Five Functional domains – Three tier architecture topology – Connectivity: Key system characteristics, Connectivity security and functional characteristics – Functions of communication layer – Overview of Predictive Maintenance Architecture.		
Unit – III	**IIoT WAN Technologies and Protocols:**	**9**
Need of Protocols – Legacy Industrial protocols – Modern Communication protocols: Industrial Ethernet, Encapsulated Field Bus, Standard Ethernet. IIoT device Low-Power WAN optimized technologies for M2M: SigFox, LoRaWAN, nWave, Dash7, Ingenue RPMA, Low Power Wi-Fi, LTE Category-M, Weightless, Millimeter Radio.		
Unit – IV	**Industrial IoT Security and Governance:**	**9**
Introduction – Security threats and vulnerabilities of IoT – Industrial challenges – Evolution of Cyber attacks: cyber attacks and solutions – Strategic principles of cyber security – cyber security measures - Industrial IoT security architecture: IIoT architecture patterns – four Tier IIoT security model- Management risks with IIoT.		
Unit – V	**Industrial IoT Analytics and Applications:**	**9**
Software Defined Networks: Difference between SDN and NFV – Cloud and Fog - Big Data and Analytics in IIoT. Recent Technological components of Robots: Industrial Robotic applications – Industrial application of AR: Maintenance, assembly, operation and training.		
		Total:45

TEXT BOOK:

1.	Alasdair Gilchrist, “Industry 4.0: The Industrial Internet of Things”, 1st Edition, Apress Media, NewYork, 2016.

REFERENCES:

1.	Alp Ustundag and EmreCevikcan, “Industry 4.0: Managing the Digital Transformation”, Springer series in Advanced Manufacturing, Switzerland, 2018.
2.	DimitriosSerpanos and Marilyn Wolf, “Internet-of-Things (IoT) Systems, Architectures, Algorithms, Methodologies”, Springer International Publishing AG, Switzerland, 2018.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped** **(Highest Level)**
CO1	explore the basics of industrial internet of things	Understanding (K2)
CO2	interpret the concepts of various architectures and components	Understanding (K2)
CO3	design and implement protocols and sensors for IIoT	Applying (K3)
CO4	impart the knowledge of IIoT security layers	Understanding (K2)
CO5	apply IIoT in real time Industrial applications	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					2	2
CO2	3	1						1					2	2
CO3	3	2	1	1	1			1					3	3
CO4	3	1						1					2	2
CO5	3	2	1	1	1			1					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	85					100
CAT2	10	50	40				100
CAT3	5	35	60				100
ESE	10	50	40				100

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

22EIO09 - INDUSTRIAL DATA COMMUNICATION
(Offered by Department of Electronics and Instrumentation Engineering)

Programme & Branch	All BE/BTech branches except Electronics and Instrumentation Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	**Nil**	**7**	**OE**	**3**	**0**	**0**	**3**

Preamble	To educate on the basic concepts of data communication, different industrial communication protocols and wireless communication.	
Unit – I	**Serial communication:**	**9**
Serial Communication: OSI reference model – Protocols – RS-232 overview, RS-232 interface standard (CCITT V.24 interface standard) – Half-duplex operation of the RS-232 interface – Limitations – RS-485 overview – The RS-485 interface standard – RS-485 vs RS-422 – The 20 mA Current loop.		
Unit – II	**Copper Cable and Fiber Optics Cable Communication:**	**9**
Copper cable: Characteristics – Cable selection – Coaxial cables – Twisted-pair cable – Distribution/installation standards – Connector standards. Fibre optics Communication: Fiber-optic cable components – Cable parameter – Types of optical fiber – Basic cable types – Connecting fibers.		
Unit – III	**MODBUS, PROFIBUS PA/DP/FMS and TCP/IP:**	**9**
MODBUS: Modbus Overview – MODBUS protocol structure – Function codes – query response cycle, transmission mode, Message Formatting. PROFIBUS PA/DP/FMS: PROFIBUS protocol stack- The PROFIBUS communication model- Relationship between application process and communication – Communication objects. TCP/IP – TCP/IP overview: Introduction – Internet Layer Protocols (Packet Transport) – Host-to-host layer: end to end reliability. TCP/IP troubleshooting: Introduction – Common problems – Typical network layer problems – Transport layer problems.		
Unit – IV	**HART and Foundation Field Bus:**	**9**
HART: HART Introduction – HART and smart instrumentation – Physical layer, Data link and application layer – HART Commands. Foundation Field Bus: Introduction – The Physical layer and Wiring Rules, The Data link layer, The Application layer, The User layer, Error detection and diagnostics - High-speed Ethernet (HSE)		
Unit – V	**Industrial Ethernet and Wireless Communication:**	**9**
Industrial Ethernet: Introduction – 10 Mbps Ethernet – 100 Mbps Ethernet – Gigabit Ethernet – Industrial Ethernet. Wireless communication: Satellite systems – Wireless LANs- Radio and wireless communication : Introduction – components of radio link – radio spectrum and frequency allocation – Radio MODEMs.		
		Total:45

TEXT BOOK:

1.	Deon Reynders, Steve Mackay, Edwin Wright, “Practical Industrial Data Communications”, 1st Edition, Elsevier, 2005.

REFERENCES:

1.	Forouzan, Behrouz A., “Data communication and Networking”, 5th Edition, Tata McGraw-Hill, New Delhi, 2013.
2.	William L.Schweber, “Data Communications”, 1st Edition, Tata McGraw-Hall, 2009.
3.	Steve Mackay, Edwin Wright, Deon Reynders,” Practical Industrial Data Networks: Design, Installation and Troubleshooting”, 1st Edition, Elsevier, 2005.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	Make use of the essentials of the communication system and learn the serial communication interface	Understanding(K2)
CO2	Interpret knowledge about Copper cable and fiber optic cable communication	Understanding(K2)
CO3	Examine the suitability of various communication protocols	Understanding(K2)
CO4	Identify the architecture and applications of HART and Field bus	Applying (K3)
CO5	Examine the concepts of Industrial Ethernet and wireless communications	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				1							2	2
CO2	3	1				1							2	2
CO3	3	1				1							2	2
CO4	3	2	1	1	1	1							3	3
CO5	3	1				1							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	80					100
CAT2	20	80					100
CAT3	20	60	20				100
ESE	20	60	20				100

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

22EIO10 - WIRELESS INSTRUMENTATION (Offered by Department of Electronics and Instrumentation Engineering)							
Programme & Branch	**All BE/BTech branches except Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**7**	**OE**	**3**	**0**	**0**	**3**

Preamble	To impart knowledge on wireless technology for instrumentation, wireless components and its applications. To provide adequate technical information on power sources, wireless protocols and network implementation	
Unit – I	**Wireless Instrumentation Technology:**	**9**
Introduction – Instruments and Instrumentation: Measurement systems – Multiplexing structures – Wireless instruments and communication protocols – RF interfaces and examples – Networks of wireless instruments – Sensor node components: Computing subsystem – Communication subsystem – Power subsystems – Sensing subsystems.		
Unit – II	**Powering Autonomous Sensors:**	**9**
Autonomous sensors – Ambient energy sources and transducers – Energy storage units – Power considerations of wireless instruments – Energy harvesting: Solar and wind energy harvesting, RF energy harvesting, Energy harvesting from vibration, Thermal energy harvesting – Energy management techniques – Calculation for battery selection – Understanding RSSI and LQI values.		
Unit – III	**Wireless Systems/Standards for Automation:**	**9**
Wireless HART: Protocol stack – Network components – Addressing control – Coexistence techniques. ISA100.11a: Introduction – Scope – Working group of ISA 100 – Features – Sensor classes – System configuration and architecture of ISA 100.11a – Comparison between ISA100.11a and WHART protocol stacks.		
Unit – IV	**Design of Wireless Devices and LoRa:**	**9**
Wireless sensor and instrument network design – Wireless integrated network sensors – Plug-and-play sensors and networks – Industrial wireless networks and automation. Introduction – Communication Methods – Difference between LoRa and LoRaWAN – LoRaWAN architecture – LoRaWAN classes.		
Unit – V	**Wireless Sensor and Instrument Applications:**	**9**
Application specific wireless sensors and instruments – Commercial wireless sensors and instruments – Industrial wireless sensor and instrument networks – Wireless human health monitoring and environmental applications – Radio frequency identification – Consumer products and other applications – Applications in Transportation and Agriculture.		
		Total:45

TEXT BOOK:

1. John G. Webster, Halit Eren, "Measurement, Instrumentation, and Sensors Handbook", 2nd Edition, CRC Press - Taylor & Francis Group, LLC, Boca Raton, Florida, 2017

REFERENCES:

1. Subhas Chandra Mukhopadhyay, "Smart Sensors, Measurement and Instrumentation", 2nd Edition , Springer Science & Business Media, Heidelberg, Germany, 2013
2. Sunit Kumar Sen, "Fieldbus and Networking in Process Automation", 1st Edition, Taylor & Francis Group, LLC, London, 2017
3. Halit Eren, "Wireless Sensors and Instruments: Networks, Design, and Applications", 1st Edition, CRC Press, 2006

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	identify different instrumentation systems and fundamentals of wireless technology	Understanding (K2)
CO2	indicate the power sources and energy storage units used for autonomous sensors	Understanding (K2)
CO3	recognize the different wireless protocols and network standards for wireless instruments	Understanding (K2)
CO4	discover design concepts and procedure for wireless devices and LoRA	Applying (K3)
CO5	demonstrate the various applications of wireless sensor and instrument systems and networks	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											2	2
CO2	3	1											2	2
CO3	3	1											2	2
CO4	3	2	1	1	1								3	3
CO5	3	2	1	1	1		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	85					100
CAT2	15	85					100
CAT3	15	50	35				100
ESE	10	70	20				100

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

22EIO11 - INSTRUMENTATION TECHNIQUES IN AGRICULTURE (Offered by Department of Electronics and Instrumentation Engineering)							
Programme & Branch	**All BE/BTech branches except Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**7**	**OE**	**3**	**0**	**0**	**3**

Preamble	To discuss the sensing and automation technology associated with agriculture.	
Unit – I	**Necessity of Instrumentation:**	**9**
Necessity of instrumentation & control for agriculture and food processing requirement, World Agriculture Scenario, Indian Agriculture sector – A synoptic Review- Areas of Concern. Information, Interpretation and Instruction Systems – Agri Instrumentation. Introduction to Transducers – Characteristics.		
Unit – II	**Agri Transducers:**	**9**
Technology Trend – Conventional and Silicon transducers, Capacitive gauges, Silicon Displacement transducer, Silicon Temperature transducer, Silicon Pressure Transducer. Grain Moisture transducers, soil moisture transducers, Humidity transducers, pH transducers, Gas transducers, Intelligent Sensors.		
Unit – III	**Automation in Agriculture:**	**9**
Microprocessor based Grain moisture measurement- Introduction, Sensing Mechanism, I/O requirement analysis. Microprocessor based Soil Nutrient Estimation Systems- Soil nutrients and their role, collection of samples, soil nutrient estimation, sensing mechanism. Preparation of soil extract for estimation of N,P,K and S, I/O requirement Analysis. SCADA Based system for Agriculture process monitoring. Case Study : Interfacing of agri sensors with Microcontroller.		
Unit – IV	**Drip Irrigation and Precision Agriculture:**	**9**
Introduction-Sensors, Hardware block Schematic, system operation, I/O Requirement Analysis, Hardware Systems. Precision: Introduction, need for precision agriculture. Subsystem and components- GPS, Agri sensors, DAS, Communication System. Precision agriculture status – Working Philosophy.		
Unit – V	**Green House Cultivation:**	**9**
Designs and classification of greenhouse- Orientation of Greenhouse / Poly house- Components of green house- Plant growing structures/containers in green house production- Environmental factors influencing greenhouse cultivation- Media preparation and fumigation- Drip irrigation and fertigation systems greenhouse cultivation- Problem management in greenhouse cultivation.		
		Total:45

TEXT BOOK:

1.	Krishna Kant , “Microprocessor Based Agri Instrumentation”, 1st Edition, PHI Private Limited, New Delhi, 2010.

REFERENCES:

1.	Greenhouse Cultivation, Tamilnadu Agritech Portal. http://agritech.tnau.ac.in/horticulture/horti_Greenhouse%20cultivation.html
2.	Sidney Walter Reginald Cox, Filby D E , “Instrumentation in Agriculture”, Lockwood Publishers, UK, 2011.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	explain the necessity of instrumentation for agriculture	Understanding (K2)
CO2	familiarize with the Soil parameters and tranducers in agricultural instrumentation	Understanding (K2)
CO3	illustrate the techniques of agriculture using Microprocessor and SCADA	Applying(K3)
CO4	outline the fundamentals of Drip Irrigation and Precision Agriculture	Understanding (K2)
CO5	utilize the concepts of instruments in Green house cultivation	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											2	2
CO2	3	1											2	2
CO3	3	2	1	1	1								3	3
CO4	3	1											2	2
CO5	3	1											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	30	70					100
CAT2	20	60	20				100
CAT3	40	60					100
ESE	20	60	20				100

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

22EIO12 - ENVIRONMENTAL SENSORS
(Offered by Department of Electronics and Instrumentation Engineering)

Programme & Branch	**All BE/BTech branches except Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**8**	**OE**	**3**	**0**	**0**	**3**

Preamble	This course is a fundamental course on sensors, instruments and real- time systems to monitor environmental systems.	
Unit – I	**Fibre Optic Sensors:**	**9**
The need for environmental monitoring and new technology-principles of fibre optic chemical sensors: Fluorescence sensors-Raman sensors-Evanescent field sensors - fibre optic sensors for environmental applications: Air pollutants, Seawater monitoring, Ground and drinking water contamination and Soil contamination.		
Unit – II	**Integrated Optic Sensors:**	**9**
Introduction to integrated optics- Fabrication of integrated optic devices- Sensor techniques in integrated optics: Evanescent waves, Spectroscopy, Ellipsometry, Surface plasmon resonance, Light scattering - Applications of integrated optic devices for environmental sensing: An integrated optic biosensor- An integrated optic gas sensor.		
Unit – III	**Piezoelectric Sensors and Gas Analysers:**	**9**
Piezoelectric crystal theory, Instrumentation, Gas analysis, Piezoelectric aerosol sensors, Piezoelectric crystal liquid sensors, PZ sensor coatings operating in liquids. Gas analysers: Principles of operation, Differential optical absorption spectroscopy, Fourier transform IR spectroscopy, Differential absorption LIDAR, Laser-induced fluorescence, Chemiluminescent techniques.		
Unit – IV	**Monitoring of Land Pollution:**	**9**
Common contaminant types and environmental behavior: Contaminants and site use, Commonly occurring contaminant types, Factors affecting contaminant behavior - Monitoring equipment and instrumentation: Discrete monitoring: indirect determination of subsurface conditions, Discrete monitoring: direct determination of subsurface conditions, Field testing kits, Continuous and automatic monitoring.		
Unit – V	**Monitoring of Water Pollution and Air Pollution:**	**9**
Water Pollution: Continuous monitoring - Physical variables: Temperature, Conductivity, salinity and total dissolved solids, Turbidity and suspended solids, Colour. Chemical variables: Dissolved oxygen, Acidity, alkalinity and pH, Anions, Cations. Biological variables: Biochemical oxygen demand- Total organic carbon, Chemical oxygen demand. Air Pollution: Air quality standards - Characterisation of atmospheric pollutants – Air pollution sampling - Monitoring modes.		
		Total:45

TEXT BOOK:

1.	Miguel F. Acevedo, “Real-Time Environmental Monitoring Sensors and Systems**”,** 1st Edition, CRC Press, United States, 2015.

REFERENCES:

1.	Janick Artiola, Ian L. Pepper, Mark L. Brusseau, “Environmental Monitoring and Characterization”, 1st Edition, Elsevier, 2004
2.	Acevedo M.F., “Data Analysis and Statistics for Geography, Environmental Science, and Engineering”, 1st Edition, CRC press, 2013

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	identify the role of fibre optic sensors for environmental monitoring	Understanding (K2)
CO2	apply the integrated optic sensors for environmental sensing	Applying (K3)
CO3	apply the piezoelectric sensors and gas analyzers for Environmental Monitoring	Applying (K3)
CO4	identify the cases and concept of land pollution	Understanding (K2)
CO5	explain the concept of Water pollution and Air pollution	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					3						2	2
CO2	3	2	1	1	1		3						3	3
CO3	3	2	1	1	1		3						3	3
CO4	3	1					3						2	2
CO5	3	1					3						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	30	50	20				100
CAT2	30	50	20				100
CAT3	40	60					100
ESE	30	50	20				100

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

22EIO13 - POLLUTION CONTROL AND MANAGEMENT (Offered by Department of Electronics and Instrumentation Engineering)							
Programme & Branch	**All BE/BTech branches except Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**8**	**OE**	**3**	**0**	**0**	**3**

Preamble	The course will cover various aspects of pollution control, including the causes and effects of pollution, regulatory frameworks, and management strategies. Students will gain an understanding of the various types of pollutants, their sources, and the impact they have on the environment and human health.	
Unit – I	**Introduction to Pollution Control Management:**	**9**
Introduction to Pollution Control Management - Professional Codes of Ethics - Environmental Ethics - Environmental Systems Overview: Water Resource Management System - Wastewater Disposal Subsystem - Air Resource Management System.		
Unit – II	**Water Pollution:**	**9**
Water Pollutants And Their Sources - Water Pollution In Rivers - Water Pollution In Lakes - Water Pollution In Estuaries - Groundwater Pollution – Applications.		
Unit – III	**Wastewater Treatment:**	**9**
Characteristics of Wastewater - Wastewater Treatment Standards - Municipal Wastewater Treatment Systems - Land Treatment For Sustainability - Sludge Treatment - Alternative Sludge Disposal Techniques.		
Unit – IV	**Air Pollution:**	**9**
Air Pollution Perspective - Effects of Air Pollutants - Origin and Fate of Air Pollutants - Micro and Macro Air Pollution - Air Pollution Meteorology - Air Pollution Control of Stationary Sources - Air Pollution Control of Mobile Sources.		
Unit – V	**Solid Waste Management:**	**9**
Characteristics of Solid Waste - Solid waste management decision alternatives - Integrated Solid Waste Management - Collection Methods - Disposal by Municipal Solid Waste Landfill - Waste to Energy – Case study.		
		Total:45

TEXT BOOK:

1.	Mackenzie L. Davis & David A. Cornwell, "Introduction To Environmental Engineering", 5th Edition, The McGraw -Hill Series, 2013.

REFERENCES:

1.	Gilbert M. Masters Wendell P. Ela , "Introduction to Environmental Engineering and Science" 3rd Edition, Pearson Education Limited, 2014.
2.	J.Jeffrey Peirce, P.Aarne Vesilind, Ruth F.Weiner, "Environmental Pollution and Control", 4th Edition, Elsevier Science & Technology Books, 1997.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	outline the fundamentals of pollution control and management	Understanding (K2)
CO2	interpret the concepts of water pollution and control methods	Understanding (K2)
CO3	summarize the methods of wastewater treatment and waste disposal	Understanding (K2)
CO4	apply suitable method for air pollution management techniques	Applying (K3)
CO5	identify various method for solid waste management techniques	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				2		1					2	2
CO2	3	1				2		1					2	2
CO3	3	1				2		1					2	2
CO4	3	2	1	1	1	2		1					3	3
CO5	3	2	1	1	1	2		1					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	20	80					100
CAT2	20	80					100
CAT3	20	40	40				100
ESE	20	40	40				100

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

22GEO01 - GERMAN LANGUAGE LEVEL 1							
(Offered by Department of Electronics and Communication Engineering)							
Programme& Branch	**All BE/BTech Engineering and Technology Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**All**	**OE**	**4**	**0**	**0**	**4**

Preamble	This course serves as an introduction to the German language and awareness towards German lifestyle and cultural aspects of Germany and German speaking countries. One can learn to introduce oneself and able to gain the basic day to day vocabulary. On keen learning one would be able to understand the sentence structure and be able to reciprocate to basic questions	
Unit – I	**Good Day (Guten Tag)**	**12**
Greetings, Self-introduction and introducing others, Numbers, Alphabets, Countries and languages spoken. Grammar – W questions, Simple sentences, Verb conjugation and personal pronoun.		
Unit – II	**Friends & Colleague (Freund und Kollegen):**	**12**
Hobbies, Profession, Week, Months, Season and Generate Profile. Grammar – Articles, Plural, Verbs – have and to be, Yes/No questions.		
Unit – III	**n the City (In der Stadt):**	**12**
Name of places/buildings in the city, asking for directions, Understanding means of transport. Grammar – definite and indefinite articles, Negation articles and Imperative		
Unit – IV	**Food and Appointment (Essen und Termin):**	**12**
Food, Shopping, initiate conversations to understand and do shopping. Grammar – Accusative case, Verbs with Accusative. Understanding time and reciprocating, Appointments, Asking excuse, Family. Grammar – Prepositions: *am, um, von...bis,* Possessive articles- *mein, dein*.., Modal verbs- *müssen, können, wollen*		
Unit – V	**Socializing (Zeit mit Freunden):**	**12**
Planning together, Birthday, Invitation, Restaurant, looking for specific information in texts. Grammar – Separable verbs, Prepositions with Accusative case, Past tense of have and to be, Personal pronoun with Accusative.		
		Total:60

TEXT BOOK:

1.	Stefanie Dengler, Paul Rusch, Helen Schmitz, Tanja Sieber, “Netzwerk Deutsch als Fremdsprache A1–ursbuch, Arbeitsbuch und Glossar with 2 CDs”, Goyal Publishers, Delhi, 2015.

REFERENCES:

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

COURSE OUTCOMES: **On completion 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	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	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 – 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

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

22GEO02 - JAPANESE LANGUAGE LEVEL 1								
(Offered by Department of Electronics and Communication Engineering)								
Programme& Branch	**All BE/BTech Engineering and Technology Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**All**	**OE**	**4**	**0**	**0**	**4**

Preamble	The basic level of Japanese which provides understanding of Hiragana, Katakana and 55 Kanjis also enables one to greet, introduce oneself and other person and also provides the ability to understand basic day to day conversations	
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 simple sentences, asking questions, positioning differentiation and owning fundamentals – new particles and usages		
Unit – III	**Introduction of Verbs, time and place markers:**	**12**
Usage of action words in sentences and framing them – place and time markers usages – giving and receiving – omission of certain particles in a sentence.		
Unit – IV	**Introduction of Adjectives, Adverbs and usages:**	**12**
Describing nouns and verbs and framing them to relate day to day conversations- positive and negative ending of the same – introduction of the likes and dislikes expressions		
Unit – V	**Introduction to Counters and Kanji:**	**12**
How to use numbers-How to use quantifiers-Present form of adjectives and Nouns-Other necessary particles-How to use numbers and quantifiers – 55 kanji characters		
		Total:60

TEXT BOOK:

1. "MINNA NO NIHONGO–Japanese for Everyone", 2nd Edition, Goyal Publishers & Distributors Pvt. Ltd., New Delhi, 2017.

REFERENCES:

1. Margherita Pezzopane, "Try N5", 2nd Edition, Tankobon Softcover, Japan, 2017.
2. Sayaka Kurashina, "Japanese Word Speedmaster", 2nd Edition, Tankobon Softcover, Japan, 2018.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	read and understand typical expression in Hiragana and Katakana	Remembering (K1)
CO2	greet and introduce oneself and other	Understanding (K2)
CO3	communicate day to day conversations – basic level	Understanding (K2)
CO4	understand the Kanjis in Japanese Script	Understanding (K2)
CO5	comprehend concept of numbers, days, months, time and counters	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 – 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

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

22GEO03 - DESIGN THINKING FOR ENGINEERS							
(Offered by Department of Computer Science and Engineering)							
Programme & Branch	**All BE/BTech Engineering and Technology Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**5**	**OE**	**3**	**1**	**0**	**4**

Preamble	Design Thinking is human-centered problem solving tool which emphasize on empathy, collaboration, co-creation and stakeholder feedback to unlock creativity and innovation, to devises feasible and viable idea/solutions.	
Unit – I	**Design Thinking and Explore:**	**9+3**
Design Thinking: Key Principles and Mindset – Five Phases, Methods and Tools of Design Thinking – User Guide – Foundation Building for Design Thinking – **Explore**: Methods & Tools – STEEP Analysis – Strategic Priorities – Activity System – Stakeholder Mapping – Opportunity Framing.		
Unit – II	**Empathize**	**9+3**
Empathize: Methods & Tools – Field Observation – Deep User Interview – Empathy Map – User Journey Map - Need Finding – User Insights - User Persona Development.		
Unit – III	**Experiment**	**9+3**
Experiment: Methods & Tools – Ideation – SCAMPER – Analogous Inspiration – Deconstruct & Reconstruct – User Experience Journey – Prototyping– Idea Refinement.		
Unit – IV	**Engage**	**9+3**
Engage: Methods & Tools – Story Telling – Art of Story Telling – Storyboarding – Co-Creation with Users – Collect Feedback from Users.		
Unit – V	**Evolve**	**9+3**
Evolve: Methods & Tools – Concept Synthesis – Strategic Requirements –Evolved Activity Systems – Activity System Integration – Viability Analysis – Innovation Tools using User Needs, CAP, 4S – Change Management - Quick Wins.		
		Lecture:45, Tutorial:15, Total:60

TEXT BOOK:

1. Lee Chong Hwa, "Design Thinking The Guidebook", Design Thinking Master Trainers of Bhutan, 2017. (E-Book)

REFERENCES:

1. Jeanne Liedtka and Tim Ogilvie, "Designing for Growth: A Design Thinking Tool Kit for Managers", Columbia University Press, 2011.
2. Jeanne Liedtka, Tim Ogilvie, and Rachel Brozenske, "The Designing for Growth FieldBook: A Step-by-Step Project Guide", Columbia University Press, 2014.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	Construct design challenge and reframe the design challenge into design opportunity.	Applying (K3)
CO2	Interview the user, and know the feelings of users to foster deep user understanding and be able to uncover the deep user insights and needs.	Applying (K3)
CO3	Develop ideas and prototypes by brain storming using the ideation tools.	Applying (K3)
CO4	Organize the user walkthrough experience using ideal user experience journey.	Applying (K3)
CO5	Develop smart strategies & implementation plan that will deliver/achieve the idea/solution deduced from earlier phases.	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	3	3	1					3	2	1		3	1
CO2	3	3	3	1					3	2	1		3	1
CO3	3	3	3	1					3	2	1		3	1
CO4	3	3	3	1					3	2	1		3	1
CO5	3	3	3	1					3	2	1		3	1

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

ASSESSMENT PATTERN – THEORY

Tests	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT 1	10	20	70				100
CAT 2	10	15	75				100
CAT 3	10	15	75				100
ESE	10	15	75				100

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

22GEO04 - INNOVATION AND BUSINESS MODEL DEVELOPMENT								
(Offered by Department of Mechatronics Engineering)								
Programme & Branch	**All BE/BTech Engineering and Technology Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**6**	**OE**	**3**	**1**	**0**	**4**

Preamble	This course will inspire the students to think innovation concepts and ideas for business model developments.	
Unit - I	**Innovation and Design Thinking:**	**9+3**
Innovation and Creativity– Types of innovation – challenges in innovation- steps in innovation management- 7 concerns of design. Design Thinking and Entrepreneurship – Design Thinking Stages: Empathize – Define – Ideate – Prototype – Test. Design thinking tools: Analogies – Brainstorming – Mind mapping		
Unit - II	**User Study and Contextual Enquiry:**	**9+3**
Explanatory research – primary and secondary data – classification of secondary data – sources of secondary data – qualitative research – focus groups – depth interviews – analysis of qualitative data – survey methods – observations- Process of identifying customer needs –organize needs into a hierarchy –establish relative importance of the needs- Establish target specifications		
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 BMC - difference and building blocks- BMC: Patterns – Design – Strategy – Process–Business model failures: Reasons and remedies		
Unit - V	**IPR and Commercialization:**	**9+3**
Need for Intellectual Property- Basic concepts - Different Types of IPs: Copy Rights, Trademarks, Patents, Geographical Indications, Trade Secrets and Industrial Design– Patent Licensing - Technology Commercialization – Innovation Marketing		
		Lecture:45, Tutorial:15, Total:60

TEXT BOOK:

1.	Rishikesha T.Krishnan, “8 Steps To Innovation: Going From Jugaad To Excellence”, Collins India, 2013.

REFERENCES:

1.	Peter Drucker, “Innovation and Entrepreneurship”, Routledge CRC Press, London, 2014.
2.	Eppinger, S.D. and Ulrich, K.T. “Product design and development”, 7th edition, McGraw-Hill Higher Education, 2020.
3.	Alexander Osterwalder, “Business model generation: A handbook for visionaries, game changers, and challengers”, 1st edition, John Wiley and Sons; 2010
4.	Indian Innovators Association, “Patent IPR Licensing – Technology Commercialization – Innovation Marketing: Guide Book for Researchers, Innovators”, Notion Press, Chennai, 2017

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	understand innovation need and design thinking phases	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	practice the procedures for protection of their ideas' IPR	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			2						3		
CO2	3	3	3	3	2	2	2	2	3	3	3	3		
CO3	2	2	3	3	3	3	3	3	3	3	3	3		
CO4				3	2	2	2	3	3	3	3	3		
CO5				3	2	2		3	2	3	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	20	30	40	10			100
CAT2	20	30	40	10			100
CAT3	30	30	40				100
ESE	20	30	30	20			100

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

<table>
<tr><td colspan="8">22GEO05 - GERMAN LANGUAGE LEVEL 2</td></tr>
<tr><td colspan="8">(Offered by Department of Electronics and Communication Engineering)</td></tr>
<tr><td>Programme& Branch</td><td>All BE/BTech Engineering and Technology Branches</td><td>Sem.</td><td>Category</td><td>L</td><td>T</td><td>P</td><td>Credit</td></tr>
<tr><td>Prerequisites</td><td>German Language Level 1</td><td>All</td><td>OE</td><td>4</td><td>0</td><td>0</td><td>4</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td>Preamble</td><td colspan="7">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 gain 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</td></tr>
<tr><td>Unit – I</td><td colspan="6">Contacts(Kontakte):</td><td>12</td></tr>
<tr><td colspan="8">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.</td></tr>
<tr><td>Unit – II</td><td colspan="6">Accomodation(Die Wohnung):</td><td>12</td></tr>
<tr><td colspan="8">Understanding Accommodation advertisements, describing accommodation and directions, responding to an invitation, Expressing feelings, Colours. Grammar – Adjective with to be verb, Adjective with sehr/zu, Adjective with Accusative, prepositions with Dative</td></tr>
<tr><td>Unit – III</td><td colspan="6">Are you Working?(Arbeiten Sie):</td><td>12</td></tr>
<tr><td colspan="8">Daily Schedule, speaking about past, understanding Job openings advertisements, Opinions, Telephonic conversations, Speaking about Jobs. Grammar – Perfect tense, Participle II – regular and irregular verbs, Conjunctions – und, oder, aber</td></tr>
<tr><td>Unit – IV</td><td colspan="6">Clothes and Style(Kleidung und mode):</td><td>12</td></tr>
<tr><td colspan="8">Clothes, Chats on shopping clothes, reporting on past, Orienting oneself in Supermarkets, Information and research about Berlin. Grammar – Interrogative articles and Demonstrative articles, Partizip II – separable and non-separable verbs, Personal pronouns in Dative, Verbs with Dative</td></tr>
<tr><td>Unit – V</td><td colspan="6">Health and Vacation(Gesundheit und Urlaub):</td><td>12</td></tr>
<tr><td colspan="8">Personal information, Human Body parts, Sports, Understanding instructions and prompts, health tips. Grammar – Imperative with du/Ihr, Modal verbs – sollen, müssen, nicht dürfen, dürfen. Suggestions for travel, Path, Postcards, weather, Travel reports, Problems in hotel, Tourist destinations. Grammar – Pronoun: man, Question words – Wer, Wen, Was, Wem, Adverbs – Zuerst, dann, Später, Zum Schl</td></tr>
<tr><td colspan="8" align="right">Total:60</td></tr>
<tr><td colspan="8">TEXT BOOK:</td></tr>
<tr><td>1.</td><td colspan="7">Stefanie Dengler, Paul Rusch, Helen Schmitz, Tanja Sieber, “Netzwerk Deutsch als Fremdsprache A1–ursbuch, Arbeitsbuch und Glossar with 2 CDs”, Goyal Publishers, Delhi, 2015.</td></tr>
<tr><td>2.</td><td colspan="7"></td></tr>
<tr><td colspan="8">REFERENCES:</td></tr>
<tr><td>1.</td><td colspan="7">https://ocw.mit.edu – Massachusetts Institute of Technology Open Courseware</td></tr>
<tr><td>2.</td><td colspan="7">https://www.dw.com/en/learn-german - Deutsche Welle , Geramany’s International Broadcaster</td></tr>
<tr><td colspan="8"></td></tr>
</table>

COURSE OUTCOMES: On completion of the course, the students will be able to		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)

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 – 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

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

22GEO06-GERMAN LANGUAGE LEVEL 3								
(Offered by Department of Electronics and Communication Engineering)								
Programme& Branch	**All BE/BTech Engineering and Technology Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	German Language Level 2	**All**	**OE**	**3**	**0**	**0**	**3**

Preamble	This course provides enriching information about various everyday situations in personal and professional life and enhances the vocabulary and speaking ability to respond to and also seek information in those situations. It also equips one to express opinions and negotiate appointments. With diligent learning one can capture all basic grammatical structure to answer confidently in everyday situations.	
Unit – I	**All about food (Rund Ums Essen):**	**9**
Understand information about person, Speak about food, Introduce self and others, Understand and explain a picture base story, To justify something, To speak about feelings, To express opinions, To answer questions on a text, To describe a restaurant. Grammar: Possessive Articles in Dative, Yes/No questions, Reflexive verbs, Sentence with ‘weil’		
Unit – II	**School days (Nach der Schulzeit):**	**9**
Understand School reports, Speak and write comments about schooldays, To speak about habits, Understand and provide City-Tipps, To Understand School types in Germany and speak about it. Grammar: Modal verbs in Past tense, Positional Verbs, Two-way prepositions in Dativ and Akkusativ.		
Unit – III	**Media in everyday life (Medien in Alltag):**	**9**
To speak about advantages and disadvantages of Media, formulate comparisons, Express your own opinion, Talk about Movies, Understand and Write Movie reviews. Grammar: Comparative degree, Comparative Sentences with ‘Als’ and ‘Wie’, Subordinate clause with ‘dass’, Superlative degree.		
Unit – IV	**Feelings and expressions (Gefühle):**	**9**
Express thanks and congratulations, Talk about feelings, To understand information about festivals and speak about it, To describe a city, Express joy and regrets, Understand and write Blog entries, Write appropriate heading. Grammar: Subordinate Clause with ‘Wenn’, Adjectives to be used along with definite articles.		
Unit – V	**Profession and Travel (Beruf und Reisen):**	**9**
To have a conversation at ticket counter, To talk about leisure activities, To gather information from Texts, Introduce people, Express career preferences, Ideate the dream job, To prepare and make telephone calls, To understand text about Workplace. Ask for information, Express uncertainty, Understand and give directions, Understand a newspaper article, Say your own opinion, Talk about the way to work, Describe a statistic, Understand information about a trip, Talk about travel. Grammar: Adjective to be used along with indefinite articles, Prepositions, verb – ‘werden’, Subordinate clause – indirect questions, All units will include elements for reading, writing, speaking and listening.		
		Total:45

TEXT BOOK:

1.	Stefanie Dengler, Paul Rusch, Helen Schmitz, Tanja Sieber, “Netzwerk Deutsch als Fremdsprache A1–ursbuch, Arbeitsbuch und Glossar with 2 CDs”, Goyal Publishers, Delhi, 2015
2.	

REFERENCES:

1.	Rosa-Maria Dallapiazza , Eduard von Jan, Till Schonherr, “Tangram 2 (German)” , Goyal Publishers, Delhi, 2011.
2.	https://www.dw.com/en/learn-german - Deutsche Welle , Geramany’s International Broadcaster

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	understand German food style, restaurant and be able express oneself.	Remembering (K1)
CO2	understand German school system and discuss about habits and provide City-Tipps	Understanding (K2)
CO3	analyze and compare media in everyday life.	Understanding (K2)
CO4	express feelings, describe a city and write blog entries.	Understanding (K2)
CO5	seek and provide information in a professional setup, give directions to others and talk about travel	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 – 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

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

22GEO07-GERMAN LANGUAGE LEVEL 4							
(Offered by Department of Electronics and Communication Engineering)							
Programme& Branch	**All BE/BTech Engineering and Technology Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**German Language Level 3**	**All**	**OE**	**3**	**0**	**0**	**3**

Preamble	This course imparts knowledge about interacting with external world, understanding various cultural aspects, behaviour and addressing relationships in personal and professional front. It helps one to understand reports from various media and at work. Enhance learner's grammatical exposure and cover the core basic grammatical concepts which would lay the foundation to have a better hold of the language. With focused learning one should be able to read and respond to reports, write simple formal and informal letters and text messages and be able to engage in simple conversations in known situations.
Unit – I	**Learning (Lernen):**	**9**
Understanding and describing learning problems, Understanding and giving advice, Giving reasons, Understanding reports about everyday work life, Talking about everyday working life, Understanding a radio report, Understanding and making a mini-presentation. Grammar: Conjunctions- denn,weil, Konjuntiv II: Sollte(suggestions), Genitive, Temporal prepositions – bis, über + Akkusativ,ab+dativ		
Unit – II	**Athletic (Sportlich):**	**9**
Expressing enthusiasm, hope, disappointment, Understanding and writing fan comments, Formulating follow-ups, Making suggestions and reacting, Making an appointment, Understanding a report about an excursion, Understanding difficult texts, Introducing a tourist attraction. Grammar: Conjunctions – deshalb, trotzdem, Verbs with Dativ and Akkusativ		
Unit – III	**Living Together (Zusammen Leben):**	**9**
To complain, apologize & give in, As for something, Understand experience reports, Report on the past, Talk about pets, Respond to information, Write and correct a story. Grammatik: Konjunctiv II- könnte, Subordinate clauses – als and Wenn.		
Unit – IV	**Good Entertainment (Gute Unterhaltung):**	**9**
Talk about music style, Buy concert tickets, Introduce a musician / band, Understand newspaper reports, Give more detailed information about a person, Understand information about painting, Understand description of a picture, Describe a picture. Grammatik: Interrogative Articles: Was fuer eine? , Pronouns – man/jemand/niemand and alles/etwas/nichts , Relative sentences in Nominativ		
Unit – V	**Passage of time and Culture (Zeitablauf & Kultur):**	**9**
Talk about wishes, Express wishes, Give Suggestions, Understand a conversation, Plan something together, To ask others something, Understand a text, Exchange information, Talk about proverbs, write a story. Understand information about other cultures, Discuss about behavior, Express intentions, Use the appropriate salutation, Understand tips in a text, Talk about forms of addressing others, Give more information, Discuss about clichés and write about them. All units will include elements for reading, writing, speaking and listening. Grammatik: Konjunctiv II (Wishes, Suggestions), Verbs with prepositions, W- questions with prepositions, Relative sentences in Akkusativ, Subordinate clauses with damit and Um…Zu.		
		Total:45

TEXT BOOK:

1.	Stefanie Dengler, Paul Rusch, Helen Schmitz, Tanja Sieber, "Netzwerk Deutsch als Fremdsprache A1–ursbuch, Arbeitsbuch", Goyal Publishers, Delhi, 2015.

REFERENCES:

1.	Rosa-Maria Dallapiazza, Eduard von Jan, Till Schonherr, "Tangram 2 (German)", Goyal Publishers, Delhi, 2011.
2.	https://www.dw.com/en/learn-german - Deutsche Welle, Geramany's International Broadcaster

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	leverage learning in Workplace, understanding reports and make presentation.	Remembering (K1)
CO2	reciprocate to different situations, make appointment and understand texts.	Understanding (K2)
CO3	handle relationships and respond appropriately to exchange information	Understanding (K2)
CO4	familiarize to various channels of entertainment	Understanding (K2)
CO5	know about various cultural aspects, usage of proverbs and cliches.	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 – 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

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

<table>
<tr><td colspan="8">22GEO08 - JAPANESE LANGUAGE LEVEL 2</td></tr>
<tr><td colspan="8">(Offered by Department of Electronics and Communication Engineering)</td></tr>
<tr><td>Programme& Branch</td><td>All BE/BTech Engineering and Technology Branches</td><td>Sem.</td><td>Category</td><td>L</td><td>T</td><td>P</td><td>Credit</td></tr>
<tr><td>Prerequisites</td><td>Japanese Language Level 1</td><td>All</td><td>OE</td><td>4</td><td>0</td><td>0</td><td>4</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td>Preamble</td><td colspan="7">The basic level of Japanese which provides understanding of Hiragana, Katakana and 110 Kanjis and provides the ability to understand basic conversations and also enables one to request other person and also understand Casual form</td></tr>
<tr><td>Unit – I</td><td colspan="6">Introduction to groups of verbs:</td><td>12</td></tr>
<tr><td colspan="8">tai form-Verb groups-te form-Give and ask permission to do an action-Present continuous form-Restrict other person from doing an action-nouns-Basic Questions</td></tr>
<tr><td>Unit – II</td><td colspan="6">Introduction to Casual Form:</td><td>12</td></tr>
<tr><td colspan="8">nai form-Dictionary form-ta form-Polite style and Casual style differences-Conversation in plain style-Place of usage of Polite style and Casual style</td></tr>
<tr><td>Unit – III</td><td colspan="6">Express opinions and thoughts:</td><td>12</td></tr>
<tr><td colspan="8">Introduction to new particle-Express someone one’s thought-Convey the message of one person to another-Ask someone if something is right -Noun modifications</td></tr>
<tr><td>Unit – IV</td><td colspan="6">Introduction to If clause and remaining Kanjis:</td><td>12</td></tr>
<tr><td colspan="8">If clause tara form-Express gratitude for an action done by other person-Hypothetical situation-Particles to use in case of Motion verbs-50 Kanjis</td></tr>
<tr><td>Unit – V</td><td colspan="6">Introduction to giving and receiving with te form and “when, even if” usages:</td><td>12</td></tr>
<tr><td colspan="8">Providing to and getting from differences - Understanding of situations and framing sentences using when and even if..etc.</td></tr>
<tr><td colspan="8" align="right">Total:60</td></tr>
<tr><td colspan="8">TEXT BOOK:</td></tr>
<tr><td>1.</td><td colspan="7">“MINNA NO NIHONGO–Japanese for Everyone”, 2nd Edition, Goyal Publishers & Distributors Pvt. Ltd., New Delhi, 2017</td></tr>
<tr><td colspan="8">REFERENCES:</td></tr>
<tr><td>1.</td><td colspan="7">Margherita Pezzopane, “Try N5”, 2nd Edition, Tankobon Softcover, Japan, 2017.</td></tr>
<tr><td>2.</td><td colspan="7">Sayaka Kurashina, “Japanese Word Speedmaster”, 2nd Edition, Tankobon Softcover, Japan, 2018.</td></tr>
<tr><td colspan="8"></td></tr>
</table>

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	differentiate groups of verbs and its forms	Remembering (K1)
CO2	understand Polite form and Casual form of Japanese	Understanding (K2)
CO3	comprehend personal communication and express greetings	Understanding (K2)
CO4	understand the Kanjis in Japanese Script and If clause	Understanding (K2)
CO5	comprehend concept of “even if”, “when” and job-related information	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 – 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

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

22GEO09 - JAPANESE LANGUAGE LEVEL 3								
(Offered by Department of Electronics and Communication Engineering)								
Programme& Branch	**All BE/BTech Engineering and Technology Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Japanese Language Level 2**	**All**	**OE**	**3**	**0**	**0**	**3**

Preamble	The intermediate level of Japanese which provides understanding of all forms ofverbs, adverbs, conjunctions, etc. which includes 150 Kanji's and provides the ability to comprehend conversations encountered in daily life	
Unit – I	**Introduction to Potential verbs:**	**9**
Causes and Reasons-Favouring Expressions-Expressing a State-Potential Verb Sentences-Simultaneous actions-Verb Groups-te Form-Customary Actions-Nouns-Basic Questions and Kanji's.		
Unit – II	**Introduction to Transitive and Intransitive verbs:**	**9**
Consequence of verbs- Embarrassment about Facts- Consequence of Verbs with an Intentions-Affirmative Sentences- Conjunctions-Basic Questions and kanji's.		
Unit – III	**Introduction to Volitional forms:**	**9**
Expressions of Speakers Intention-Expressing Suggestion or Advice-Usage of Adverbs and Quantifiers-Basic Questions and kanji's.		
Unit – IV	**Introduction to Imperative and Prohibitive verbs:**	**9**
Commanding person- Interrogatives-Expressions of Third Person-Actions and its Occurrence - Possibilities of an Action-Changing of States Basic Questions and Kanji's.		
Unit – V	**Introduction to Conditional form and Passive verbs:**	**9**
Description of Requirement and Speaker's Judgement, HabitualActions, Directions and suggestions-Passive forms of Verbs-Basic Questions and Kanji's.		
		Total:45

TEXT BOOK:

1.	"MINNA NO NIHONGO–Japanese for Everyone", 2nd Edition, Goyal Publishers & Distributors Pvt. Ltd., New Delhi, 2017.

REFERENCES:

1.	Margherita Pezzopane, "Try N5", 2nd Edition, Tankobon Softcover, Japan, 2017.
2.	Sayaka Kurashina, "Japanese Word Speedmaster", 2nd Edition, Tankobon Softcover, Japan, 2018.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	read and understand BasicVocabularies.	Remembering (K1)
CO2	understand Conversations used in daily life.	Understanding (K2)
CO3	comprehend personal communication and express greetings.	Understanding (K2)
CO4	understand the Kanji's in Japanese Script.	Understanding (K2)
CO5	comprehend Coherent conversations in everyday situations.	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 – 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

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

22GEO10 -JAPANESE LANGUAGE LEVEL 4								
(Offered by Department of Electronics and Communication Engineering)								
Programme& Branch	**All BE/BTech Engineering and Technology Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**JAPANESE LANGUAGE LEVEL 3**	**All**	**OE**	**3**	**0**	**0**	**3**

Preamble	The intermediate level of Japanese provides understanding of expressions of verbs, its pattern, Relationships which also includes 150 Kanji's and also provides the ability to understand relationship among the people.	
Unit – I	**Introduction to Reasoning:**	**9**
Causes and Sequences-Causes and Effects-Interrogative Patterns-Adjective as a Noun -Basic Questions and Kanji's		
Unit – II	**Introduction to Exchanging of things:**	**9**
Expressions for Giving and Receiving of Things-Polite Expression of Request-Indicating a Purpose of Actions-Basic Quantifiers-Basic Questions and kanji's.		
Unit – III	**Introduction to States of an Action:**	**9**
Sentence Pattern to Indicate Appearance-Degree of Action and State-Adjectives as Adverbs- Convey information -Basic Questions and kanji's.		
Unit – IV	**Introduction to Causative Verbs:**	**9**
Causative Forms of Verbs-Asking Opportunity to do something-Hypothetical Questions-Judgement and Course of an actions-Basic Questions and Kanji's.		
Unit – V	**Introduction to Relationship in Social Status:**	**9**
Honorific expressions- Respectful expressions- Humble expressions-Polite expressions-Basic Questions and Kanji's.		
		Total:45

TEXT BOOK:

1.	"MINNA NO NIHONGO–Japanese for Everyone", 2nd Edition, Goyal Publishers & Distributors Pvt. Ltd., New Delhi, 2017.

REFERENCES:

1.	Margherita Pezzopane, "Try N5", 2nd Edition, Tankobon Softcover, Japan, 2017.
2.	Sayaka Kurashina, "Japanese Word Speedmaster", 2nd Edition, Tankobon Softcover, Japan, 2018.

COURSE OUTCOMES: On completion 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)

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 – 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

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

22GEO11 - FRENCH LANGUAGE LEVEL 1							
(Offered by Department of Electronics and Communication Engineering)							
Programme& Branch	**All BE/BTech Engineering and Technology Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Fundamentals of French Language**	**All**	**OE**	**4**	**0**	**0**	**4**

Preamble	This course provides a foundation of the French language as well as an understanding of the French culture and lifestyle of France and other French-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	**Introduction**	**12**
French and French culture, alphabets, pronunciation, accents, rules, and terms for pronunciation (mas-fem), Salutations, numbers.		
Unit – II	**Daily Life**	**12**
Subject Pronoun, Francophonie's, adjectives – colors, week, months, seasons.		
Unit – III	**Articles and Verbs**	**12**
Articles - Indefinite, definite, partitive, and contracted, (examples), introductions to verbs, 1st group of verb		
Unit – IV	**In the City**	**12**
2nd group of verbs, irregular verbs (avoir, etre, faire …..) present yourself & negative sentences. (faire and Jouer verb with the expressions)		
Unit – V	**Food and Culture**	**12**
Prepositions – preposition of places (country, cities and etc), Imperative mode, invitations, culture – food (wine, cheese ….) Future (recent future)		
		Total:60

TEXT BOOK:

1.	A1 – saison

REFERENCES:

1.	Apprenons les francais – 0 and 1
2.	Grammaire – langue et de civilization francaises – Mauger G, Les idees – 0 and 1

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	Understand the grammatical structure of the language and introduce self to others.	Remembering (K1)
CO2	Understand basic verbs and appropriate vocabulary.	Understanding (K2)
CO3	Ask for directions and arrange for transportation, etc, as needed.	Understanding (K2)
CO4	Understand the food habits of France and ask for appointments	Understanding (K2)
CO5	Learn to socialize in French-speaking countries	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		**2**
CO2								1	2	3		3		2
CO3								1	2	3		3		2
CO4								1	2	3		3		2
CO5								1	2	3		3		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

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

<table>
<tr><td colspan="8">22GEO12 -FRENCH LANGUAGE LEVEL 2</td></tr>
<tr><td colspan="8">(Offered by Department of Electronics and Communication Engineering)</td></tr>
<tr><td>Programme& Branch</td><td>All BE/BTech Engineering and Technology Branches</td><td>Sem.</td><td>Category</td><td>L</td><td>T</td><td>P</td><td>Credit</td></tr>
<tr><td>Prerequisites</td><td>Fundamentals of French Language</td><td>All</td><td>OE</td><td>4</td><td>0</td><td>0</td><td>4</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td>Preamble</td><td colspan="7">This course is designed to assist students in developing vocabulary in accordance with the Common European Framework of Reference for Languages at the A2 level. This course will aid in the integration of basic grammar structures as well as the acquisition of vocabulary necessary to comprehend and respond in everyday circumstances. The learner will be able to develop a thorough comprehension of French grammar and confidently express themselves in everyday circumstances.</td></tr>
<tr><td>Unit – I</td><td colspan="6">French and You</td><td>12</td></tr>
<tr><td colspan="8">Habits, Strengths & Weakness, Recommendations, Sentiments, Motivations, about favorite films and Types of screens in the movie world, Verbs (Regulars and irregulars), Reflexive Verbs, Prepositions</td></tr>
<tr><td>Unit – II</td><td colspan="6">Eat and Repeat</td><td>12</td></tr>
<tr><td colspan="8">Favorite foods, Recopies, Types of meals, Describing House and Kitchen, Presentation of the recipe, Comparatives, Possessive pronouns, Present continuous tense, Simple conditional form</td></tr>
<tr><td>Unit – III</td><td colspan="6">Vacation</td><td>12</td></tr>
<tr><td colspan="8">Invitations, presentation, Greetings, Goodbyes, Activities on vacation, past experiences, Describing favorite place, Recommendations on various tours, Past perfect, Past imperfect tense</td></tr>
<tr><td>Unit – IV</td><td colspan="6">Likes and Views</td><td>12</td></tr>
<tr><td colspan="8">Favorite persons & things, Giving advice, Experience, Moods, Illness, Discomforts, Symptoms, Roleplay (Doctor & Patient, Guide & Tourist, Pharmacist & Patient), Past perfect, Past indefinite, Imperative</td></tr>
<tr><td>Unit – V</td><td colspan="6">Then and Now</td><td>12</td></tr>
<tr><td colspan="8">Habits, customs, circumstances of the past and present, Debates on past and present situations and feelings. Past imperfect tense, Past perfect and Present comparatives.</td></tr>
<tr><td colspan="8" align="right">Total:60</td></tr>
<tr><td colspan="8">TEXT BOOK:</td></tr>
<tr><td>1.</td><td colspan="7">A2 – Saison</td></tr>
<tr><td colspan="8">REFERENCES:</td></tr>
<tr><td>1.</td><td colspan="7">Apprenons les francais – 0 and 1</td></tr>
<tr><td>2.</td><td colspan="7">Grammaire – langue et de civilization francaises – Mauger G .Les idees – 0 and 1</td></tr>
<tr><td colspan="8"></td></tr>
</table>

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	Understand the French language in deep and its usage	Remembering (K1)
CO2	Preparation of their Favorite recipes, Know the Objects used in Kitchen and house.	Understanding (K2)
CO3	Converse about their vacation, their Favorite Destination	Understanding (K2)
CO4	Understand complex verbs and be able to communicate about their past experiences	Understanding (K2)
CO5	Know the difference between Past and Present and Compare them.	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 – 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

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

22GEO13- FRENCH LANGUAGE LEVEL 3							
(Offered by Department of Electronics and Communication Engineering)							
Programme& Branch	**All BE/BTech Engineering and Technology Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Fundamentals of French Language**	**All**	**OE**	**3**	**0**	**0**	**3**
Preamble	This course gives knowledge regarding a variety of personal and professional circumstances, as well as improving vocabulary and speaking abilities to reply to and seek information in those settings. It also gives you the ability to articulate yourself and arrange appointments. With perseverance, one can master all of the essential grammatical structures needed to respond confidently in everyday circumstances. It almost gives you an idea of how Natives communicate.						
Unit – I	**Start Over**						**9**
Use of periphrases, Discuss a day in life, work, problems in the world, Predictions about the future (actions and situations), Hypothetical situations, Imperfect and future tense.							
Unit – II	**Prohibitions and More**						**9**
Prohibitions, Obligations, Habits to change, social customs, Use of the 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**						**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							
Unit – IV	**Travel and Communication**						**9**
Talk about Tours, Types of tourism and communication, Send messages, petitions, Talk to people on the telephone, Roleplay (Tourists and Guide, Tourists and Travel agents), Past Pluscumperfect, All Past tenses.							
Unit – V	**Let's Talk**						**9**
Expression of Interests, Sentiments, Feelings, Sensations, Manias etc. Certain suggestions to make a better future, the use of superlatives, Exclamatory phrases, subjunctives.							
							Total:45

TEXT BOOK:

1.	B1 – Saison

REFERENCES:

1.	Apprenons les francais – 0 and 1
2.	Grammaire – langue et de civilization francaises – Mauger G Les idees – 0 and 1

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	Learn on Future tense.	Remembering (K1)
CO2	Understand Permissions and Prohibitions.	Understanding (K2)
CO3	Knowing about Letter writing, Creating Ads, Expressing Desires, and Instructing Others.	Understanding (K2)
CO4	Understanding rules for travel and Enhancing communications.	Understanding (K2)
CO5	Expressing the feelings and emotions using advanced grammar	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		**2**
CO2								1	2	3		3		2
CO3								1	2	3		3		2
CO4								1	2	3		3		2
CO5								1	2	3		3		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

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

22GEO14 - SPANISH LANGUAGE LEVEL 1								
(Offered by Department of Electronics and Communication Engineering)								
Programme& Branch	**All BE/BTech Engineering and Technology Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Fundamentals of Spanish Language**	**All**	**OE**	**4**	**0**	**0**	**4**

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**
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, Animals, Professions, Parts of the body, Opinions on family cultures, Articles – Definite and Indefinite, Hobbies, Regular and Irregular verbs.	
Unit – IV	**In the City (En la Cuidad):** **12**
Buildings in the city, Name of the places, asking for directions, Helping each other, Description of house and its components, Modes of Transport, Grammar - Possessive articles, prepositions	
Unit – V	**Food and Culture(La comida y cultura):** **12**
Food (types and varieties) , shopping, ordering at a restaurant, inviting to parties, Roleplay (as diner and customer, salesman and customer…etc.) Past tense (all three tenses-Past Participle, Indefinite past and past imperfect- (to be and to have)	
	Total:60

TEXT BOOK:

1.	Chicos Chicas Libro de Alumno nivel 1, Ma Angeles Palomino , edelsa, GRUPO DIDASCALIA, S.A., plaza cuidad de salta,3-28043 MADRID(ESPANA).

REFERENCES:

1.	https://nuevadelhi.cervantes.es/en/spanish_courses/students/spanish_general_courses/spanish_courses_level_a1.htm

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	understand the grammatical structure of the language and introduce self to others.	Remembering (K1)
CO2	understand basic verbs and appropriate vocabulary.	Understanding (K2)
CO3	ask for directions and arrange for transportation, etc, as needed.	Understanding (K2)
CO4	understand the food habits of Spain and Latin countries and ask for appointments	Understanding (K2)
CO5	learn to socialize in Spanish speaking countries	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		**2**
CO2								1	2	3		3		2
CO3								1	2	3		3		2
CO4								1	2	3		3		2
CO5								1	2	3		3		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

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

22GEO15 - SPANISH LANGUAGE LEVEL 2							
(Offered by Department of Electronics and Communication Engineering)							
Programme& Branch	**All BE/BTech Engineering and Technology Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Fundamentals of Spanish Language**	**All**	**OE**	**4**	**0**	**0**	**4**
Preamble	This course aims to help the Learner to acquire the vocabulary as per theframework of Spanish language A2 level competence. This course will help to assimilate the basicgrammar structures and gain 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 Spanish grammar and confidently articulate in day today situations.						
Unit – I	**Spanish and You (El Español y tú)**						**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 (**Comer y repetir**)**						**12**
Favorite foods, Recipies, Types of meals, Describing House and Kitchen, Presentation of recipe, Comparatives, Possessive pronouns, Present continuous tense, Simple conditional form							
Unit – III	**Its Vacation Time (**Tiempo de vacaciones)						**12**
Invitations, presentation, Greetings, Goodbyes, Activities on vacation, past experiences, Describing favorite place, Recommendations on various tours, Past perfect, Past imperfect tense, Usage of Todavia or No							
Unit – IV	**Likes and Views (**Gustasyvistas)						**12**
Favorite persons & things, Giving advices, Experience, Moods, Illness, Discomforts, Symptoms, Roleplay (Doctor & Patient, Guide & Tourist, Pharmacist & Patient), Past perfect, Past indefinite, Imperative							
Unit – V	**Then and Now(Antes y Ahora)**						**12**
Habits, customs, circumstances of the past and present, Debates on past and present situations and feelings. Past imperfect tense, Past perfect and Present comparatives.							
							Total:60

TEXT BOOK:

1.	AULA INTERNACIONAL 2 (A2) Jaime Corpas, AgusinGarmendia, Nuria Sanchez, Carmen Soriano Goyal Publishers and Distributors Pvt LTD, 86, UB Jawahar Nagar, Kamla Nagar, Delhi-110007.

REFERENCES:

1.	https://nuevadelhi.cervantes.es/en/spanish_courses/students/spanish_general_courses/spanish_courses_level_a1.htm

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	understand the Spanish language in deep and its usage	Remembering (K1)
CO2	prepare for their Favorite recipes, Know the Objects used in Kitchen and house.	Understanding (K2)
CO3	converse about their vacation, their Favorite Destination	Understanding (K2)
CO4	understand complex verbs and be able to communicate about their past experiences	Understanding (K2)
CO5	know the difference between Past and Present and Comparing them.	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		**2**
CO2								1	2	3		3		2
CO3								1	2	3		3		2
CO4								1	2	3		3		2
CO5								1	2	3		3		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

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

<table>
<tr><td colspan="9">22GEO16 - SPANISH LANGUAGE LEVEL 3</td></tr>
<tr><td colspan="9">(Offered by Department of Electronics and Communication Engineering)</td></tr>
<tr><td>Programme& Branch</td><td>All BE/BTech Engineering and Technology Branches</td><td>Sem.</td><td>Category</td><td>L</td><td>T</td><td>P</td><td>Credit</td></tr>
<tr><td>Prerequisites</td><td>Fundamentals of Spanish Language</td><td>All</td><td>OE</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td>Preamble</td><td colspan="7">This course provides enriching information about various everyday situations in personal and professional life and enhances the vocabulary and speaking ability to respond to and also seek information in those situations. It also equips one to express opinions and negotiate appointments. With diligent learning one can capture all basic grammatical structure to answer confidently in everyday situations. It almost gives a basic idea on how Natives speak.</td></tr>
<tr><td>Unit – I</td><td colspan="6">Start Over(Volver a Empezar)</td><td>9</td></tr>
<tr><td colspan="8">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.</td></tr>
<tr><td>Unit – II</td><td colspan="6">Prohibitions and More(Prohibiciones y mas)</td><td>9</td></tr>
<tr><td colspan="8">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.</td></tr>
<tr><td>Unit – III</td><td colspan="6">Let’s be Creative (Seamoscreatives)</td><td>9</td></tr>
<tr><td colspan="8">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.</td></tr>
<tr><td>Unit – IV</td><td colspan="6">Travel and Communication (Viajar y comunicar)</td><td>9</td></tr>
<tr><td colspan="8">Talk about Tours, Types of tourism and communication, Send messages, petitions, Talk to people on telephone, Role play(Tourists and Guide, Tourists and Travel agents), Past Pluscumperfect, All Past tenses.</td></tr>
<tr><td>Unit – V</td><td colspan="6">Let’s Talk(Hablemos)</td><td>9</td></tr>
<tr><td colspan="8">Expression of Interests, Sentiments, Feelings, Sensations, Manias etc. Certain suggestions to make a better future, use of superlatives, Exclamatory phrases, subjunctive.</td></tr>
<tr><td colspan="8" align="right">Total:45</td></tr>
<tr><td colspan="8">TEXT BOOK:</td></tr>
<tr><td>1.</td><td colspan="7">Aula International 3 (B1) [Paperback] Jaime Corpas, Agusin Garmendia, Nuria Sanchez, Carmen Soriano Goyal Publishers and Distributors Pvt LTD, 86, UB Jawahar Nagar, Kamla Nagar, Delhi-110007.</td></tr>
<tr><td colspan="8">REFERENCES:</td></tr>
<tr><td>1.</td><td colspan="7">https://nuevadelhi.cervantes.es/en/spanish_courses/students/spanish_general_courses/spanish_courses_level_a1.htm</td></tr>
<tr><td colspan="8"></td></tr>
</table>

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	learn on Future tense.	Remembering (K1)
CO2	understand about Permissions and Prohibitions.	Understanding (K2)
CO3	knowing about Letter writing, Creating Ads, Expressing Desires and Instructing Others.	Understanding (K2)
CO4	understanding rules for travel and Enhance communications.	Understanding (K2)
CO5	expressing the feelings and emotions using advanced grammar	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		**2**
CO2								1	2	3		3		2
CO3								1	2	3		3		2
CO4								1	2	3		3		2
CO5								1	2	3		3		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

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

<table>
<tr><td colspan="8">22GEO17 - ENTREPRENEURSHIP DEVELOPMENT</td></tr>
<tr><td colspan="8">(Offered by Department of Mechatronics Engineering)</td></tr>
<tr><td>Programme & Branch</td><td>All BE/BTech Engineering and Technology Branches</td><td>Sem.</td><td>Category</td><td>L</td><td>T</td><td>P</td><td>Credit</td></tr>
<tr><td>Prerequisites</td><td>Engineering Economics & Management</td><td>7</td><td>OE</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td>Preamble</td><td colspan="7">The purpose of this course to create entrepreneurial awareness among engineering students.</td></tr>
<tr><td>Unit – I</td><td colspan="6">Entrepreneurship Concepts:</td><td>9</td></tr>
<tr><td colspan="8">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</td></tr>
<tr><td>Unit – II</td><td colspan="6">Entrepreneurial Ventures and opportunity assessment:</td><td>9</td></tr>
<tr><td colspan="8">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.</td></tr>
<tr><td>Unit – III</td><td colspan="6">Business Plan:</td><td>9</td></tr>
<tr><td colspan="8">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 formulation - Presentation of the Business Plan: The ‘Pitch’- case studies</td></tr>
<tr><td>Unit – IV</td><td colspan="6">Financing and accounting:</td><td>9</td></tr>
<tr><td colspan="8">Forms of entrepreneurial capital – Sources of Financial capital: debt financing- Commercial banks and other sources, equity financing: Initial Public offering (IPO), Private placement - Venture capitalists - Angel investors-New forms of financing: Impact investors, Micro-financing, Peer-to-Peer Lending, Crowd funding - Natural capital. Preparing Financial Budget, Break even analysis, Taxation-Direct and indirect taxes, Insolvency and Bankruptcy- Case Study</td></tr>
<tr><td>Unit – V</td><td colspan="6">Small Business Management:</td><td>9</td></tr>
<tr><td colspan="8">Definition of Small Scale Industries: Strengths and Weaknesses, Sickness in Small Enterprises: Symptoms -Causes and remedies- Indian Startup Ecosystem – Institutions supporting small business enterprises, Business Incubators – Government Policy for Small Scale Enterprises - Growth Strategies in small industry – Expansion, Diversification, Joint Venture, Merger, FDI and Sub-Contracting</td></tr>
<tr><td colspan="8" align="right">Total:45</td></tr>
</table>

TEXT BOOK:

1.	Donald F. Kuratko,”Entrepreneurship: Theory, Process, Practice”, 11th Edition, Cengage Learning, Boston, 2020.

REFERENCES:

1.	Robert D. Hisrich, Michael P. Peters & Dean A. Shepherd, Sabyasachi Sinha "Entrepreneurship", 11th Edition, McGraw Hill, Noida, 2020.
2.	Charantimath Poornima .M, "Entrepreneurship Development and Small Business Enterprises", 3rd Edition, Pearson Education, Noida, 2018.
3.	Gordon E & Natarajan K, "Entrepreneurship Development", 6th Edition, Himalaya Publishing House, Mumbai, 2017.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	understand the importance of entrepreneurship and demonstrate the traits of an entrepreneur	Applying (K3)
CO2	identify suitable entrepreneurial ventures and business opportunity	Applying (K3)
CO3	assess the components of business plan	Analyzing (K4)
CO4	appraise the sources of finance and interpret accounting statements	Applying (K3)
CO5	interpret the causes of sickness of small scale enterprises and its remedies	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						2	2	1	1		3	2		
CO2	1	2	2	2		2	2	1	1		3	2		
CO3	2	2	2	2	2	2	2	2	2	2	3	2		
CO4	1	1	2	1		2	1	1	1	2	3	2		
CO5	1	1	2	1		2	1	1	1	2	3	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	40	40				100
CAT2	20	30	30	20			100
CAT3	30	30	40				100
ESE	10	30	40	20			100

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

22GEX01 – NCC Studies (Army Wing) – I								
(Offered by Department of Electrical and Electronics Engineering)								
Programme & Branch	**All BE/BTech Engineering and Technology Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**5 / 6**	**OE**	**3**	**0**	**2**	**4**

Preamble	This course is designed especially for NCC Cadets. This course will help develop character, camaraderie, discipline, secular outlook, the spirit of adventure, sportsman spirit and ideals of selfless service amongst cadets by working in teams, learning military subjects including weapon training.	
Unit - I	**NCC Organisation & National Integration**	**9**
NCC Organisation – History of NCC- NCC Organisation- NCC Training- NCC Uniform – Promotion of NCC cadets – Aim and advantages of NCC Training- NCC badges of Rank- Honours and Awards – Incentives for NCC cadets by central and state govt. National Integration- Unity in diversity- contribution of youth in nation building- national integration council- Images and Slogans on National Integration.		
Unit - II	**Basic physical Training & Drill**	**9**
Basic physical Training – various exercises for fitness(with Demonstration)-Food – Hygiene and Cleanliness. Drill- Words of commands- position and commands- sizing and forming- saluting- marching- turning on the march and wheeling- saluting on the march- side pace, pace forward and to the rear- marking time- Drill with arms- ceremonial drill- guard mounting. (WITH DEMONSTRATION)		
Unit - III	**Weapon Training**	**9**
Main Parts of a Rifle- Characteristics of 5.56mm INSAS rifle- Characteristics of .22 rifle- loading and unloading – position and holding- safety precautions – range procedure- MPI and Elevation- Group and Snap shooting- Long/Short range firing(WITH PRACTICE SESSION) - Characteristics of 7.62mm SLR- LMG- carbine machine gun.		
Unit - IV	**Social Awareness and Community Development**	**9**
Aims of Social service-Various Means and ways of social services- family planning – HIV and AIDS- Cancer its causes and preventive measures- NGO and their activities- Drug trafficking- Rural development programmes - MGNREGA-SGSY-JGSY-NSAP-PMGSY-Terrorism and counter terrorism- Corruption – female foeticide -dowry –child abuse-RTI Act- RTE Act- Protection of children from sexual offences act- civic sense and responsibility		
Unit - V	**Specialized Subject (ARMY)**	**9**
Basic structure of Armed Forces- Military History – War heroes- battles of Indo-Pak war- Param Vir Chakra- Career in the Defence forces- Service tests and interviews-Fieldcraft and Battlecraft-Basics of Map reading including practical.		
		Lecture :45, Practical:30, Total:75

TEXT BOOK:

1.	National Cadet Corps- A Concise handbook of NCC Cadets by Ramesh Publishing House, New Delhi, 2014

REFERENCES:

1.	Cadets Handbook – Common Subjects SD/SW published by DG NCC, New Delhi.
2.	Cadets Handbook- Specialized Subjects SD/SW published by DG NCC, New Delhi
3.	NCC OTA Precise published by DG NCC, New Delhi.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	display sense of patriotism, secular values and shall be transformed into motivated youth who will contribute towards nation building through national unity and social cohesion.	Applying (K3)
CO2	demonstrate Health Exercises, the sense of discipline, improve bearing, smartness, turnout, develop the quality of immediate and implicit obedience of orders..	Applying (K3)
CO3	basic knowledge of weapons and their use and handling.	Applying (K3)
CO4	understanding about social evils and shall inculcate sense of whistle blowing against such evils and ways to eradicate such evils	Applying (K3)
CO5	acquaint, expose & provide knowledge about Army/Navy/ Air force and to acquire information about expansion of Armed Forces, service subjects and important battles.	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	3	3	3	3				
CO2					3									
CO3	3	2	1	1										
CO4	3	2	1	1										
CO5	3	2	1	1										

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	-	-	-	-	-	-	-
CAT2	-	-	-	-	-	-	-
CAT3	-	-	-	-	-	-	-
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.						

22GEX02 - NCC STUDIES (AIR WING) – I							
(Offered by Department of Information Technology)							
Programme & Branch	**All BE/BTech Engineering and Technology Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**5 / 6**	**OE**	**3**	**0**	**2**	**4**

Preamble	This course is designed especially for NCC Cadets. This course will help develop character, camaraderie, discipline, secular outlook, the spirit of adventure, sportsman spirit and ideals of selfless service amongst cadets by working in teams, honing qualities such as self-discipline, self-confidence, self-reliance and dignity of labour in the cadets.	
Unit–I	**NCC Organization and National Integration**	**9+3**
NCC Organization – History of NCC- NCC Organization- NCC Training- NCC Uniform – Promotion of NCC cadets – Aim and advantages of NCC Training - NCC badges of Rank - Honors' and Awards – Incentives for NCC cadets by central and state govt. History and Organization of IAF - Indo-Pak War-1971 - Operation Safed Sagar. National Integration - Unity in diversity - contribution of youth in nation building - national integration council - Images and Slogans on National Integration.		
Unit–II	**Drill and Weapon Training**	**9+3**
Drill- Words of commands - position and commands - sizing and forming - saluting - marching - turning on the march and wheeling - saluting on the march - side pace, pace forward and to the rear - marking time - Drill with arms - ceremonial drill - guard mounting.(WITH DEMONSTRATION). Main Parts of a Rifle - Characteristics of .22 rifle - loading and unloading – position and holding - safety precautions – range procedure - MPI and Elevation - Group and Snap shooting - Long/Short range firing (WITH PRACTICE SESSION).		
Unit–III	**Principles of Flight**	**9+3**
Laws of motion-Forces acting on aircraft – Bernoulli's theorem - Stalling - Primary control surfaces – secondary control surfaces - Aircraft recognition.		
Unit-IV	**Aero Engines**	**9+3**
Introduction of Aero engine -Types of engine - piston engine - jet engines - Turbo prop engines-Basic Flight Instruments - Modern trends.		
Unit–V	**Aero Modeling**	**9+3**
History of aeromodeling - Materials used in Aero-modeling - Types of Aero-models – Static Models - Gliders - Controlline models - Radio Control Models - Building and Flying of Aero-models.		
		Lecture:45, Tutorial:30, Total:75

TEXT BOOK:

1.	"National Cadet Corps - A Concise handbook of NCC Cadets", Ramesh Publishing House, NewDelhi, 2014.

REFERENCES/ MANUAL / SOFTWARE:

1.	"Cadets Handbook – Common Subjects SD/SW", DGNCC, New Delhi.
2.	"Cadets Handbook – Specialised Subjects SD/SW", DGNCC, New Delhi.
3.	"NCCOTA Precise", DGNCC, New Delhi.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	build sense of patriotism, secular values and shall be transformed into motivated youth who will carry out nation building through national unity and social cohesion.	Applying (K3)
CO2	demonstrate the sense of discipline with smartness and have basic knowledge of weapons and their use and handling	Applying (K3)
CO3	illustrate various forces and moments acting on aircraft	Applying (K3)
CO4	outline the concepts of aircraft engine and rocket propulsion	Applying (K3)
CO5	design, build and fly chuck gliders/model air planes and display static models.	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	3	3	3	3				
CO2					3									
CO3	3	2	1	1										
CO4	3	2	1	1										
CO5	3	2	1	1										

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	-	-	-	-	-	-	-
CAT2	-	-	-	-	-	-	-
CAT3	-	-	-	-	-	-	-
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.						

22MBO01 - COST ACCOUNTING FOR ENGINEERS							
(Offered by Department of Management Studies)							
Programme& Branch	**All BE/BTech Engineering and Technology Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**NIL**	**5**	**OE**	**3**	**1**	**0**	**4**

Preamble	To provide an In-depth study of the Cost Accounting principles and techniques for identification, analysis and classification of costs components to facilitate decision Making.	
Unit – I	**Introduction to Cost Accounting**	**9 + 3**
Introduction to Cost Accounting: Meaning - Scope, objectives and significance of Cost Accounting its relationship with financial 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**
Material Costs: Procurement of materials – Inventory management and control – scrap, spoilage, defectives and wastage **Labour Costs:** Time Keeping, Time booking and payroll – Labour turnover – principles and methods of remuneration and incentive schemes. **Overheads:** Collection, classification and apportionment and allocation of overheads.		
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**
Features of Job Costing - Batch Costing - Preparation of Cost Sheet Under Job Costing, and Batch Costing - Process Costing - Process Loss - Normal and Abnormal Loss.		
Unit – V	**Cost Accounting Techniques**	**9 + 3**
Budget and Budgetary Control: Budgetary control as a management Tool – Installation of Budgetary control system classification of budgets – Fixed and Flexible Budgeting. **Standard Costing and Variance Analysis:** Budgetary control and standard costing – Suitability of standard costing – Standard costing as a management Tool – Cost variances – Direct material cost variances – Direct labour cost variances – Overhead variances – Sales variance.		
		Lecture: 45, Tutorial: 15, Total:60

TEXT BOOKS

1.	JawaharLal, SeemaSrivastava, Manisha Singh, “ Cost Accounting, Text, Problems and Cases”, 6th Edition, McGraw Hill Education, New Delhi, 2020.
2.	William Lanen, Shannon Anderson and Michael Maher, “Fundamentals of cost Accounting”,7th Edition, McGraw Hill Education, New Delhi, 2020.

REFERENCES

1.	M.N.Arora and PriyankaKatyal, “Cost Accounting”, 5th Edition, Vikas publishing House, New Delhi, 2023.
2.	Ravi M.Kishore, “ Cost and Management Accounting”, 6th Edition, Taxmann, New Delhi, 2021
3.	M.N.Arora, “Cost and Management Accounting”,11th Edition, Vikas Publishing, New Delhi, 2021.

COURSE OUTCOMES: **On completion 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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	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 – 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	15	35	50				100
CAT 3	15	35	50				100
ESE	25	25	50				100

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

22MBO02 Economic Analysis for Decision Making							
(Offered by Department of Management Studies)							
Programme& Branch	**All BE/BTech Engineering and Technology Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Basic understanding of differential calculus**	**6**	**OE**	**3**	**1**	**0**	**4**

Preamble	The course aims at introducing a few vital techniques required for carrying out economic analysis for making informed managerial decisions.	
Unit – I	**Economic Optimization**	**9 + 3**
Economic Optimization: Theory of firm – Business versus Economic profit – Revenue relations – Cost relations – Profit relations – Marginal versus incremental concept.		
Unit – II	**Forecasting**	**9 + 3**
Forecasting: Forecasting applications – Techniques –Naire method – Moving average – Exponential smoothing - Trend analysis – Linear Trend – Growth Trend – Sales, cost and revenue forecasting.		
Unit – III	**Production and Cost Analysis**	**9 + 3**
Production: Production function – Returns to scale and returns to factor – Total, managerial and average product – Law of diminishing returns – Optimal input usage – Production function estimation. **Cost Analysis:** Economic and Accounting costs – Time in cost analysis – Short run cost – Long run cost – cost relations – cost volume – profit analysis.		
Unit – IV	**Competitive Market Analysis**	**9 + 3**
Competitive Market Analysis: Characteristics of competitive markets – Profit maximisation – Marginal analysis in competition – competitive market supply curve – Equilibrium in competitive markets - Monopoly – Monopolistic competition.		
Unit – V	**Game theory and Competitive Strategy**	**9 + 3**
Game Theory Basics - Prisoner's Dilemma - Saddle Point - Two Person Zero Sum Game - Games without Saddle Points - Dominance Rule - Mixed Strategies.		
		Lecture: 45, Tutorial: 15, Total:60

TEXT BOOKS

1.	Mark Hirschey, “Managerial Economics”, 12th Edition, Cengage Learning, New Delhi, 2022.
2.	Geetika, PiyaliGhosh, Purba Roy Choudhury, “Managerial Economics”, 3rd Edition, McGraw Hill Education, New Delhi, 2019.

REFERENCES

1.	Gupta. G, “Managerial Economics”, 2nd Edition, McGraw Hill Education, New Delhi, 2019.
2.	Ahuja. H. L, “Principles of Microeconomics”, 22nd Edition, S. Chand Publishing, New Delhi, 2019.
3.	PanneerSelvam R, P. Sivasankaran, P. Senthilkumar., “Managerial Economics”, 1st Edition, Cengage Learning, New Delhi, 2018.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	Understand revenue, cost and profit relations and apply techniques to find best course of action.	Applying (K3)
CO2	Apply appropriate forecasting techniques for estimating sales, cost and revenue.	Applying (K3)
CO3	Understand the relation between inputs and output of production system and perform cost – volume – profit analysis	Applying (K3)
CO4	Apply market equilibrium concepts in monopoly and monopolistically competitive markets.	Applying (K3)
CO5	Understand game theory and apply in different strategic decisions	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					1	3			
CO2					2					1	3			
CO3					2					1	3			
CO4					2					1	3			
CO5					2					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	35	35	30				100
CAT2	15	45	40				100
CAT 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)							
Programme& Branch	**All BE/BTech Engineering and Technology Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Basic understanding of differential calculus**	**7**	**OE**	**3**	**1**	**0**	**4**

Preamble	Marketing analytics enables marketers to measure, manage and analyze marketing performance to maximize its effectiveness and optimize return on investment (ROI). This course exposes the students with the tools to measure customer value and apply analytic tools to various marketing decisions.	
Unit – I	**Market & Marketing Analytics**	**9 + 3**
Introduction - Introduction to marketing analytics, Models & Metrics **Market Insight** - Market sizing. **Market Segmentation** –Segmentation, Targeting & Positioning		
Unit – II	**Business & Competition**	**9 + 3**
Competitive Analysis - Competitor identification, analysis, and actions **Business Strategy** –Scenarios, Decision Model, Metrics **Business Operations** - 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**
Distribution Analytics –Characteristics, Channel evaluation and selection, Multichannel distribution and metrics. **Promotion Analytics** - Promotion budget estimation and allocation, Metrics		
Unit – V	**Sales**	**9 + 3**
Sales Analytics - Metrics for sales, profitability, and support		
		Lecture: 45, Tutorial: 15, Total:60

TEXT BOOKS

1.	Stephen Sorger, "Marketing Analytics: Strategic Models and Metrics", 1st Edition, Admiral Press, UK, 2016.
2.	Wayne L. Winston, "Marketing Analytics: Data-Driven Techniques with Microsoft Excel", 1st Edition, Wiley, New Delhi, 2018.

REFERENCES

1.	Tommy Blanchard, "Data Science for Marketing Analytics", 1st Edition, Packt Publishing, UK, 2019.
2.	Mike Grigsby, "Marketing Analytics", 2nd Edition, Kogan Page, UK, 2018.
3.	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	Understand the importance of Analytics in Marketing, size and segment the market	Understanding (K2)
CO2	Understand the Business, competition and its related decisions.	Understanding (K2)
CO3	Identify important features of a product and suitable pricing methods.	Applying (K3)
CO4	Assess Channel performance and Promotion Metrics.	Applying (K3)
CO5	Assess sales performance.	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		
CO2										2	3	1		
CO3										2	3	1		
CO4										2	3	1		
CO5										2	3	1		

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	35	65					100
CAT2	15	35	50				100
CAT 3	15	15	70				100
ESE	25	25	50				100

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

KONGU ENGINEERING COLLEGE, PERUNDURAI, ERODE-638060
(AUTONOMOUS)
BOARD OF ELECTRONICS AND INSTRUMENTATION ENGINEERING

PROGRAMME: **BE - EIE**
HONOURS DEGREE TITLE: **INTELLIGENT SENSOR TECHNOLOGY**

The following courses are identified to earn additional 18 credits to get a Honours degree with specialization in EIE.

S.No	Course Code	Course Title	Credits	Prerequisites	Semester
1.	22EIH01	Intelligent Building Automation	4	Transducers Engineering	5
2.	22EIH02	System on chip	3	Digital Logic Circuits	5
3.	22EIH03	Intelligent Technology in Industrial Automation	4	Transducers Engineering	6
4.	22EIH04	Embedded IoT	3	Microcontroller and its Applications	6
5.	22EIH05	Smart Sensors and Intelligent Instrumentation	4	Transducers Engineering	7
		TOTAL	**18**		

22EIH01- INTELLIGENT BUILDING AUTOMATION							
Programme & Branch	**BE & Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Transducers Engineering**	**5**	**Honours**	**3**	**1**	**0**	**4**

Preamble	This course discusses about the wide variety of techniques available for all building automation areas such as energy, HVAC, information, transportation, safety, security, maintenance, and facility management. This course enables scientists and engineers engaged in research on and the development and application of sensors in the building control area
Unit – I	**Building Automation System** **9+3**
Introduction–Definitions of intelligent building – Facilities management vs intelligent buildings – Technology systems and evolution of intelligent buildings – Introduction to building automation System (BAS) –The progress of BAS – Programming and monitoring platforms and environment.	
Unit – II	**BAS Communication Standards and Internet Technologies** **9+3**
BACnet and its features – Lon Works and its features– EIB and its features – Compatibility of different open protocol standards – Integration at management level – Internet protocols – use of Internet technologies at automation level – use of Internet technologies at management level – Convergence networks and total integration.	
Unit – III	**Lighting, Security and Safety Control Systems** **9+3**
Introduction to lighting control systems – Systems based on common automation protocols–Strategies for energy management and lighting control – Basic CCTV components and analogue CCTV systems – IP surveillance system – Access control systems – Burglar alarm systems.	
Unit – IV	**Control and Optimization of Air- Conditioning Systems** **9+3**
Typical control loops of the air- conditioning process – Control of CAV systems: Basic control of CAV systems, Sequential split range control of AHU – Control of VAV systems: Control of VAV air handling units, VAV terminal and room temperature control – Outdoor air ventilation control and optimization – Optimal control methods used for HVAC systems – Optimal control of air side systems.	
Unit – V	**Control and Optimization of Central Chilling Systems** **9+3**
Basic working principles – Basic components and typical types – Chiller capacity control and safety interlocks – Chiller energy performance – Optimal control of central chilling systems – Optimal set point reset of chilled water supply temperature – Sequence control of multiple chiller plants: Temperature based sequence control, Bypass flow based sequence control.	
	Lecture:45, Tutorial:15, Total:60

TEXT BOOK:

1. Shengwei Wang, “Intelligent Buildings and Building Automation”, 1st Edition, Spon Press (an imprint of the Taylor & Francis Group), 2010.

REFERENCES:

1. O. Gassmann, H. Meixner, "Sensors in Intelligent Buildings", 1st Edition, Wiley-VCH Verlag GmbH, Germany, 2001.
2. NJATC, "Building Automation Control Devices and Applications", 1st Edition, American Technical Publishers, 2008.
3. Singh S. K., ‘Industrial Instrumentation and Control’, 3rd Edition, Tata McGraw Hill Publishing Company, New Delhi, 2009.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	describe the functions intelligent building automation system	Understanding (K2)
CO2	summarize the need of BAS Communication Standards and Internet Technologies	Understanding (K2)
CO3	explain the different lighting, safety and security systems in building automation	Understanding (K2))
CO4	interpret the various Control and Optimization of Air- Conditioning Systems	Applying (K3)
CO5	illustrate the various Control and Optimization of Central Chilling Systems	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	2											2	2
CO2	3	2											2	2
CO3	3	3	1	1	1								2	2
CO4	3	3	1	1	1								3	3
CO5	3	3	1	1	1								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	25	75					100
CAT2	30	70					100
CAT3	10	40	50				100
ESE	20	50	30				100

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

22EIH02- SYSTEM ON CHIP								
Programme & Branch	**BE & Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Digital Logic Circuits**	**5**	**Honours**	**3**	**0**	**0**	**3**

Preamble	To infer the concepts of hardware and software with the communication, design flow, subsystems and methodologies on a chip	
Unit – I	**System-on-Chip:**	**9**
The System-on-Chip Concept -The Cast of Players- SoC Interfaces for Custom Hardware-Four Design Principles in SoC Architecture-Heterogeneous and Distributed Data Processing-Heterogeneous and Distributed Communications-Heterogeneous and Distributed Storage-Hierarchical Control.		
Unit – II	**Principles of Hardware/Software Communication**:	**9**
Connecting Hardware and Software-Synchronization Schemes-Synchronization Concepts-One-Way and Two-Way Handshake-Blocking and Non-blocking Data-Transfer-Tight and Loose Coupling. Introduction to Bus.		
Unit – III	**VLSI Sub Systems**:	**9**
Introduction- single bit addition-carry propagate addition-subtraction- multiplier input addition-Magnitude comparators-Binary counters-Serial Multiplication-low power Static RAMs.		
Unit – IV	**VLSI Design Flow :**	**9**
Introduction to Integrated Circuits-Pre-RTL Methodologies-RTL to GDS Implementation Flow-Verification Techniques-Testing Techniques-Post-GDS Processes. Chip Planning –Placement-Routing-Physical Verification and Signoff-Post-silicon Validation.		
Unit – V	**Design Methodologies**:	**9**
Microprocessor / DSPs –Programmable Logics-gate Array and Sea of Gate arrays-Cell based Design-Full Custom Design-Platform based Design-System on Chip. Mixed Signal and Custom Design Flow. Example: Portable Multimedia System- Network On Chip.		
		Total:45

TEXT BOOK:

1.	Patrick Schaumont, “ A Practical Introduction to Hardware/Software Co-design”, 2nd Edition, Springer, New York, 2012.

REFERENCES:

1.	Sneh Saurabh, “Introduction to VLSI Design Flow”, Cambridge University Press, England, 2023
2.	Neil H.E.Waste and David Money Harris,”CMOS VLSI Design - A Circuits and Systems Perspective”, 4th Edition, Addison Wesley, Boston, 2011.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	recall the basic concepts of System on Chip	Understanding (K2)
CO2	acquire the knowledge of the communication architectures used in System on Chip	Understanding (K2)
CO3	apply data path logic to design combinational and sequential circuits	Applying(K3)
CO4	make use of the design flow for design of high performance circuits	Applying(K3)
CO5	explain the various design methodologies for chip design	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				1		1					2	2
CO2	3	1				1		1					2	2
CO3	3	2	1	1	1	1		1					3	3
CO4	3	2	1	1	1	1		1					3	3
CO5	3	1				1		1					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	30	70					100
CAT2	20	60	20				100
CAT3	20	60	20				100
ESE	20	60	20				100

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

22EIH03- INTELLIGENT TECHNOLOGY IN INDUSTRIAL AUTOMATION							
Programme & Branch	**BE & Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Transducers Engineering**	**6**	**Honours**	**3**	**1**	**0**	**4**

Preamble	To impart the significance of intelligent techniques in measurements and automation.
Unit – I	**Modeling and Linearization of Intelligent Sensors**: **9+3**
Introduction –classification –smart sensors-cogent sensors – soft sensors-rough set theory – model structures: ARMAX model-artificial neural network model. Self adapting sensors - Self validating sensors: functional validation –applications. Linearization of positive and negative coefficient resistive sensors - amplifier based linearization-interpolation- piecewise linearization-artificial neural network based linearization – non-linear adaptive filter based linearization.	
Unit – II	**Intelligent Technology in Signal Analysis** : **9+3**
Introduction – types of test and metering instruments – example of intelligent instrument – structure principle of data acquired system –simulation of ADC -noise analysis technology –noise simulation model –weak signal detection. Measurement uncertainty – data processing algorithms – inverse problem and its processing – methodologies in intelligent instrument design – intelligent computing – accuracy design theory – software test – reliability engineering in intelligent instrument.	
Unit – III	**Arduino and MATLAB in Intelligent Instrument**: **9+3**
MATLAB in intelligent Instrument: Predictive maintenance - computer vision – robotics system- Arduino in intelligent Instrument: SLAM –PHM – IoT in intelligent instrument: power instrument in IoT - vector network analyser in IoT –Data communication technology: IIC bus –SPI bus – EPA bus- blue tooth communication technology in IoT. Foundational design using Proteus: 7 segment LED and matrix key design – IoT design by Proteus.	
Unit – IV	**Sensors with Artificial Intelligence**: **9+3**
Introduction -Multi dimensional intelligent sensors- AI for prognostic instrumentation – ANN based intelligent sensors – fuzzy logic based intelligent sensors- intelligent sensors standards and protocols:IEEE 1451 standard –CEBUS communication protocol for smart home –J1850 Bus – MI bus-plug-n-play smart sensor protocol.	
Unit – V	**Applications of Intelligent Sensor Technology**: **9+3**
State –of -the- art instruments of Siemens, Honeywell and ABB – fault tolerance of condition monitoring – fault analysis and diagnosis. Wearable intelligent instrument – bio-potential measurements – Mobile robot –smart car –smart UAV.	
	Lecture:45, Tutorial:15, Total:60

TEXT BOOK:

1.	Manabendra Bhuyan , “Intelligent Instrumentation –Principles and Applications”, CRC Press-Taylor &Francis group, 1st Edition, 2011
2.	Chang Jian Deng, “Modern Intelligent Instruments – Theory and Applications”, Bentham Science Publishers Pvt. Ltd, Singapore, 1st Edition, 2020.

REFERENCES:

1.	Stuart Russell and Peter Norvig, “Artificial Intelligence: A Modern Approach”, 2nd Edition, Prentice Hall, 2003.
2.	Sudip Misra, Chandana Roy, Anandarup Mukherjee," Introduction to Industrial internet of things and industry 4.0", 1st Edition, CRC press, 2021.
3.	Rich and Knight, "Artificial Intelligence", 3rd Edition, Tata McGraw Hill, 2014.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	develop modelling of instrument using intelligent technologies	Applying (K3)
CO2	apply the intelligent technologies for analyzing the signal	Applying (K3)
CO3	interface MATLAB and Arduino for intelligent sensor technology and communication	Applying (K3)
CO4	understand the applications of artificial intelligence and its protocols in sensor technology	Understanding (K2)
CO5	understand the recent trends in intelligent sensor technology in industrial applications	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	2	1	1	1								3	3
CO2	3	2	1	1	1								3	3
CO3	3	2	1	1	1								3	3
CO4	3	1											2	2
CO5	3	1											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	40	20	40				100
CAT2	40	20	40				100
CAT3	40	40	20				100
ESE	40	40	20				100

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

22EIH04- EMBEDDED IOT							
Programme & Branch	**BE & Electronics and Instrumentation Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Microcontroller and its Applications**	**6**	**Honours**	**3**	**0**	**0**	**3**

Preamble	To impart basic principles and concepts on Internet of Things technologies and its role in real time applications	
Unit – I	**Fundamentals and Applications of IoT:**	**9**
Introduction to Internet of Things (IoT) – Characteristics – IoT architecture – Architecture Layers – Functional components of IoT – IoT Technology Fundamentals – Challenges of IoT – Introduction to IIoT and its requirements.		
Unit – II	**IoT Network Protocols and Communication:**	**9**
Infrastructure protocol: Internet Protocol Version 6, Data protocols: Message Queue Telemetry Transport – Constrained Application Protocol – Advanced Message Queuing Protocol. Connectivity Technologies: RFID – ZigBEE – Bluetooth – Near Field Communication – Wireless HART – Z–Wave – 6 LoWPAN – LoRaWAN.		
Unit – III	**Sensor Networks and Cloud Computing:**	**9**
Wireless Sensor Networks – Sensor Nodes – Software Defined Networking. Machine to Machine Communication. Cloud Computing Fundamental: Components and Cloud Models – Service Model – Service Management and Security.		
Unit – IV	**IoT Physical Devices and End Points :**	**9**
Review of Python Programming – Raspberry Pi Basic Architecture – Pin Configuration – Accessing GPIO – Remote Data Logging – Integration of Sensors and Actuators with Raspberry Pi – LED, Camera, Temperature and Humidity Sensor Interfacing.		
Unit – V	**Applications of IoT:**	**9**
Smart Cities and Smart Homes Monitoring, Weather Monitoring System, Agriculture: Smart water management system, Remote Healthcare Monitoring System, Smartphone based Monitoring system (Only Block diagram Approaches)		
		Total:45

TEXT BOOK:

1.	Misra, S., Mukherjee, A., & Roy, A, "Introduction to IoT", 1st Edition, Cambridge: Cambridge University Press. 2021. (Unit I,II, III, IV,V)
2.	Arshdeep Bahga, Vijay Madisetti, "Internet of Things – A hands–on approach", 1st Edition, Universities Press, 2015. (Unit III, IV)

REFERENCES:

1.	Olivier Hersent, David Boswarthick and Omar Elloumi, "The Internet of Things: Key Applications and Protocols", John Wiley and Sons Limited, UK 2012.
2.	Arora, Sumeet, Ramachandra Gambheer, and Meenakshi Vohra, "Design of Secure IoT Systems: A Practical Approach Across Industries", 1st Edition, McGraw Hill, New York, 2021.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	understand the basic concepts of IoT and its present developments	Understanding (K2)
CO2	understand IoT communication protocols for Interfacing	Understanding (K2)
CO3	acquire knowledge about sensor networks and Cloud Computing	Understanding (K2)
CO4	implementation on IoT Physical Devices and sensor interfacing	Applying (K3)
CO5	recognize IoT applications and control	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											2	2
CO2	3	1											2	2
CO3	3	1											2	2
CO4	3	2	1	1	1								3	3
CO5	3	1											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	30	60	10				100
CAT2	30	60	10				100
CAT3	20	60	20				100
ESE	20	60	20				100

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

22EIH05- SMART SENSORS AND INTELLIGENT INSTRUMENTATION

Programme & Branch	BE & Electronics and Instrumentation Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	**Transducers Engineering**	**7**	**Honours**	**3**	**1**	**0**	**4**

Preamble	This course enhances the students to understand all the processes involved in the industries, the various unit operations and be able to apply control schemes to these processes to get the output with desired specifications	
Unit – I	**Basics of Smart Sensors and Micromachining:**	**9+3**
Introduction, Mechanical-Electronic transitions in sensing, nature of sensors, overview of smart sensing and control systems, integration of micromachining and microelectronics, introduction to micromachining, bulk micromachining, wafer bonding, surface micromachining, other micromachining techniques. Case study to build smart sensors.		
Unit – II	**MCUs and DSPs for Sensor:**	**9+3**
Introduction, MCU control, MCUs for sensor interface: Peripherals, Memory, Input / Output, Onboard ADC, Power saving capability, Local voltage or current regulation, Modular MCU design. DSP control, Software, tools and support, sensor integration. Case study for building smart sensors with MCUs and DSPs.		
Unit – III	**Sensor Communication and MEMS:**	**9+3**
Wireless zone sensing, surface acoustical wave devices, intelligent transportation system, RF-ID, Micro optics, micro-grippers, micro-probes, micro- mirrors, FEDs, communications for smart sensors - sources and standards, automotive protocols, industrial networks, office and building automation, home automation, protocols in silicon, other aspects of network communications.		
Unit – IV	**Packaging, Testing and Reliability of Smart Sensors:**	**9+3**
Introduction, Semiconductor packaging applied to sensors, hybrid packaging, packaging for monolithic sensors, reliability implications, testing smart sensors. Unit Standards for Smart Sensors: Introduction, setting the standards for smart sensors and systems, IEEE 1451.1, IEEE 1451.2, IEEE P1451.3, IEEE 1451.4, extending the systems to network.		
Unit – V	**Implications of Smart Sensor Standards and Recent Trends:**	**9+3**
Introduction, sensor plug-and-play, communicating sensor data via existing wiring, automated/remote sensing and web, process control over the internet, alternative standards, HVAC sensor chip, MCU with integrated pressure sensors, alternative views of smart sensing, smart loop.		
		Lecture:45, Tutorial:15, Total:60

TEXT BOOK:

1.	Randy Frank, “Understanding Smart Sensors”, 2nd Edition, Artech House Publications, 2013.
2.	Youn-Long Lin, “Smart Sensors and Systems”, Springer Nature, 2015

REFERENCES:

1.	G. K. Ananthasuresh, K. J. Vinoy, S. Gopalakrishnan, K. N. Bhat, V. K. Aatre, “Micro and Smart Systems: Technology and modeling”, Willey Publications, 2012.
2.	Krzysztof Iniewski, “Smart Sensors for Industrial Applications”, CRC Press, 2013.
3.	Santhosh K V, “Smart Sensors Measurements and Instrumentation”, Lecture Notes in Electrical Engineering, Springer Nature, 2021.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	describe the principle of smart sensors and process of micromachining in development of smart sensors.	Applying (K3)
CO2	apply the intelligent systems by interfacing the smart sensors to MCUs and DSPs.	Applying (K3)
CO3	apply the use of smart sensors in communication, MEMS and automation	Applying (K3)
CO4	explain the standards of smart sensors by the assessment of reliability testing and packaging	Understanding (K2)
CO5	discuss the applications of smart sensors in different fields and recent development.	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											2	2
CO2	3	2	1	1	1								3	3
CO3	3	2	1	1	1								3	3
CO4	3	1											2	2
CO5	3	2	1	1	1								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	10	40	50				100
CAT2	10	40	50				100
CAT3	10	40	50				100
ESE	10	40	50				100

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