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
ELECTRICAL AND ELECTRONICS ENGINEERING

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

KONGU
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 ELECTRICAL AND ELECTRONICS ENGINEERING

VISION

To be a centre of excellence for providing quality education in the frontier areas of Electrical and Electronics Engineering to benefit the society for the nation and beyond.

MISSION

Department of Electrical and Electronics Engineering is committed to:

MS1:	Develop innovative, competent, ethical and quality engineers to contribute for technical advancements to meet societal needs.
MS2:	Provide state-of-the-art facilities for continual improvement in teaching-learning process and research activities.
MS3:	Enrich the knowledge and skill of the students to cater to the industrial needs and motivate them to become entrepreneurs.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

Graduate of Electrical and Electronics Engineering program will:

PEO1:	Succeed in professional career by utilizing fundamental knowledge of basic sciences and engineering.
PEO2:	Design, simulate, analyze and develop Electrical and Electronics Engineering based products which are reliable, cost effective and safe.
PEO3:	Demonstrate communication skills, team work, ethics, codes of professional practice as well as an aptitude for continuous learning.

MAPPING OF MISSION STATEMENTS (MS) WITH PEOs

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

1 – Slight, 2 – Moderate, 3 – Substantial

PROGRAM OUTCOMES (POs)

Graduates of Electrical and Electronics 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 Electrical and Electronics Engineering will:	
PSO1	Comprehend and analyse electro dynamic systems using the nuances of electrical and electronics engineering to meet the industrial demands.
PSO2	Able to apply computational tools for the design, analysis and control of power systems integrated with renewable energy sources and electric vehicle to provide solutions to the real time.

MAPPING OF PEOs WITH POs AND PSOs

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

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:

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

*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:

<table>
<tr><th>Sl. No.</th><th>Category of Course</th><th>Continuous Assessment Marks</th><th>End Semester Examination Marks</th></tr>
<tr><td>1.</td><td>Theory</td><td>40</td><td>60</td></tr>
<tr><td>2.</td><td>Theory cum Practical (The distribution of marks shall be decided based on the credit weightage assigned to theory and practical components.)</td><td>50</td><td>50</td></tr>
<tr><td>3.</td><td>Practical</td><td>60</td><td>40</td></tr>
<tr><td>4.</td><td>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</td><td>100</td><td>---</td></tr>
<tr><td>5.</td><td>Project Work II Phase I / Project Work II Phase II / Internships</td><td>50</td><td>50</td></tr>
<tr><td>6.</td><td>One / Two credit Course</td><td rowspan="2">The distribution of marks shall be decided based on the credit weightage assigned</td><td rowspan="2">---</td></tr>
<tr><td>7.</td><td>All other Courses</td></tr>
</table>

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)	Super visor	Review Committee (excluding supervisor)	Super visor	Ext. Exr.	Super visor	Exr.1	Exr.2
0	0	10	10	15	15	20	10	10	10

7.6.4 The Project Report prepared according to approved guidelines and duly signed by the Supervisor shall be submitted to Head of the Department. The candidate(s) must submit the project report within the specified date as per the academic schedule of the semester. If the project report is not submitted within the specified date then the candidate is deemed to have failed in the Project Work and redo it in the subsequent semester.

7.6.5 If a candidate fails to secure 50% of the continuous assessment marks in the project work, he / she shall not be permitted to submit the report for that particular semester and shall have to redo it in the subsequent semester and satisfy attendance requirements.

7.6.6 The end semester examination of the project work shall be evaluated based on the project report submitted by the candidate in the respective semester and viva-voce examination by a committee consisting of two examiners and supervisor of the project work.

7.6.7 If a candidate fails to secure 50 % of the end semester examination marks in the project work, he / she shall be required to resubmit the project report within 30 days from the date of declaration of the results and a fresh viva-voce examination shall be conducted as per clause 7.6.6.

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

7.7 Project Work I / Industrial Training

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

<table>
<tr><td colspan="9">Continuous Assessment
(Max. 100 Marks)</td></tr>
<tr><td colspan="2" rowspan="2">Zeroth Review</td><td colspan="2" rowspan="2">Review I
(Max.. 20 Marks)</td><td colspan="2" rowspan="2">Review II
Max.. 30 Marks)</td><td colspan="3">Review III
(Max. 50 Marks)</td></tr>
<tr><td>Report Evaluation (Max. 20 Marks)</td><td colspan="2">Viva - Voce
(Max. 30 Marks)</td></tr>
<tr><td>Review Committee</td><td>Supervisor</td><td>Review Committee (excluding supervisor)</td><td>Supervisor</td><td>Review Committee (excluding supervisor)</td><td>Supervisor</td><td>Review Committee</td><td>Supervisor</td><td>Review Committee</td></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
(For the students admitted in the academic year 2022-23)

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	08.93
BS	8	8		4					20	11.90
ES	8	8	4	4					24	14.28
PC	3	4	15	13	15	8			58	34.50
PE					3	3	9	3	18	10.71
OE					4	4	3	3	14	08.33
EC				2	2	6	5	4	19	11.30
MC										
Semester wise Total	23	24	21	23	24	23	20	10	168	100

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.	22EGL31	Communication Skills Development Laboratory	0	0	2	1	III
5.	22GCT31	Universal Human Values	2	0	0	2	VI
6.	22GCT71	Economics and Management for Engineers	3	0	0	3	VII
7.	22TAM01	Heritage of Tamils	1	0	0	1	II
8.	22TAM02	Tamils and Technology	1	0	0	1	III
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.	22PHT15	Physics for Electrical and Electronics Engineering	3	0	0	3	I
3.	22PHL15	Physics Laboratory for Electrical and Electronics Engineering	0	0	2	1	I
4.	22MAC21	Multivariable Calculus and Complex Analysis	3	1*	2*	4	II
5.	22CYT24	Chemistry for Electrical and Electronics Engineering	3	0	0	3	II
6.	22CYL11	Chemistry Laboratory for Electrical Systems	0	0	2	1	II
7.	22MAT41	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.	20MET11	Engineering Drawing	3	0	0	3	I
3.	20MEL11	Engineering Practices Laboratory	0	0	2	1	I
4.	22EET21	Electromagnetic Theory	3	0	0	3	II
5.	22CSC22	Data Structures using C	3	0	2	4	II
6.	22EEL21	Electric Circuits Laboratory	0	0	2	1	II
7.	22ITC31	Java Programming	3	0	2	4	III
8.	22ITC41	Programming in Python	3	0	2	4	III
Total Credits to be earned						**24**	

PROFESSIONAL CORE (PC)								
S. No.	Course Code	Course Name	L	T	P	C	Sem	Domain/ Stream
1.	22EET11	Electric Circuit Analysis	3	0	0	3	I	EL
2.	22EEC21	Electrical Measurements and Instrumentation	3	0	2	4	II	CA
3.	22EET31	DC Machines and Transformers	3	1	0	4	III	EM
4.	22EET32	Analog Electronics	3	0	0	3	III	EL
5.	22EET33	Digital Electronics	3	0	0	3	III	EL
6.	22EET34	Generation, Transmission and Distribution	3	0	0	3	III	PS
7.	22EEL31	DC Machines and Transformers Laboratory	0	0	2	1	III	EM
8.	22EEL32	Analog and Digital Electronics Laboratory	0	0	2	1	III	EL
9.	22EET41	Synchronous and Induction Machines	3	1	0	4	IV	EM
10.	22EET42	Control systems	3	1	0	4	IV	CA
11.	22EET44	Microcontrollers and its interfacing	3	0	0	3	IV	EL
12.	22EEL41	Synchronous and Induction Machines Laboratory	0	0	2	1	IV	EM
13.	22EEL42	Control System Laboratory	0	0	2	1	IV	CA
14.	22EET51	Power System Analysis	3	1	0	4	V	PS
15.	22EET52	Power Electronics	3	0	0	3	V	PE
16.	22EEC51	Signals and Systems	2	0	2	3	V	EL
17.	22EET53	Embedded System Design	3	0	0	3	V	EL
18.	22EEL51	Embedded System Laboratory	0	0	2	1	V	EL
19.	22EEL52	Power Electronics Laboratory	0	0	2	1	V	PE
20.	22EET61	Power System Protection and Switchgear	3	0	0	3	VI	PS
21.	22EET62	Electric Drives and Control	3	0	0	3	VI	PE
22.	22EEL61	Power System Laboratory	0	0	2	1	VI	PS
23.	22EEL62	Electric Drives Laboratory	0	0	2	1	VI	PE
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.	22EEE01	Power Semiconductor Devices	3	0	0	3	PE
2.	22EEE02	Artificial intelligence applications to power systems	3	0	0	3	PS
3.	22EEE03	Renewable Energy System	3	0	0	3	ES
4.	22EEE04	Modeling of Electrical Machines	3	0	0	3	EM
5.	22EEE05	VLSI Design	3	0	0	3	EL
6.	22EEE06	Industry 4.0 for Electrical Engineers	3	0	0	3	CA
Semester – VI							
Elective – II							
7.	22EEE07	Advanced Power Electronic Circuits	3	0	0	3	PE
8.	22EEE08	Substation Engineering and Automation	3	0	0	3	PS
9.	22EEE09	Design, Installation and Commissioning of Solar and Wind Energy Systems	3	0	0	3	ES
10.	22EEE10	Special Electrical Machines	3	0	0	3	EM
11.	22EEE11	Sensors and Actuators	3	0	0	3	EL
12.	22EEE12	Avionics	3	0	0	3	CA
Semester – VII							
Elective – III							
13.	22EEE13	Design of Power Converters	3	0	0	3	PE
14.	22EEE14	Restructured Power System	3	0	0	3	PS
15.	22EEE15	Energy Storage Systems and Controllers	3	0	0	3	ES
16.	22EEE16	Advanced Electric Drives and Control	3	0	0	3	EM
17.	22EEE17	Advanced Embedded Systems	3	0	0	3	EL
18.	22EEE18	PLC and SCADA System	3	0	0	3	CA
Elective – IV							
19.	22EEE19	Pulse Generating Circuits for Power Converters	3	0	0	3	PE
20.	22EEE20	High Voltage Engineering	3	0	0	3	PS
21.	22EEE21	Electric Vehicle Technology	3	0	0	3	ES
22.	22EEE22	Finite Element Analysis of Electrical Machines	3	0	0	3	EM

23.	22EEE23	Digital Twin Technology	3	0	0	3	EL
24.	22EEE24	Soft Computing and Intelligent Controllers	3	0	0	3	CA
Elective - V							
25.	22EEE25	Power Electronic Interfaces to Renewable Energy	3	0	0	3	PE
26.	22EEE26	Smart Grid	3	0	0	3	PS
27.	22EEE27	Microgrid	3	0	0	3	ES
28.	22EEE28	Electrical Machine Design	3	0	0	3	EM
29.	22EEE29	Digital Image Processing and Multi Resolution Analysis	3	0	0	3	EL
30.	22EEE30	Industrial Automation	3	0	0	3	CA
Semester - VIII							
Elective - VI							
31.	22EEE31	Power Quality	3	0	0	3	PE
32.	22EEE32	Power System Security	3	0	0	3	PS
33.	22EEE33	Artificial Intelligent Techniques for Electric Vehicles	3	0	0	3	ES
34.	22EEE34	Electrical Machine Control and Maintenance	3	0	0	3	EM
35.	22EEE35	Digital Signal Processing and its Applications	3	0	0	3	EL
36.	22EEE36	Electric Power Utilisation	3	0	0	3	CA
		Total Credits to be earned				**18**	

***** Domain/Stream Abbreviations: PE – Power Electronics, PS – Power System, ES – Energy Storage, EM – Electrical Machines, EL-Electronics, CA – Controller and Automation

EMPLOYABILITY ENHANCEMENT COURSES (EC)

S. No.	Course Code	Course Name	L	T	P	C	Sem
1.	22GCL41/ 22GCI41	Professional Skills Training – I / Industrial Training – I	--	--	--	2	IV
2.	22GCL51/ 22GCI51	Professional Skills Training – II / Industrial Training – II	--	--	--	2	V
3.	22GEP61	Comprehensive Test and Viva	--	--	--	2	VI
4.	22EEP61	Project Work – I	0	0	8	4	VI
5.	22EEP71	Project Work – II Phase – I	0	0	10	5	VII
6.	22EEP81	Project Work – II Phase – II	--	--	8	4	VIII
		Total Credits to be earned				**19**	

MANDATORY COURSES (EC)							
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	

OPEN ELECTIVE COURSES OFFERED TO OTHER DEPARTMENTS (OE)							
S. No.	Course Code	Course Name	L	T	P	C	Sem
1.	22EEO01	Solar and Wind Energy Systems	3	1	0	4	V
2.	22EEO02	Electrical Wiring and Lighting	3	1	0	4	V
3.	22EEO03	Programmable Logic Controller and SCADA	3	1	0	4	V
4.	22EEO04	Analog and Digital Electronics	3	1	0	4	V
5.	22EEO05	Power Electronics and Drives	3	1	0	4	V
6.	22EEO06	Introduction to Sensors and Actuators	3	1	0	4	V
7.	22EEO07	Energy Conservation and Management	3	1	0	4	VI
8.	22EEO08	Microprocessors and Microcontrollers Interfacing	3	1	0	4	VI
9.	22EEO09	Electrical Safety	3	1	0	4	VI
10.	22EEO10	VLSI System Design	3	1	0	4	VI
11.	22EEO11	Automation for Industrial Applications	3	1	0	4	VI
12.	22EEO12	Electric Vehicle	3	0	0	3	VII
13.	22EEO13	E-Waste Management	3	0	0	3	VII
14.	22EEO14	Embedded System Design	3	0	0	3	VII
15.	22EEO15	Energy Storage Systems and Controllers	3	0	0	3	VII
16.	22EEO16	AI Techniques for Engineering Applications	3	0	0	3	VII
17.	22EEO17	Smart Grid Technologies	3	0	0	3	VIII
18.	22EEO18	Biomass Energy Systems	3	0	0	3	VIII
19.	22GEX01	NCC Studies (Army Wing) - I	3	0	2	4	V/VI

KEC R2022: (22 Batch) SCHEDULING OF COURSES – BE (Electrical and Electronics 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)	22PHT15 Physics for Electrical and Electronics Engineering (3-0-0-3)	22EET11 Electric Circuit Analysis (3-0-0-3)	22CSC11 Problem Solving and Programming in C (3-0-2-4)	22MET11 Engineering Drawing (3-0-0-3)	22PHL15 Physics Laboratory for Electrical and Electronics Engineering (0-0-2-1)	22MNT11 Student Induction Program (0-0-0-0)	22MEL11 Engineering Practices Lab (0-0-2-1)	22VEC11 Yoga and Values for Holistic Development (0-0-0-1)	23
II	22EGT21 Communication Skills II (3-0-0-3)	22MAC21 Multivariable Calculus and Complex Analysis (3-1*-2*-4)	22CYTT24 Chemistry for Electrical and Electronics Engineering (3-0-0-3)	22EEC21 Electrical Measurements and Instrumentation (3-0-2-4)	22EET21 Electromagnetic Theory (3-0-0-3)	22CSC22 Data Structures using C (3-0-2-4)	22CYL11 Chemistry Laboratory for Electrical Systems (0-0-2-1)	22EEL21 Electric Circuits Laboratory (0-0-2-1)	22TAM01 Heritage of Tamils (1-0-0-1)		24
III	22ITC31 Java Programming (3-0-2-4)	22EET31 DC Machines and Transformers (3-1-0-4)	22EET32 Analog Electronics (3-0-0-3)	22EET33 Digital Electronics (3-0-0-3)	22EET34 Generation, Transmission and Distribution (3-0-0-3)	22MNT31 Environmenta l Science (2-0-0-0)	22EEL31 DC Machines and Transformers Laboratory (0-0-2-1)	22EEL32 Analog and Digital Electronics Laboratory (0-0-2-1)	22EGL31 Communication Skills Development Laboratory (0-0-2-1)	22TAM22 Tamils and Technology (1-0-0-1)	21
IV	22MAT41 Transforms and Partial Differential Equations (3-1*-2*-4)	22ITC41 Python Programming (3-0-2-4)	22EET41 Synchronous and Induction Machines (3-1-0-4)	22EET42 Control systems (3-1-0-4)	22EET44 Microcontrollers and its interfacing (3-0-0-3)	22GCL41/ 22GCI41 Professional Skills Training – I /Industrial Training – I (0-0-0-2)	22EEL41 Synchronous and Induction Machines Laboratory (0-0-2-1)	22EEL42 Control System Laboratory (0-0-2-1)			23
V	22EET51 Power System Analysis (3-1-0-4)	22EET52 Power Electronics (3-0-0-3)	22EEC51 Signals and Systems (2-0-2-3)	22EET53 Embedded System Design (3-0-0-3)	Professional Elective – I (3-0-0-3)	Open Elective – I (3-1-0-4)	22EEL51 Embedded System Laboratory (0-0-2-1)	22EEL52 Power Electronics Laboratory (0-0-2-1)	22GCL51/ 22GCI51 Professional Skills Training – II / Industrial Training – II (0-0-0-2)		24
VI	22EET61 Power System Protection and Switchgear (3-0-0-3)	22EET62 Electric Drives and Control (3-0-0-3)	Professional Elective – II (3-0-0-3)	Open Elective – II (3-1-0-4)	22EEL61 Power System Laboratory (0-0-2-1)	22EEL62 Electric Drives Laboratory (0-0-2-1)	22GCT31 Universal Human Values (2-0-0-2)	22GEP61 Comprehensive Test and Viva (2-0-0-2)	22EEP61 Project Work – I (0-0-8-4)		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)	22EEP71 Project Work II Phase I (0-0-10-5)					20
VIII	Open Elective IV (3-0-0-3)	Professional Elective VI (3-0-0-3)	22EEP81 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	22PHT15	Physics for Electrical and Electronics Engineering	✓	✓	✓						✓	✓		✓	✓	✓
1	22EET11	Electric Circuit Analysis	✓	✓	✓	✓	✓				✓			✓	✓	✓
1	22CSC11	Problem Solving and Programming in C	✓	✓	✓	✓	✓					✓		✓	✓	✓
1	22MET11	Engineering Drawing	✓	✓	✓		✓					✓			✓	✓
1	22PHL15	Physics Laboratory for Electrical and Electronics Engineering	✓	✓	✓	✓					✓	✓		✓	✓	✓
1	22MNT11	Student Induction Program														
1	22MEL11	Engineering Practices Laboratory	✓		✓	✓	✓	✓			✓	✓		✓	✓	✓
1	22VEC11	Yoga and Values for Holistic Development						✓		✓	✓					
1	22TAM01	Heritage of Tamils						✓		✓	✓	✓		✓		
1	22GCL12	Foundation Lab –II	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓		
2	22EGT21	Communication Skills II						✓			✓	✓	✓	✓	✓	✓
2	22MAC21	Multivariable Calculus and Complex Analysis	✓	✓	✓		✓								✓	✓
2	22CYT24	Chemistry for Electrical and Electronics Engineering	✓	✓	✓	✓			✓						✓	✓
2	22EEC21	Electrical Measurements and Instrumentation	✓	✓	✓	✓					✓			✓	✓	✓
2	22EET21	Electromagnetic Theory	✓	✓	✓					✓				✓	✓	✓
2	22CSC22	Data Structures using C	✓	✓	✓	✓									✓	✓
2	22CYL11	Chemistry Laboratory for Electrical Systems	✓	✓	✓	✓			✓						✓	✓
2	22EEL21	Electric Circuits Laboratory	✓	✓	✓	✓								✓	✓	✓
2	22EET22	Electromagnetic Fields	✓	✓	✓						✓			✓	✓	✓
2	22GCL11	Foundation Lab – I	✓	✓	✓		✓				✓	✓		✓		
	22TAM02	Tamils and Technology						✓		✓	✓	✓		✓		
3	22ITC31	Java Programming	✓	✓	✓	✓									✓	✓
3	22EET31	DC Machines and Transformers	✓	✓	✓	✓	✓		✓		✓			✓	✓	✓
3	22EET32	Analog Electronics	✓	✓	✓	✓	✓				✓			✓	✓	✓
3	22EET33	Digital Electronics	✓	✓	✓	✓	✓				✓			✓	✓	✓

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
3	22EET34	Generation, Transmission and Distribution	✓	✓	✓	✓	✓	✓						✓	✓	✓
3	22MNT31	Environmental Science	✓	✓	✓				✓						✓	✓
3	22EEL31	DC Machines and Transformers Laboratory	✓	✓	✓	✓	✓				✓			✓	✓	✓
3	22EEL32	Analog and Digital Electronics Laboratory	✓	✓	✓	✓	✓	✓			✓			✓	✓	✓
3	22EGL31	Communication Skills Development Laboratory									✓	✓		✓	✓	✓
3	22EET35	Electric Circuit Theory	✓	✓	✓	✓	✓				✓			✓	✓	✓
3	22EET36	Measurements and Instrumentation	✓	✓	✓	✓					✓			✓	✓	✓
3	22EEL33	Circuits and Measurements Laboratory	✓	✓	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓
4	22MAT41	Transforms and Partial Differential Equations	✓	✓	✓										✓	✓
4	22ITC41	Python Programming	✓	✓	✓	✓									✓	✓
4	22EET41	Synchronous and Induction Machines	✓	✓	✓	✓	✓		✓		✓			✓	✓	✓
4	22EET42	Control systems	✓	✓	✓	✓	✓	✓			✓			✓	✓	✓
4	22EET44	Microcontrollers and its interfacing	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓
4	22GCL41/ 22GCI41	Professional Skills Training – I / Industrial Training – I	✓	✓				✓	✓	✓	✓	✓	✓	✓	✓	✓
4	22EEL41	Synchronous and Induction Machines Laboratory	✓	✓	✓	✓	✓			✓				✓	✓	✓
4	22EEL42	Control System Laboratory	✓	✓	✓	✓	✓				✓			✓	✓	✓
4	22EEL43	Microprocessors and Microcontrollers Interfacing Laboratory	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓
4	22EET45	Continuous and Discrete Time Signals and Systems	✓	✓	✓	✓	✓				✓			✓	✓	✓
5	22EET51	Power System Analysis	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
5	22EET52	Power Electronics	✓	✓	✓	✓	✓	✓			✓		✓	✓	✓	✓
5	22EEC51	Signals and Systems	✓	✓	✓	✓	✓				✓			✓	✓	✓
5	22EET53	Embedded System Design	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓
5	22EEL51	Embedded System Laboratory	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓
5	22EEL52	Power Electronics Laboratory	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓
5	22GCL51/ 22GCI51	Professional Skills Training – II / Industrial Training – II														
6	22EET61	Power System Protection and Switchgear	✓	✓	✓	✓	✓	✓	✓		✓			✓	✓	✓

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
6	22EET62	Electric Drives and Control	✓	✓	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓
6	22EEL61	Power System Laboratory	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓
6	22EEL62	Electric Drives Laboratory	✓	✓	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓
6	22GCT31	Universal Human Values	✓	✓	✓	✓										
6	22GEP61	Comprehensive Test and Viva	✓	✓	✓	✓					✓	✓	✓		✓	✓
6	22EEP61	Project Work – I	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
6	22EEL63	Power Electronics and Drives Laboratory	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
6	22EEL64	Power and Energy Laboratory	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓
7	22GCT71	Engineering Economics and Management	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓		
7	22EEP71	Project Work – II Phase – I	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
8	22EEP81	Project Work – II Phase – II	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Professional Elective Courses														
5	22EEE01	Power Semiconductor Devices	✓	✓	✓			✓						✓	✓	✓
5	22EEE02	Artificial Intelligence Applications To Power Systems	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓
5	22EEE03	Renewable Energy System	✓	✓	✓	✓			✓	✓				✓	✓	✓
5	22EEE04	Modeling of Electrical Machines	✓	✓	✓	✓				✓				✓	✓	✓
5	22EEE05	VLSI Design	✓	✓	✓	✓	✓				✓		✓	✓	✓	✓
5	22EEE06	Industry 4.0 for Electrical Engineers	✓	✓	✓	✓		✓	✓		✓			✓	✓	✓
6	22EEE07	Advanced Power Electronic Circuits	✓	✓	✓			✓			✓			✓	✓	✓
6	22EEE08	Substation Engineering and Automation	✓	✓	✓	✓	✓		✓		✓			✓	✓	✓
6	22EEE09	Design, Installation and Commissioning of Solar and Wind Energy Systems	✓	✓	✓	✓	✓	✓	✓					✓	✓	✓
6	22EEE10	Special Electrical Machines	✓	✓	✓	✓		✓						✓	✓	✓
6	22EEE11	Sensors and Actuators	✓	✓	✓		✓							✓	✓	✓
6	22EEE12	Avionics	✓	✓	✓	✓		✓			✓			✓	✓	✓
7	22EEE13	Design of Power Converters	✓	✓	✓	✓		✓			✓		✓	✓	✓	✓
7	22EEE14	Restructured Power System	✓	✓	✓	✓		✓	✓				✓	✓	✓	✓
7	22EEE15	Energy Storage Systems and Controllers	✓	✓	✓				✓				✓	✓	✓	✓

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
7	22EEE16	Advanced Electric Drives and Control	✓	✓	✓	✓		✓	✓		✓	✓		✓	✓	✓
7	22EEE17	Advanced Embedded Systems	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
7	22EEE18	PLC and SCADA System	✓	✓	✓	✓	✓	✓	✓		✓			✓	✓	✓
7	22EEE19	Pulse Generating Circuits for Power Converters	✓	✓	✓	✓	✓						✓	✓	✓	✓
7	22EEE20	High Voltage Engineering	✓	✓	✓	✓			✓		✓			✓	✓	✓
7	22EEE21	Electric Vehicle Technology	✓	✓	✓	✓		✓	✓			✓		✓	✓	✓
7	22EEE22	Finite Element Analysis of Electrical Machines	✓	✓	✓			✓			✓			✓	✓	✓
7	22EEE23	Digital Twin Technology	✓	✓	✓	✓	✓	✓					✓	✓	✓	✓
7	22EEE24	Soft Computing and Intelligent Controllers	✓	✓	✓	✓	✓	✓						✓	✓	✓
7	22EEE25	Power Electronic Interfaces to Renewable Energy	✓	✓	✓			✓	✓		✓			✓	✓	✓
7	22EEE26	Smart Grid	✓	✓	✓		✓			✓				✓	✓	✓
7	22EEE27	Microgrid	✓	✓	✓	✓		✓			✓			✓	✓	✓
7	22EEE28	Electrical Machine Design	✓	✓	✓	✓			✓		✓			✓	✓	✓
7	22EEE29	Digital Image Processing and Multi Resolution Analysis	✓	✓	✓	✓	✓						✓	✓	✓	✓
7	22EEE30	Industrial Automation	✓	✓	✓	✓			✓		✓			✓	✓	✓
7	22EEE37	Embedded Systems	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓
8	22EEE31	Power Quality	✓	✓	✓	✓			✓	✓				✓	✓	✓
8	22EEE32	Power system security	✓	✓	✓	✓			✓					✓	✓	✓
8	22EEE33	Artificial Intelligent Techniques for Electric Vehicles	✓	✓	✓	✓	✓				✓			✓	✓	✓
8	22EEE34	Control and Maintenance of Electrical Machines	✓	✓	✓				✓	✓			✓	✓	✓	✓
8	22EEE35	Digital Signal Processing and its Applications	✓	✓	✓		✓				✓		✓	✓	✓	✓
8	22EEE36	Electric Power Utilization	✓	✓	✓	✓			✓				✓	✓	✓	✓
		OPEN ELECTIVE														
5	22EEO01	Solar and Wind Energy Systems	✓	✓	✓			✓	✓					✓		
5	22EEO02	Electrical Wiring and Lighting	✓	✓	✓	✓	✓							✓		

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
5	22EEO03	Programmable Logic Controller and SCADA	✓	✓	✓	✓		✓			✓			✓		
5	22EEO04	Analog and Digital Electronics	✓	✓	✓	✓	✓							✓		
5	22EEO05	Power Electronics and Drives	✓	✓	✓	✓	✓	✓			✓					
5	22EEO06	Sensors and Actuators	✓	✓	✓			✓						✓		
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	✓	✓	✓	✓			✓		✓			✓		
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	✓	✓	✓	✓										
8	22EEO17	Smart Grid Technologies	✓	✓	✓	✓	✓			✓				✓		
8	22EEO18	Biomass Energy Systems	✓	✓	✓			✓	✓				✓	✓		
		OPEN ELECTIVE OFFERED BY OTHER DEPARTMENT														
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	22EIO01	Measurements and Instrumentation	✓	✓	✓	✓	✓									
5	22EIO02	Biomedical Instrumentation and Applications	✓	✓	✓	✓	✓	✓		✓						

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
5	22EIO03	Industrial Automation	✓	✓	✓	✓	✓									
5	22CSX01	Fundamentals of Databases	✓	✓	✓											
5	22CSX02	Data science for Engineers	✓	✓	✓	✓	✓									
5	22CSX03	Enterprise Application Development Using Java	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
5	22CSO01	Computational science for Engineers	✓	✓	✓											
5	22CSO02	Formal Languages and Automata Theory	✓	✓	✓											
5	22ITO01	Artificial Intelligence	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓			
5	22ITX01	Next Generation Databases	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
5	22CDO01	Fundamentals of User Experience Design	✓	✓	✓	✓	✓				✓	✓	✓			
5	22ADO01	Data Warehousing and Data Mining	✓	✓	✓											
5	22ALO01	Business Intelligence	✓	✓	✓											
5	22CHO01	Industrial Enzymology	✓	✓	✓							✓	✓	✓		
5	22CHO02	Waste to Energy Conversion	✓	✓												
5	22CHO03	Applied Nanotechnology	✓	✓	✓	✓	✓	✓	✓	✓				✓		
5	22FTX01	Baking Technology	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓		
5	22FTO01	Food Processing Technology	✓	✓	✓	✓		✓				✓		✓		
5	22MAO01	Mathematical Foundations for Machine Learning	✓	✓	✓	✓	✓									
5	22MAO02	Numerical Computing	✓	✓	✓											
5	22MAO03	Stochastic Processes and Queuing Theory	✓	✓	✓											
5	22MAO04	Statistics for Engineers	✓	✓	✓											
5	22PHO01	Thin Film Technology	✓	✓	✓						✓	✓		✓		
5	22PHO02	High Energy Storage Devices	✓	✓	✓						✓	✓		✓		
5	22PHO03	Structural and Optical Characterization of Materials	✓	✓	✓						✓	✓		✓		
5	22CYO01	Instrumental Methods of Analysis	✓	✓	✓	✓										
5	22CYO02	Chemistry Concepts for Competitive Examinations	✓	✓	✓											
5	22CYO03	Organic Chemistry for Industry	✓	✓	✓	✓										
5	22MBO01	Cost Accounting for Engineers										✓	✓	✓		
6	22CEO01	Disaster Management	✓	✓	✓			✓	✓					✓		

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		
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	✓	✓	✓											
6	22MAO07	Number Theory and Cryptography	✓	✓	✓		✓									
6	22PHO04	Synthesis, Characterization and Biological Applications of Nanomaterials	✓	✓	✓						✓	✓		✓		
6	22PHO05	Techniques of Crystal Growth	✓	✓	✓						✓	✓		✓		

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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	22EIO06	Introduction to Distributed Control Systems	✓	✓	✓	✓	✓			✓		✓				
7	22EIO07	Instrumentation in Aircraft Navigation and Control	✓	✓	✓	✓	✓									
7	22EIO08	Industry 4.0 with Industrial IoT	✓	✓	✓	✓	✓			✓						
7	22EIO09	Industrial Data Communication	✓	✓	✓	✓	✓	✓								
7	22EIO10	Wireless Instrumentation	✓	✓	✓	✓	✓		✓							
7	22EIO11	Instrumentation Techniques in Agriculture	✓	✓	✓	✓	✓									
7	22CSO03	Nature Inspired optimization techniques	✓	✓	✓											
7	22ITO05	Fundamentals of Cloud Computing	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
7	22ITO06	Introduction to Ethical Hacking	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
7	22CDO02	Introduction to Mobile Game Design	✓	✓	✓	✓										
7	22CDO03	Introduction to Graphics Design	✓	✓	✓	✓										
7	22ADO02	Neural Networks and Deep Learning	✓	✓	✓	✓										
7	22ALO02	Industrial Machine Learning	✓	✓	✓											
7	22CHO07	Hydrogen Energy	✓	✓										✓		
7	22CHO08	Rubber Technology	✓	✓				✓	✓					✓		

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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	✓		✓			✓	✓	✓						
8	22MTO05	Micro and Nano Electromechanical Systems	✓	✓	✓	✓								✓		
8	22AUO03	Public Transport Management	✓	✓				✓	✓	✓				✓		
8	22AUO04	Autonomous Vehicles	✓	✓	✓	✓	✓	✓	✓					✓		
8	22ECO02	Optical Engineering	✓	✓	✓	✓		✓	✓	✓	✓			✓		
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	✓	✓	✓			✓		✓		✓		✓		

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

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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
22PHT15	Physics for Electrical and Electronics Engineering	3	0	0	3	40	60	100	BS
22EET11	Electric Circuit Analysis	3	0	0	3	40	60	100	PC
22CSC11	Problem Solving and Programming in C	3	0	2	4	100	0	100	ES
22MET11	Engineering Drawing	2	1	0	3	40	60	100	ES
Practical / Employability Enhancement									
22PHL15	Physics Laboratory for Electrical and Electronics 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**				

*Alternate Weeks

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
22CYT24	Chemistry for Electrical and Electronics Engineering	3	0	0	3	40	60	100	BS
22EEC21	Electrical Measurements and Instrumentation	3	0	2	4	50	50	100	PC
22EET21	Electromagnetic Theory	3	0	0	3	40	60	100	ES
22CSC22	Data Structures using C	3	0	2	4	50	50	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
22EEL21	Electric Circuits Laboratory	0	0	2	1	60	40	100	ES
Total Credits to be earned					**24**				

*Alternate Weeks

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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
22EET31	DC Machines and Transformers	3	1	0	4	40	60	100	PC
22EET32	Analog Electronics	3	0	0	3	40	60	100	PC
22EET33	Digital Electronics	3	0	0	3	40	60	100	PC
22EET34	Generation, Transmission and Distribution	3	0	0	3	40	60	100	PC
22MNT31	Environmental Science	2	0	0	0	100	0	100	MC
22TAM02	Tamils and Technology	1	0	0	1	100	0	100	HS
Practical / Employability Enhancement									
22EEL31	DC Machines and Transformers Laboratory	0	0	2	1	60	40	100	PC
22EEL32	Analog and Digital Electronics Laboratory	0	0	2	1	60	40	100	PC
22EGL31	Communication Skills Development Laboratory	0	0	2	1	60	40	100	HS
				Total Credits to be earned	**21**				

SEMESTER – IV									
Course 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
22EET41	Synchronous and Induction Machines	3	1	0	4	40	60	100	PC
22EET42	Control Systems	3	1	0	4	40	60	100	PC
22EET43	Microcontrollers and its interfacing	3	0	0	3	40	60	100	PC
Practical / Employability Enhancement									
22EEL41	Synchronous and Induction Machines Laboratory	0	0	2	1	60	40	100	PC
22EEL42	Control Systems Laboratory	0	0	2	1	60	40	100	PC
22GCL41/ 22GCI41	Professional Skills Training – I / Industrial Training – I *	--	--	--	2	100	0	100	EC
				Total Credits to be earned	**23**				

*80 hours of training

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SEMESTER – V									
Course Code	**Course Title**	**Hours / Week**			**Credit**	**Maximum Marks**			**Cate gory**
		L	**T**	**P**		**CA**	**ESE**	**Total**	
Theory/Theory with Practical									
22EET51	Power System Analysis	3	1	0	4	40	60	100	PC
22EET52	Power Electronics	3	0	0	3	40	60	100	PC
22EEC51	Signals and Systems	2	0	2	3	50	50	100	PC
22EET53	Embedded System Design	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/ 50	60/ 50	100	OE
Practical / Employability Enhancement									
22EEL51	Embedded System Laboratory	0	0	2	1	60	40	100	PC
22EEL52	Power Electronics Laboratory	0	0	2	1	60	40	100	PC
22GCL51/ 22GCI51	Professional Skills Training – II / Industrial Training – II *	--	--	--	2	100	0	100	EC
				Total Credits to be earned	**24**				

*80 hours of training

SEMESTER – VI									
Course Code	**Course Title**	**Hours / Week**			**Credit**	**Maximum Marks**			**Cate gory**
		L	**T**	**P**		**CA**	**ESE**	**Total**	
Theory/Theory with Practical									
22EET61	Power System Protection and Switchgear	3	0	0	3	40	60	100	PC
22EET62	Electric Drives and Control	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/ 50	60/ 50	100	OE
Practical / Employability Enhancement									
22EEL61	Power System Laboratory	0	0	2	1	60	40	100	PC
22EEL62	Electric Drives Laboratory	0	0	2	1	60	40	100	PC
22GET31	Universal Human Values	2	0	0	2	100	0	100	HS
22GEP61	Comprehensive Test and Viva	--	---	---	2	100	0	100	EC
22EEP61	Project Work – I	0	0	8	4	50	50	100	EC
				Total Credits to be earned	**23**				

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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									
22EEP71	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									
	Open Elective – IV	3	0	0	3	40	60	100	OE
	Professional Elective – VI	3	0	0	3	40	60	100	PE
Practical / Employability Enhancement									
22EEP81	Project Work – II Phase – II	---	---	8	4	50	50	100	EC
	Total Credits to be earned				**10**				

Total Credits: 168

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PROFESSIONAL ELECTIVES (PEs)							
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Domain/ Stream**
Semester - V							
Elective – I							
1.	22EEE01	Power Semiconductor Devices	3	0	0	3	PE
2.	22EEE02	Artificial Intelligence Applications to Power Systems	3	0	0	3	PS
3.	22EEE03	Renewable Energy System	3	0	0	3	ES
4.	22EEE04	Modeling of Electrical Machines	3	0	0	3	EM
5.	22EEE05	VLSI Design	3	0	0	3	EL
6.	22EEE06	Industry 4.0 for Electrical Engineers	3	0	0	3	CA
Semester – VI							
Elective – II							
7.	22EEE07	Advanced Power Electronic Circuits	3	0	0	3	PE
8.	22EEE08	Substation Engineering and Automation	3	0	0	3	PS
9.	22EEE09	Design, Installation and Commissioning of Solar and Wind Energy Systems	3	0	0	3	ES
10.	22EEE10	Special Electrical Machines	3	0	0	3	EM
11.	22EEE11	Sensors and Actuators	3	0	0	3	EL
12.	22EEE12	Avionics	3	0	0	3	CA
Semester – VII							
Elective – III							
13.	22EEE13	Design of Power Converters	3	0	0	3	PE
14.	22EEE14	Restructured Power System	3	0	0	3	PS
15.	22EEE15	Energy Storage Systems and Controllers	3	0	0	3	ES
16.	22EEE16	Advanced Electric Drives and Control	3	0	0	3	EM
17.	22EEE17	Embedded Computing Systems	3	0	0	3	EL
18.	22EEE18	PLC and SCADA System	3	0	0	3	CA
Elective – IV							
19.	22EEE19	Pulse Generating Circuits for Power Converters	3	0	0	3	PE
20.	22EEE20	High Voltage Engineering	3	0	0	3	PS

21.	22EEE21	Electric Vehicle Technology	3	0	0	3	ES
22.	22EEE22	Finite Element Analysis of Electrical Machines	3	0	0	3	EM
23.	22EEE23	Digital Twin Technology	3	0	0	3	EL
24.	22EEE24	Soft Computing and Intelligent Controllers	3	0	0	3	CA
Elective - V							
25.	22EEE25	Power Electronic Interfaces to Renewable Energy	3	0	0	3	PE
26.	22EEE26	Smart Grid	3	0	0	3	PS
27.	22EEE27	Microgrid	3	0	0	3	ES
28.	22EEE28	Electrical Machine Design	3	0	0	3	EM
29.	22EEE29	Digital Image Processing and Multi Resolution Analysis	3	0	0	3	EL
30.	22EEE30	Industrial Automation	3	0	0	3	CA
31.	22GEE01	Fundamentals of Research	3	0	0	3	-
32.	22GEE02	Total Quality Management	3	0	0	3	-
Semester - VIII							
Elective - VI							
33.	22EEE31	Power Quality	3	0	0	3	PE
34.	22EEE32	Power System Security	3	0	0	3	PS
35.	22EEE33	Artificial Intelligent Techniques for Electric Vehicles	3	0	0	3	ES
36.	22EEE34	Electrical Machine Control and Maintenance	3	0	0	3	EM
37.	22EEE35	Digital Signal Processing and its Applications	3	0	0	3	EL
38.	22EEE36	Electric Power Utilisation	3	0	0	3	CA
Total Credits to be earned						**18**	

***** Domain/Stream Abbreviations: PE – Power Electronics, PS – Power System, ES – Energy Storage, EM – Electrical Machines, EL-Electronics, CA – Controller and Automation

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OPEN ELECTIVE COURSES OFFERED TO OTHER DEPARTMENTS (OE)							
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Sem**
1.	22EEO01	Solar and Wind Energy Systems	3	1	0	4	V
2.	22EEO02	Electrical Wiring and Lighting	3	1	0	4	V
3.	22EEO03	Programmable Logic Controller and SCADA	3	1	0	4	V
4.	22EEO04	Analog and Digital Electronics	3	1	0	4	V
5.	22EEO05	Power Electronics and Drives	3	1	0	4	V
6.	22EEO06	Introduction to Sensors and Actuators	3	1	0	4	V
7.	22EEO07	Energy Conservation and Management	3	1	0	4	VI
8.	22EEO08	Microprocessors and Microcontrollers Interfacing	3	1	0	4	VI
9.	22EEO09	Electrical Safety	3	1	0	4	VI
10.	22EEO10	VLSI System Design	3	1	0	4	VI
11.	22EEO11	Automation for Industrial Applications	3	1	0	4	VI
12.	22EEO12	Electric Vehicle	3	0	0	3	VII
13.	22EEO13	E-Waste Management	3	0	0	3	VII
14.	22EEO14	Embedded Systems and IOT	3	0	0	3	VII
15.	22EEO15	Energy Storage Systems and Controllers	3	0	0	3	VII
16.	22EEO16	AI Techniques for Engineering Applications	3	0	0	3	VII
17.	22EEO17	Smart Grid Technologies	3	0	0	3	VIII
18.	22EEO18	Biomass Energy Systems	3	0	0	3	VIII
19.	22GEX01	NCC Studies (Army Wing) - I	3	0	2	4	V/VI

B.E. DEGREE IN ELECTRICAL AND ELECTRONICS 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	1*	2*	4	50	50	100	BS
22PHT15	Physics for Electrical and Electronics 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									
22PHL15	Physics Laboratory for Electrical and Electronics Engineering	0	0	2	1	60	40	100	BS
22GCL12	Foundation Lab –II	0	0	6	3	100	0	100	ES
22VEC11	Yoga and Values for Holistic Development	-	-	-	1	100	0	100	HS
22MNT11	Student Induction Program	-	-	-	0	100	0	100	MC
	Total Credits to be earned				**23**				

*Alternate Weeks

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
22CYT24	Chemistry for Electrical and Electronics Engineering	3	0	0	3	40	60	100	BS
22CSC22	Data Structures using C	3	0	2	4	50	50	100	ES
22EET22	Electromagnetic Fields	3	1	0	4	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 Lab – I	0	0	6	3	100	0	100	ES
	Total Credits to be earned				**23**				

*Alternate Weeks

B.E. DEGREE IN ELECTRICAL AND ELECTRONICS ENGINEERING CURRICULUM - R2022
(For the students admitted from 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
22EET32	Analog Electronics	3	0	0	3	40	60	100	PC
22EET33	Digital Electronics	3	0	0	3	40	60	100	PC
22EET35	Electric Circuit Theory	3	1	0	4	40	60	100	PC
22EET36	Measurements and Instrumentation	3	0	0	3	40	60	100	PC
22MNT31	Environmental Science	2	0	0	0	100	0	100	MC
Practical / Employability Enhancement									
22EEL32	Analog and Digital Electronics Laboratory	0	0	2	1	60	40	100	PC
22EEL33	Circuits and Measurements 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					**20**				

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	0	2	4	40	60	100	BS
22ITC41	Programming in Python	3	0	2	4	50	50	100	ES
22EET31	DC Machines and Transformers	3	1	0	4	40	60	100	PC
22EET43	Microcontrollers and its interfacing	3	0	0	3	40	60	100	PC
22EEC51	Signals and Systems	2	0	2	3	50	50	100	PC
Practical / Employability Enhancement									
22EEL31	DC Machines and Transformers Laboratory	0	0	2	1	60	40	100	PC
22EEL43	Microprocessors and Microcontrollers Interfacing Laboratory	0	0	2	1	60	40	100	PC
22GCL41/ 22GCI41	Professional Skills Training – I / Industrial Training – I	--	--	--	2	100	0	100	EC
Total Credits to be earned					**22**				

*80 hours of training

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SEMESTER – V

Course Code	Course Title	Hours / Week L	T	P	Credit	Maximum Marks CA	ESE	Total	Category
Theory/Theory with Practical									
22EET41	Synchronous and Induction Machines	3	1	0	4	40	60	100	PC
22EET42	Control Systems	3	1	0	4	40	60	100	PC
22EET34	Generation, Transmission and Distribution	3	0	0	3	40	60	100	PC
22EET52	Power Electronics	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/ 50	60/ 50	100	OE
Practical / Employability Enhancement									
22EEL41	Synchronous and Induction Machines Laboratory	0	0	2	1	60	40	100	PC
22EEL42	Control Systems Laboratory	0	0	2	1	60	40	100	PC
22GCL51/ 22GCI51	Professional Skills Training – II / Industrial Training – II	--	--	--	2	100	0	100	EC
	Total Credits to be earned				**25**				

*80 hours of training

SEMESTER – VI

Course Code	Course Title	Hours / Week L	T	P	Credit	Maximum Marks CA	ESE	Total	Category
Theory/Theory with Practical									
22EET51	Power System Analysis	3	0	0	3	40	60	100	PC
22EET62	Electric Drives and Control	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/ 50	60/ 50	100	OE
Practical / Employability Enhancement									
22EEL61	Power System Laboratory	0	0	2	1	60	40	100	PC
22EEL63	Power Electronics and Drives Laboratory	0	0	2	1	60	40	100	PC
22EEP61	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**				

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SEMESTER – VII									
Course Code	**Course Title**	**Hours / Week**			**Credit**	**Maximum Marks**			**Cate gory**
		L	**T**	**P**		**CA**	**ESE**	**Total**	
Theory/Theory with Practical									
22GCT71	Engineering Economics and Management	3	0	0	3	40	60	100	HS
22EET61	Power System Protection and Switchgear	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									
22EEP71	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**			**Cate gory**
		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									
22EEP81	Project Work – II Phase – II	---	---	8	4	50	50	100	EC
Total Credits to be earned					**10**				

Total Credits: 168

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PROFESSIONAL ELECTIVES (PEs)							
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Domain/ Stream**
Semester - V							
Elective – I							
1.	22EEE01	Power Semiconductor Devices	3	0	0	3	PE
2.	22EEE02	Artificial Intelligence Applications to Power Systems	3	0	0	3	PS
3.	22EEE03	Renewable Energy System	3	0	0	3	ES
4.	22EEE04	Modeling of Electrical Machines	3	0	0	3	EM
5.	22EEE05	VLSI Design	3	0	0	3	EL
6.	22EEE06	Industry 4.0 for Electrical Engineers	3	0	0	3	CA
Semester – VI							
Elective – II							
7.	22EEE07	Advanced Power Electronic Circuits	3	0	0	3	PE
8.	22EEE08	Substation Engineering and Automation	3	0	0	3	PS
9.	22EEE09	Design, Installation and Commissioning of Solar and Wind Energy Systems	3	0	0	3	ES
10.	22EEE10	Special Electrical Machines	3	0	0	3	EM
11.	22EEE11	Sensors and Actuators	3	0	0	3	EL
12.	22EEE12	Avionics	3	0	0	3	CA
Semester–VII							
Elective –III							
13.	22EEE13	Design of Power Converters	3	0	0	3	PE
14.	22EEE14	Restructured Power System	3	0	0	3	PS
15.	22EEE15	Energy Storage Systems and Controllers	3	0	0	3	ES
16.	22EEE16	Advanced Electric Drives and Control	3	0	0	3	EM
17.	22EEE17	Embedded Computing Systems	3	0	0	3	EL
18.	22EEE18	PLC and SCADA System	3	0	0	3	CA
Elective – IV							
19.	22EEE19	Pulse Generating Circuits for Power Converters	3	0	0	3	PE
20.	22EEE20	High Voltage Engineering	3	0	0	3	PS

21.	22EEE21	Electric Vehicle Technology	3	0	0	3	ES
22.	22EEE22	Finite Element Analysis of Electrical Machines	3	0	0	3	EM
23.	22EEE23	Digital Twin Technology	3	0	0	3	EL
24.	22EEE24	Soft Computing and Intelligent Controllers	3	0	0	3	CA
25.	22EEE25	Power Electronic Interfaces to Renewable Energy	3	0	0	3	PE
26.	22EEE26	Smart Grid	3	0	0	3	PS
27.	22EEE27	Microgrid	3	0	0	3	ES
28.	22EEE28	Electrical Machine Design	3	0	0	3	EM
29.	22EEE29	Digital Image Processing and Multi Resolution Analysis	3	0	0	3	EL
30.	22EEE30	Industrial Automation	3	0	0	3	CA
31.	22GEE01	Fundamentals of Research	3	0	0	3	-
32.	22GEE02	Total Quality Management	3	0	0	3	-
Semester - VIII							
Elective - V							
33.	22EEE31	Power Quality	3	0	0	3	PE
34.	22EEE32	Power System Security	3	0	0	3	PS
35.	22EEE33	Artificial Intelligent Techniques for Electric Vehicles	3	0	0	3	ES
36.	22EEE34	Electrical Machine Control and Maintenance	3	0	0	3	EM
37.	22EEE35	Digital Signal Processing and its Applications	3	0	0	3	EL
38.	22EEE36	Electric Power Utilisation	3	0	0	3	CA
Total Credits to be earned						**18**	

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

OPEN ELECTIVE COURSES OFFERED TO OTHER DEPARTMENTS (OE)							
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Sem**
1.	22EEO01	Solar and Wind Energy Systems	3	1	0	4	V
2.	22EEO02	Electrical Wiring and Lighting	3	1	0	4	V
3.	22EEO03	Programmable Logic Controller and SCADA	3	1	0	4	V
4.	22EEO04	Analog and Digital Electronics	3	1	0	4	V
5.	22EEO05	Power Electronics and Drives	3	1	0	4	V
6.	22EEO06	Introduction to Sensors and Actuators	3	1	0	4	V
7.	22EEO07	Energy Conservation and Management	3	1	0	4	VI
8.	22EEO08	Microprocessors and Microcontrollers Interfacing	3	1	0	4	VI
9.	22EEO09	Electrical Safety	3	1	0	4	VI
10.	22EEO10	VLSI System Design	3	1	0	4	VI
11.	22EEO11	Automation for Industrial Applications	3	1	0	4	VI
12.	22EEO12	Electric Vehicle	3	0	0	3	VII
13.	22EEO13	E-Waste Management	3	0	0	3	VII
14.	22EEO14	Embedded Systems and IOT	3	0	0	3	VII
15.	22EEO15	Energy Storage Systems and Controllers	3	0	0	3	VII
16.	22EEO16	AI Techniques for Engineering Applications	3	0	0	3	VII
17.	22EEO17	Smart Grid Technologies	3	0	0	3	VIII
18.	22EEO18	Biomass Energy Systems	3	0	0	3	VIII
19.	22GEX01	NCC Studies (Army Wing) - I	3	0	2	4	V/VI

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.	22EIO01	Measurements and Instrumentation	3	1	0	4	EIE
10.	22EIO02	Biomedical Instrumentation and Applications	3	1	0	4	EIE
11.	22EIO03	Industrial Automation	3	1	0	4	EIE
12.	22CSX01	Fundamentals of Databases	3	0	2	4	CSE
13.	22CSX02	Data science for Engineers	3	0	2	4	CSE
14.	22CSX03	Enterprise Application Development Using Java	3	0	2	4	CSE
15.	22CSO01	Computational science for Engineers	3	1	0	4	CSE
16.	22CSO02	Formal Languages and Automata Theory	3	1	0	4	CSE
17.	22ITO01	Artificial Intelligence	3	1	0	4	IT
18.	22ITX01	Next Generation Databases	3	0	2	4	IT
19.	22GEX02	NCC Studies (Air Wing) - 1	3	0	2	4	IT
20.	22CDO01	Fundamentals of User Experience Design	3	1	0	4	CSD
21.	22ADO01	Data Warehousing and Data Mining	3	1	0	4	AIDS
22.	22ALO01	Business Intelligence	3	1	0	4	AIML
23.	22CHO01	Industrial Enzymology	3	1	0	4	CHEM
24.	22CHO02	Waste to Energy Conversion	3	1	0	4	CHEM
25.	22CHO03	Applied Nanotechnology	3	1	0	4	CHEM
26.	22FTX01	Baking Technology	3	0	2	4	FT

27.	22FTO01	Food Processing Technology	3	1	0	4	FT
28.	22MAO01	Mathematical Foundations for Machine Learning	3	1	0	4	MATHS
29.	22MAO02	Numerical Computing	3	1	0	4	MATHS
30.	22MAO03	Stochastic Processes and Queuing Theory	3	1	0	4	MATHS
31.	22MAO04	Statistics for Engineers	3	1	0	4	MATHS
32.	22PHO01	Thin Film Technology	3	1	0	4	PHYSICS
33.	22PHO02	High Energy Storage Devices	3	1	0	4	PHYSICS
34.	22PHO03	Structural and Optical Characterization of Materials	3	1	0	4	PHYSICS
35.	22CYO01	Instrumental Methods of Analysis	3	1	0	4	CHEMISTRY
36.	22CYO02	Chemistry Concepts for Competitive Examinations	3	1	0	4	CHEMISTRY
37.	22CYO03	Organic Chemistry for Industry	3	1	0	4	CHEMISTRY
		SEMESTER VI					
38.	22CEO01	Disaster Management	3	1	0	4	CIVIL
39.	22MEX02	Design of Experiments	3	0	2	4	MECH
40.	22MTO02	Robotics	3	1	0	4	MTS
41.	22MTO03	3D Printing and Design	3	1	0	4	MTS
42.	22AUO01	Automotive Electronics	3	1	0	4	ECE
43.	22ECX03	PCB Design and Fabrication	3	0	2	4	ECE
44.	22EIO04	PLC Programming with High Level Languages	3	1	0	4	EIE
45.	22EIO05	Virtual Instrumentation	3	1	0	4	EIE
46.	22CSX04	Foundations of Machine Learning	3	0	2	4	CSE
47.	22CSX05	Web Engineering	3	0	2	4	CSE
48.	22ITX02	Advanced Java Programming	3	0	2	4	IT
49.	22ITO02	Internet of Things	3	1	0	4	IT
50.	22ITO03	Fundamentals of Software Development	3	1	0	4	IT
51.	22ITO04	Mobile Application Development	3	1	0	4	IT
52.	22CDX01	Fundamentals of User Interactive Design	3	0	2	4	CSD
53.	22ADX01	Data Visualization	3	0	2	4	AIDS
54.	22ALX01	Data Exploration and Visualization Techniques	3	0	2	4	AIML

55.	22CHO04	Air Pollution Monitoring and Control	3	1	0	4	CHEM
56.	22CHO05	Paints and Coatings	3	1	0	4	CHEM
57.	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
58.	22MAO05	Graph Theory and its Applications	3	1	0	4	MATHS
59.	22MAX01	Data Analytics using R Programming	3	0	2	4	MATHS
60.	22MAO06	Operations Research	3	1	0	4	MATHS
61.	22MAO07	Number Theory and Cryptography	3	1	0	4	MATHS
62.	22PHO04	Synthesis, Characterization and Biological Applications of Nanomaterials	3	1	0	4	PHYSICS
63.	22PHO05	Techniques of Crystal Growth	3	1	0	4	PHYSICS
64.	22CYO04	Corrosion Science and Engineering	3	1	0	4	CHEMISTRY
65.	22CYO05	Chemistry of Cosmetics in Daily Life	3	1	0	4	CHEMISTRY
66.	22CYO06	Nanocomposite Materials	3	1	0	4	CHEMISTRY
		SEMESTER VII					
67.	22CEO02	Introduction to Smart Cities	3	0	0	3	CIVIL
68.	22CEO03	Environmental Health and Safety	3	0	0	3	CIVIL
69.	22MEO01	Fundamentals of Ergonomics	3	0	0	3	MECH
70.	22MEO02	Principles of Management and Industrial Psychology	3	0	0	3	MECH
71.	22MEO03	Waste Heat Recovery System and Storage	3	0	0	3	MECH
72.	22MTO04	Drone System Technology	3	0	0	3	MTS
73.	22AUO02	Vehicle Maintenance	3	0	0	3	AUTO
74.	22ECO01	Wearable Devices	3	0	0	3	ECE
75.	22ECX04	Electronic Hardware and Troubleshooting	2	0	2	3	ECE
76.	22EIO06	Introduction to Distributed Control Systems	3	0	0	3	EIE
77.	22EIO07	Instrumentation in Aircraft Navigation and Control	3	0	0	3	EIE
78.	22EIO08	Industry 4.0 with Industrial IoT	3	0	0	3	EIE
79.	22EIO09	Industrial Data Communication	3	0	0	3	EIE
80.	22EIO10	Wireless Instrumentation	3	0	0	3	EIE

81.	22EIO11	Instrumentation Techniques in Agriculture	3	0	0	3	EIE
82.	22CSO03	Nature Inspired optimization techniques	3	0	0	3	CSE
83.	22ITO05	Fundamentals of Cloud Computing	3	0	0	3	IT
84.	22CDO02	Introduction to Mobile Game Design	3	0	0	3	CSD
85.	22CDO03	Introduction to Graphics Design	3	0	0	3	CSD
86.	22ADO02	Neural Networks and Deep Learning	3	0	0	3	AIDS
87.	22ALO02	Industrial Machine Learning	3	0	0	3	AIML
88.	22CHO07	Hydrogen Energy	3	0	0	3	CHEM
89.	22CHO08	Rubber Technology	3	0	0	3	CHEM
90.	22FTO02	Principles of Food safety	3	0	0	3	FT
91.	22FTO03	Fundamentals of Food Packaging and Storage	3	0	0	3	FT
92.	22MAO08	Non-Linear Optimization	3	0	0	3	MATHS
93.	22MAO09	Optimization for Engineers	3	0	0	3	MATHS
94.	22CYO07	Waste and Hazardous Waste Management	3	0	0	3	CHEMISTRY
95.	22CYO08	Chemistry in Every day Life	3	0	0	3	CHEMISTRY
		SEMESTER VIII					
96.	22CEO04	Infrastructure Planning and Management	3	0	0	3	CIVIL
97.	22CEO05	Environmental Laws and Policy	3	0	0	3	CIVIL
98.	22MEO04	Safety Measures for Engineers	3	0	0	3	MECH
99.	22MEO05	Energy Conservation in Thermal Equipments	3	0	0	3	MECH
100.	22MEO06	Climate Change and New Energy Technology	3	0	0	3	MECH
101.	22MTO05	Micro and Nano Electromechanical Systems	3	0	0	3	MTS
102.	22AUO03	Public Transport Management	3	0	0	3	ECE
103.	22AUO04	Autonomous Vehicles	3	0	0	3	ECE
104.	22ECO02	Optical Engineering	3	0	0	3	ECE
105.	22EIO12	Environmental Sensors	3	0	0	3	EIE
106.	22EIO13	Pollution Control and Management	3	0	0	3	EIE
107.	22CSO04	Machine Translation	3	0	0	3	CSE
108.	22CSO05	Fundamentals of Blockchain	3	0	0	3	CSE
109.	22ITO06	Introduction to Ethical Hacking	3	0	0	3	IT

110.	22ITO07	Business Continuity Planning	3	0	0	3	IT
111.	22CDX02	Virtual Reality and Augmented Reality	3	0	0	3	CSD
112.	22ADO03	Business Analytics	3	0	0	3	AIDS
113.	22ALO03	Machine Learning for Smart Cities	3	0	0	3	AIML
114.	22CHO09	Industrial Accident Prevention and Management	3	0	0	3	CHEM
115.	22CHO10	Electrochemical Engineering	3	0	0	3	CHEM
116.	22CHO11	Smart and Functional Materials	3	0	0	3	CHEM
117.	22FTO04	Food Ingredients	3	0	0	3	FT
118.	22FTO05	Food and Nutrition	3	0	0	3	FT
119.	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

22EGT11 - COMMUNICATION SKILLS I

(Common to All Engineering and Technology Branches)

Programme & Branch	**All B.E./B.Tech. Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**I**	**HS**	**3**	**0**	**0**	**3**

Preamble	This course is designed to impart required levels of Communication Skills and Proficiency in English language necessary for different professional contexts.

Unit – I	**Grammar, Vocabulary, Listening, Speaking, Reading & Writing**	**9**

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

Unit – II	**Grammar, Vocabulary, Listening, Speaking, Reading & Writing**	**9**

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

Unit – III	**Grammar, Vocabulary, Listening, Speaking, Reading & Writing**	**9**

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

Unit – IV	**Grammar, Vocabulary, Listening, Speaking, Reading & Writing**	**9**

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

Unit – V	**Grammar, Vocabulary, Listening, Speaking, Reading & Writing**	**9**

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

Total:45

TEXT BOOK:

1.	Sanjay Kumar & Pushp Lata, “Communication Skills”, 2nd Edition, Oxford University Press, New Delhi, 2018.

REFERENCES:

1.	Ashraf Rizvi, "Effective Technical Communication", 2nd Edition, McGraw-Hill India, 2017.
2.	S. P. Dhanavel, "English and Communication Skills for Students of Science and Engineering", Orient BlackSwan Publishers, Hyderabad, 2009.
3.	Jack C. Richards and Chuck Sandy, “Passages” Student’s Book 1, 3rd Edition, Cambridge University Press, New York, 2014.

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**

22PHT15 – PHYSICS FOR ELECTRICAL AND ELECTRONICS ENGINEERING

Programme & Branch	BE- Electrical and Electronics Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	**Nil**	**1**	**BS**	**3**	**0**	**0**	**3**

Preamble	This course aims to impart the knowledge on semiconducting materials, superconducting materials, dielectric materials, nanomaterials and operational amplifiers. It also describes the applications of aforementioned topics in electrical engineering.	
Unit – I	**Semiconducting materials :**	**9**
Properties – Elemental and compound semiconductors – Intrinsic and extrinsic semiconductors – Carrier concentration in n-type semiconductors and p-type semiconductors – Variation of Fermi level in extrinsic semiconductors with temperature – Hall effect – Determination of hall coefficient – Applications – Formation of p-n junction – Biasing of p-n junction – Applications of p-n junction – Solar cell: Principle, construction, working and applications.		
Unit – II	**Superconducting materials:**	**9**
Superconductivity – Temperature dependence of resistivity – Critical field – Meissner effect – Critical current – Persistent current – Isotope effect – BCS theory of superconductivity (qualitative) – Type-I superconductors and Type-II superconductors – High temperature superconductors – Cryotron – Josephson effect – Superconducting quantum interference device (SQUID).		
Unit – III	**Dielectric materials:**	**9**
Solid, liquid and gaseous dielectric materials – Dielectric constant – Polarization – Displacement vector – Electric susceptibility – Types of polarization mechanisms: Electronic, ionic, orientational and space-charge – Frequency and temperature dependence – Internal field – Clausius-Mosotti relation – Dielectric loss – Uses of dielectric materials in capacitors.		
Unit – IV	**Nanomaterials:**	**9**
Nano scale – Surface-to-volume ratio – Quantum confinement – Nano structures: Quantum well, Quantum wire and Quantum dot – Nanomaterial synthesis: Top-down and bottom-up approaches – Ball milling – Electron beam lithography – Physical vapour deposition – Chemical vapour deposition – Sol-gel method – Applications.		
Unit – V	**Operational amplifiers:**	**9**
Symbol and characteristics of operational amplifier – Common mode rejection ratio – Slew rate – Inverting amplifier – Operational amplifier as an adder – Operational amplifier as a substractor – Operational amplifier as an integrator – Operational amplifier as a differentiator – Operational amplifier as a voltage follower.		
		Total:45

TEXT BOOK:

1.	Hitendra K. Malik and A.K. Singh, "Engineering Physics", 2nd Edition McGraw-Hill Education , New Delhi, 2018. (Units I,II,III,IV)
2.	Murugeshan R. and Kiruthiga Sivaprasath, "Modern Physics", 18th edition, S Chand And Company Limited, New Delhi, 2019. (Unit V)

REFERENCES:

1.	Charles Kittel, "Introduction to Solid State Physics", 8th Edition, John Wiley &Sons,New Jersey, 2004.
2.	Pillai S.O. and Sivakami Pillai, "Rudiments of Materials Science", 3rd Edition, New Age International Publishers, New Delhi, 2012.
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	use the concept of density of states to compute the carrier concentration of extrinsic semiconductors. Also to explain the phenomenon related to formation p-n junction, Hall Effect and the working of solar cell.	Applying (K3)
CO2	apply the concept of Cooper pair to comprehend the properties, types and applications of superconductors.	Applying (K3)
CO3	apply the concept of electric dipole moment and electric polarization to comprehend the different polarization mechanisms in dielectrics, Clausius-Mosotti relation, dielectric loss and to describe its uses in capacitors.	Applying (K3)
CO4	utilize appropriate methods to prepare nanomaterials and also to comprehend their properties and applications.	Applying (K3)
CO5	use the characteristics of operational amplifier to perform addition, subtraction, integration and differentiation and voltage follower.	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	2	1
CO2	3	2	2						2	2		2	2	1
CO3	3	2	2						2	2		2	2	1
CO4	3	2	2						2	2		2	2	1
CO5	3	2	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	40	45				100
CAT2	15	40	45				100
CAT3	15	40	45				100
ESE	10	40	50				100

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

22EET11 - ELECTRIC CIRCUIT ANALYSIS

Programme & Branch	**BE – Electrical and Electronics Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**1**	**PC**	**3**	**0**	**0**	**3**

Preamble	This course aims to impart knowledge on analysis of electric AC and DC circuits.	
Unit – I	**DC and AC Circuits:**	**9**
DC CIRCUITS: Types of sources- Dependent and Independent sources - Source transformation - Current and Voltage division rule - Mesh and nodal analysis - super mesh and super node analysis. **AC CIRCUITS :**Power, power factor, impedance triangle, voltage triangle and power triangle of RL and RC circuits – Mesh and nodal analysis.		
Unit - II	**Network Theorems:**	**9**
DC and AC: Superposition Theorem – Thevenin's Theorem – Norton's Theorem – Maximum Power Transfer Theorem -Reciprocity Theorem - Millman's Theorem-Application to DC and AC circuits.		
Unit - III	**Resonance and DC Transients:**	**9**
Resonance circuits: Resonant Frequency, Current and Voltage Variations, Bandwidth, Q factor for series resonance circuits- Basic concept of simple parallel resonance circuit. **DC Transients:** natural and forced response of RL, RC and RLC circuits		
Unit - IV	**Three Phase Circuits:**	**9**
Star-Delta transformation - Star and Delta systems – Line and Phase Quantities - Three Phase Power - Balanced and Unbalanced Circuit – Three wire and Four wire systems.		
Unit - V	**Two-Port Networks and Coupled Circuits:**	**9**
Two-Port Networks: Impedance Parameter –Admittance Parameter –ABCD Parameters – T and π Representation. **Coupled Circuits**: Mutual inductance – Dot Convention – Coefficient of Coupling – Analysis of Simple Coupled Circuits.		
		Total:45

TEXT BOOK:

1.	Sudhakar A. and Shyammohan S. Palli, "Circuits and networks- Analysis and Synthesis", 5th Edition, Tata McGraw Hill Publishing Company, New Delhi, 2017.

REFERENCES:

1.	Charles K. Alexander , Matthew N.O. Sadiku , "Fundamentals of Electric Circuits", 7thEdition, Tata McGraw Hill Publishing Company, New Delhi, 2022
2.	AbhijitChakrabarti, "Circuit Theory Analysis and Synthesis", 7th Revised Edition, Dhanapat Rai & Co., New Delhi, 2018.
3.	Robert L. Boylestad, "Introductory Circuit Analysis", 13thEdition, Pearson Education, India, 2018

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	evaluate electric circuits using dependent and independent sources.	Applying (K3)
CO2	analyze DC and AC networks using various theorems.	Analyzing (K4)
CO3	explain resonant and DC transients using R,L,C elements.	Applying (K3)
CO4	differentiate balanced and unbalanced loads in three phase AC circuits.	Applying (K3)
CO5	interpret the concept of coupled circuits and two port 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	1	1	1				1			1	3	2
CO2	2	3	2	2					1			1	3	2
CO3	3	2	1	1					1			1	3	2
CO4	3	2	1	1					1			1	3	2
CO5	3	2	1	1					1			1	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	10	25	65	-	-	-	100
CAT2	10	20	30	30	-	-	100
CAT3	10	45	40	-	-	-	100
ESE	5	20	57	18	-	-	100

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

22CSC11 - PROBLEM SOLVING AND PROGRAMMING IN C							
(Common to All Engineering and Technology branches except CSE, IT, CSD, AIDS & AIML)							
Programme & Branch	**All BE/BTech Engineering & Technology branches , except CSE, IT, CSD, AIDS & AIML**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**1**	**BS**	**3**	**0**	**2**	**4**

Preamble	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	
Unit – I	**Introduction to C and Operators:**	**9**
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		
Unit – II	**Control Statements and Arrays:**	**9**
Decision-making and looping statements, Arrays: Declaring, initializing and accessing arrays – operations on arrays – Two-dimensional arrays and their operations.		
Unit – III	**Functions:**	**9**
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		
Unit – IV	**Strings and Pointers:**	**9**
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		
Unit – V	**User-defined Data Types and File Handling:**	**9**
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()		

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)

22PHL15 - PHYSICS LABORATORY FOR ELECTRICAL AND ELECTRONICS ENGINEERING							
Programme & Branch	**BE- Electrical and Electronics 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 physical parameters such as band gap, Hall coefficient, specific resistance, AC frequency, velocity of ultrasound, compressibility of a liquid, thickness of thin wire, thermal conductivity, Young's modulus and knowledge on the working of p-n diode, UJT and LCR circuit and also to impart skills on writing coding / developing project / product related to societal requirement.

LIST OF EXPERIMENTS / EXERCISES:

1.	Determination of the band gap of a given semiconducting material using post-office box / Determination of the Hall coefficient of a material using Hall effect arrangement.
2.	Observation of the I-V characteristics of a p-n junction diode.
3.	Observation of the I-V characteristics of a uni junction transistor / Studying the variation of current and voltage in a series LCR circuit.
4.	Determination of the specific resistance of the given metallic wire using Carey-Foster's bridge.
5.	Determination of the frequency of alternating current using electrically vibrating tuning fork (Melde's apparatus).
6.	Determination of the velocity of ultrasonic waves in a liquid and the compressibility of the liquid using ultrasonic interferometer.
7.	Determination of the thickness of a thin wire using air-wedge method.
8.	Determination of the thermal conductivity of a bad conductor using Lee's disc.
9.	Determination of the Young's modulus of the material of a given beam using uniform bending 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 band gap of semiconducting materials using the concept of variation of resistance with temperature or to determine the Hall coefficient of a material using the concept of Hall effect and to obtain the I-V characteristics of a p-n diode. To obtain I-V characteristics of UJT using the concept of region with negative resistance or to study the variation of current in a series LCR circuit.	Applying (K3), Precision (S3)
CO2	determine the specific resistance of a given wire using the principle of Wheatstone bridge. To determine the AC frequency and the velocity of ultrasound in a liquid by means of formation of standing waves and to determine and thickness of a thin film using the concept of interference.	Applying (K3), Precision (S3)
CO3	determine the thermal conductivity of a bad conductor using concept of heat conduction through materials and the Young's modulus of a material using the concepts of elasticity and bending moment of a beam 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	2	1
CO2	3	2	2	3					2	2		2	2	1
CO3	3	2	2	3					2	2		2	2	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/ 2**	**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>
</table>

Preamble	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.

Unit – I	**Grammar, Vocabulary, Listening, Speaking, Reading & Writing**	**9**

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

Unit – II	**Grammar, Vocabulary, Listening, Speaking, Reading & Writing**	**9**

Grammar: Concord **- Vocabulary:** Phrasal verbs **-** Idioms & Phrases - **Listening:** Listening to celebrity talks - **Speaking:** Talking about celebrities - Practicing Pronunciation through web tools - **Reading:** Company correspondence, technical texts/working principles of a machine - **Writing:** Description: Person, Place**,** Process, Product and Picture

Unit – III	**Grammar, Vocabulary, Listening, Speaking, Reading & Writing**	**9**

Grammar: Discourse markers **-** Transitional words and phrases **- Vocabulary:** Commonly confused words **- Listening:** Listening to guest lectures **- Speaking:** Technical & Non-technical presentations **-** Workshop presentations **- Reading:** Reputed company profiles, Business Plans **- Writing:** a dream job/company **-** Letter to the Editor **–** Biography & Autobiography **-** Checklist

Unit – IV	**Grammar, Vocabulary, Listening, Speaking, Reading & Writing**	**9**

Grammar: Degrees of Comparison **-** Punctuations **–** Fragments & run-ons **- Vocabulary:** British & American **-** Spelling & words **- Listening:** Listening to global accents **-** listening to motivational speeches **-** S**peaking:** Narrating personal milestones **-** Sports commentaries **-** Movie Enactment **- Reading:** Narrative passages **- Writing:** E mail **-** Agenda & Minutes of Meeting **-** Special & Technical reports

Unit – V	**Grammar, Vocabulary, Listening, Speaking, Reading & Writing**	**9**

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

Total:45

TEXT BOOK:

1.	Sanjay Kumar & Pushp Lata, “Communication Skills”, 2nd Edition, Oxford University Press, New Delhi, 2018.

REFERENCES:

1.	Meenakshi Raman and Sangeeta Sharma. “Technical Communication- Principles and Practice”. 4th Edition, Oxford University Press, New Delhi, 2022.
2.	Murphy Raymond, "English Grammar in Use", 5th Edition, Cambridge University Press, New York, 2019.
3.	Jack C. Richards and Chuck Sandy, “Passages” Student’s Book 2, 3rd Edition, Cambridge University Press, New York, 2014.

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**

22CYT24 – CHEMISTRY FOR ELECTRICAL AND ELECTRONICS ENGINEERING							
Programme & Branch	**B.E & Electrical and Electronics Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**2**	**BS**	**3**	**0**	**0**	**3**

Preamble	This course aims to emphasize the engineering students to realize the importance of electrochemistry, metal finishing, organic electronic materials, fuels & combustion and the need for e-waste management.

Unit – I	**ELECTROCHEMISTRY**	**9**
Introduction – cells – types – representation of galvanic cell – electrode potential – Nernst equation (derivation of cell EMF) – calculation of cell EMF from single electrode potential – reference electrodes: construction, working and applications of standard hydrogen electrode, standard calomel electrode, glass electrode – EMF series and its applications – potentiometric titrations (redox) – conductometric titrations – mixture of weak and strong acid vs strong base.		
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	**ORGANIC ELECTRONIC MATERIALS**	**9**
Introduction – conducting polymers – p-type and n-type organic semiconducting materials – advantages over inorganic semiconducting materials – organic dielectric materials – processing and fabrication – spin coating, evaporation, sputtering, electrospinning, drop casting, templating – organic light emitting diodes – working, types and applications – comparison of LCD vs LED –organic field-effect transistors and organic solar cells- working, types and applications.		
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, IV, V.
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-III, 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.	O.G.Palanna, “Engineering Chemistry”, second Edition, McGraw Hill Education (India) Private Limited, Chennai, 2018.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	apply the principles of electrochemistry for various applications	Applying (K3)
CO2	apply the concept of plating techniques in industrial metal finishing	Applying (K3)
CO3	utilize the organic electronic materials for various applications	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									2	1
CO2	3	2	1	1									2	1
CO3	3	2	1	1									2	1
CO4	3	2	1	1									2	1
CO5	3	2	1	1			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	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)

22EEC21 - ELECTRICAL MEASUREMENTS AND INSTRUMENTATION							
Programme & Branch	**B.E & Electrical and Electronics Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**2**	**ES**	**3**	**0**	**2**	**4**

Preamble	This course aims in imparting knowledge of Basic principles of Electrical Measurements, construction and working principle of different Electromechanical Instruments. It also aims in imparting fundamental knowledge of measurement of Power, Energy, Resistance, Impedance and different Electronic measuring instruments.

Unit – I	**Basics of Measurements:**	**9**
Importance of Measurement – Purpose of Measurement – Methods of Measurement – Functional blocks of a Measurement System – Static and Dynamic Characteristics. Types of Instruments-Types of Errors – Operating Forces in Analog Instruments.		
Unit – II	**Electromechanical Instruments:**	**9**
Permanent Magnet Moving Coil (PMMC): Construction and Working Principle – Torque Equation and Problems – Ammeter Shunts – Voltmeter Multipliers (Simple Problems) – Moving Iron Instruments: General Torque Equation – Classification – Construction, Working – Construction and Working of CT and PT – Calibration		
Unit – III	**Measurement of Power, Power factor and Energy**	**9**
Electrodynamometer Wattmeter: Construction –Theory- Low Power factor Wattmeter– Three Phase Wattmeter – Power Factor Meters: Single Phase Electrodynamometer Power Factor Meter – Single Phase Induction Type Energy Meters: Construction – Theory of Operation – Phantom Loading.		
Unit – IV	**Measurement of Resistance and Impedance**	**9**
Classification of Resistances – Kelvin‘s Double Bridge – A.C Bridges: Introduction – Sources and Detectors – Measurement of Self Inductance & Capacitance: Maxwell‘s Inductance Bridge – Capacitance Bridge – Schering Bridge – Wien‘s Bridge – Meggar (Earth tester).		
Unit – V	**Electronic Measuring Instruments**	**9**
Digital Multi meters –Function generators, Weston Type Frequency Meter – Digital Recording Systems-digital Data Acquisition system –Single Phase Digital Energy Meter-Intelligent Panel Meters.		

LIST OF EXPERIMENTS / EXERCISES:

1.	Calibration Of DC voltmeter and DC ammeter
2.	Calibration of Single phase Energy meter
3.	Measurement of High AC Currents Using Current Transformer.
4.	Measurement of High AC Voltage Using Potential Transformer
5.	Range Extension of DC voltmeter
6.	Range Extension of DC Ammeter
7.	Measurement of Medium and Low Resistances using DC bridges
8.	Measurement of Electrical parameters using Power Quality Analyzer

Lecture: 45, Practical : 30 ,Total: 75

TEXT BOOK:

1.	Sawhney A.K., “Electrical and Electronic Measurements and Instrumentation”, 19th Revised Edition, Dhanpath Rai& Co., New Delhi, 2021

REFERENCES/ MANUAL / SOFTWARE:

1.	Gupta J.B., “A Course in Electronic and Electrical Measurements and Instrumentation”,13th Edition, S.K.Kataria& Sons, New Delhi, 2013.
2.	Edward William Golding and Frederick Charles Widdis, “Electrical Measurements and Measuring Instruments”, 6th Edition, Reem Publications, New Delhi, 2011.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	explain the functional blocks of measurement system and the static and dynamic characteristics of instruments.	Understanding(K2) Manipulation (S2)
CO2	outline the concepts of different measuring Instrument and Calibrate different Instruments.	Applying (K3) Manipulation (S2)
CO3	explain the concepts of instruments used for measuring electrical parameters	Understanding(K2) Manipulation (S2)
CO4	make use of the bridges for measurement of Resistance, Capacitance and Inductance	Applying (K3) Manipulation (S2)
CO5	identify an appropriate digital instrument for measurement of electrical parameters	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	2	1									2	3	1
CO2	3	1	2	2								2	3	1
CO3	3	2							1			2	2	1
CO4	3	2	1	1								2	3	2
CO5	3	2	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	60	20				100
CAT3	20	60	20				
ESE	15	55	30				100

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

22EET21 – ELECTROMAGNETIC THEORY							
Programme & Branch	**BE – Electrical and Electronics Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**2**	**BS**	**3**	**0**	**0**	**3**

Preamble	This course explores the concepts of static electric, static magnetic and electromagnetic fields and its applications	
Unit – I	**Introduction to Vector Algebra and Electric Fields:**	**9**
Scalar and Vector Fields – Review of vector algebra. Cartesian and Curvilinear Coordinates System – Conversion of co-ordinate system. Divergence – Divergence Theorem – Curl – Stoke's Theorem. **Coulomb's law and Electric field intensity:** Electric Charge – Types of Charge Distribution – Coulomb's Law – Electric Field Intensity Due to Point Charge, Line Charge and Surface Charge Distribution.		
Unit – II	**Electrostatics:**	**9**
Electric Flux Density, Gauss's Law and Potential: Electric Flux Density – Gauss's Law – Application of Gauss's Law – Potential Difference – Potential – Conservative Property – Potential Gradient **Conductors, Dielectrics and Capacitors:** Conduction Current, Displacement Current – Polarization – Law of Continuity – Boundary Condition: Conductor-Dielectric and Dielectric-Dielectric – Capacitors: Parallel Plate, Transmission Line – Poisson's and Laplace's Equations.		
Unit – III	**Steady Magnetic Fields:**	**9**
Magento static Field: Biot-Savart's Law – Ampere's Circuital Law – Application of Ampere's law – Magnetic Field due Straight Conductors , Circular Loop – Magnetic Flux – Magnetic Flux Density – Energy Stored. **Force and Inductance:** Magnetic Force, Moving Charge in a Magnetic Field, Lorentz Force – Force Between Two Parallel Current Carrying Conductors –Magnetic Boundary Conditions – Magnetic Circuit – Self and Mutual Inductance – Inductance of Solenoid		
Unit – IV	**Electromagnetics:**	**9**
Time varying fields: Time Varying Fields – Transformer and Rotational EMF. Maxwell's equation: Maxwell's Equation in Point Form and Integral Form **Electromagnetic Radiation:** Ironising and non – ironising radiation –radiation effects –radiation measurements Introduction to EMI and EMC – Definition – Types – causes and remedial measures		
Unit – V	**Application of electromagnetic fields: (Block diagram approach)**	**9**
Domestic– SMPS, fans, induction cooking. **Industry:** Generator, sensors and actuators. **Transport**: magnetic levitation. **Medical**: Magnetic resonance imaging, magnetotherapy. **Communication**: EM waves in different types of communication – Electromagnetic Spectrum		
		Total:45

TEXT BOOK:

1.	Sadiku Matthew N.O., "Principles of Electromagnetics", 6th Edition, Oxford University Press, New Delhi, 2021.

REFERENCES:

1.	HaytJr W.H., Buck J.A., JaleelAkhtar M., "Engineering Electromagnetics" 9th Edition McGraw Hill Education, India, 2020.
2.	Meenakumari,R., Subasri,R., "Electromagnetic Fields", 2nd Edition, New Age International Publishers, Chennai, 2007.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	distinguish the various coordinate systems and charge distribution	Applying (K3)
CO2	apply Gauss's law for the evaluation of EFI for different configurations and its application in capacitor	Applying (K3)
CO3	infer about the MFI and inductance for different configurations	Applying (K3)
CO4	recap the electromagnetic waves and its parameters	Understanding (K2)
CO5	recapitulate the sources of EMI and the control techniques to reduce EMI	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	2	3
CO2	3	2	1						1			1	2	3
CO3	3	2	1						1			1	2	3
CO4	3	2	1						1			1	2	3
CO5	3	2							1			1	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	10	30	60				100
CAT2	10	40	50				100
CAT3	20	80					100
ESE	5	50	45				100

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

22CSC22 – DATA STRUCTURES USING C							
(Common to ECE, EEE, EIE and MTS Branches)							
Programme & Branch	**BE - ECE, EEE, EIE and MTS Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Programming in C**	**2**	**PC**	**3**	**0**	**2**	**4**

Preamble	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.	
Unit – I	**List:**	**9**
Data Structures - Abstract Data Types (ADT) - List ADT and Array Implementation - Linked List - Doubly Linked List - Circular Linked List – Application: Polynomial Addition		
Unit – II	**Stack and Queues:**	**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		
Unit – III	**Trees:**	**9**
Trees-Preliminaries – Binary Trees –Binary Tree Traversals - The Search Tree ADT – Binary Search Trees–Priority Queues (Binary Heap)- Application: Expression Tree		
Unit – IV	**Graphs:**	**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.		
Unit – V	**Sorting and Hashing:**	**9**
Sorting - Preliminaries – Insertion Sort – Quicksort – Merge sort – Heapsort – Hashing – General Idea – Hash Function – Separate Chaining – Open addressing.		

LIST OF EXPERIMENTS / EXERCISES:

1.	Implementation of C programs using pointers
2.	Implementation of singly linked list and its operations
3.	Implementation of doubly linked list and its operations
4.	Implementation of Stack and its operations
5.	Implementation of Queue and its operations
6.	Implementation of Stack and Queue using Singly Linked List
7.	Convert a given In-fix Expression into Post-fix Expression using Stack ADT
8.	Evaluate the Post-fix Expression using Stack ADT
9.	Implementation of Binary Search Tree traversals
10.	Implementation of sorting algorithms: Insertion and Quick sort

Lecture:45, Practical:30, Total:75

TEXT BOOK:

1.	Weiss M. A., "Data Structures and Algorithm Analysis in C", 2nd Edition, Pearson Education Asia, New Delhi, 2016.

REFERENCES/ MANUAL / SOFTWARE:

1.	Horowitz Sahni, Andreson Freed, "Fundamentals of Data Structures in C", 2nd Edition, Universities Press, Hyderabad, 2011.
2.	Langsam Y.M., Augenstein J. and Tenenbaum A. M., “Data Structures using C and C++”, 2nd Edition, Pearson Education, 2015.

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

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)

22TAM01 - HERITAGE OF TAMILS								
(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	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.	
UNIT I	**Language and Literature**	**3**
Language families in india - dravidian languages – tamil as a classical language - classical literature in tamil – secular nature of sangam literature – distributive justice in sangam literature - management principles in thirukural - tamil epics and impact of buddhism & jainism in tamil land - bakthi literature azhwars and nayanmars - forms of minor poetry - development of modern literature in tamil - contribution of bharathiyar and bharathidhasan.		
UNIT II	**Heritage - Rock Art Paintings to Modern Art – Sculpture**	**3**
Hero stone to modern sculpture - bronze icons - tribes and their handicrafts - art of temple car making - - massive terracotta sculptures, village deities, thiruvalluvar statue at kanyakumari, making of musical instruments - mridhangam, parai, veenai, yazh and nadhaswaram - role of temples in social and economic life of tamils.		
UNIT III	**Folk and Martial Arts**	**3**
Therukoothu – karagattam - villu pattu - kaniyan koothu – oyillattam - leather puppetry – silambattam – valari - tiger dance - sports and games of tamils.		
UNIT IV	**Thinai Concept of Tamils**	**3**
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.		
UNIT V	**Contribution of Tamils to Indian National Movement and Indian Culture**	**3**
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.		
		Total: 15

TEXT BOOK:

1.	S.Muthuramalingam, M.Saravanakumar, Heritage of Tamils, Yes Dee Publishing Pvt Ltd, 2023.

REFERENCES:

1.	Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukarasu) (Published by : International Institute of Tamil Studies).
2.	The Contribution of Tamil of the Tamils to Indian Culture(Dr.M.Valarmathi)(Puplished by International Institute of Tamil Studies).
3.	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).

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)

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- determine 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						2	1
CO2	3	2	1	3			3						2	1
CO3	3	2	1	3			2						2	1

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

22EEL21 - ELECTRIC CIRCUITS LABORATORY							
Programme & Branch	**BE – Electrical and Electronics Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Electric Circuit Analysis**	**2**	**BS**	**0**	**0**	**2**	**1**

Preamble	This course helps the students to demonstrate current and voltage in electric circuits through simulation as well as discrete components.

LIST OF EXPERIMENTS / EXERCISES:

1.	Determination of loop currents in mesh analysis.
2.	Simulation of mesh analysis using dependent sources.
3.	Verification of super position theorem / maximum power transfer theorem.
4.	Design and simulation of series / parallel resonance circuit for a given frequency. (discrete components/simulation software)
5.	Simulation of DC transients in RL / RC circuits.
6.	Simulation and determination of circuit parameters in three phase balanced and unbalanced loads.
7.	Measurement of self inductance, mutual inductance and coefficient of coupling.
8.	Determination of Z and Y parameters for the T and π networks. (discrete components/simulation software)
9.	Construct and simulate the passive filters using open CV.
10.	PCB board implementation of DC/AC circuits.
	Total:30

REFERENCES/ MANUAL /SOFTWARE:

1.	Laboratory Manual
2.	Multisim software

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	demonstrate the verification of network theorems and measurement of three phase power.	Applying(K3), Precision (S3)
CO2	design and simulate resonant, transients and filters using software tools.	Applying (K3), Manipulation (S2)
CO3	design, simulate and implement various DC and AC circuits.	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								1	3	2
CO2	3	2	1	1								1	3	2
CO3	3	2	1	1								1	3	2

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

22EET22 – ELECTROMAGNETIC FIELDS

Programme & Branch	BE – Electrical and Electronics Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	**Nil**	**2**	**PC**	**3**	**1**	**0**	**4**

Preamble	This course explores the concepts of static electric, static magnetic and electromagnetic fields and its applications

Unit – I	**Introduction to Vector Algebra and Electric Fields:**	**9**

Scalar and Vector Fields – Review of vector algebra. Cartesian and Curvilinear Coordinates System – Conversion of co-ordinate system. Divergence – Divergence Theorem – Curl – Stoke's Theorem.
Coulomb's law and Electric field intensity: Electric Charge – Types of Charge Distribution – Coulomb's Law – Electric Field Intensity Due to Point Charge, Line Charge and Surface Charge Distribution.

Unit – II	**Electrostatics:**	**9**

Electric Flux Density, Gauss's Law and Potential: Electric Flux Density – Gauss's Law – Application of Gauss's Law – Potential Difference – Potential – Conservative Property – Potential Gradient
Conductors, Dielectrics and Capacitors: Conduction Current, Displacement Current – Polarization – Law of Continuity – Boundary Condition: Conductor-Dielectric and Dielectric-Dielectric – Capacitors: Parallel Plate, Transmission Line – Poisson's and Laplace's Equations.

Unit – III	**Steady Magnetic Fields:**	**9**

Magento static Field: Biot-Savart's Law – Ampere's Circuital Law – Application of Ampere's law – Magnetic Field due Straight Conductors , Circular Loop – Magnetic Flux – Magnetic Flux Density – Energy Stored.
Force and Inductance: Magnetic Force, Moving Charge in a Magnetic Field, Lorentz Force – Force Between Two Parallel Current Carrying Conductors –Magnetic Boundary Conditions – Magnetic Circuit – Self and Mutual Inductance – Inductance of Solenoid

Unit – IV	**Electromagnetics:**	**9**

Time varying fields: Time Varying Fields – Transformer and Rotational EMF. Maxwell's equation: Maxwell's Equation in Point Form and Integral Form – Wave equation.
Electromagnetic Radiation: Ironising and non – ironising radiation –radiation effects –radiation measurements
Introduction to EMI and EMC – Definition – Types – causes and remedial measures

Unit – V	**Application of electromagnetic fields: (Block diagram approach)**	**9**

Domestic– SMPS, fans, induction cooking. **Industry:** Generator, sensors and actuators. **Transport**: magnetic levitation. **Medical**: Magnetic resonance imaging, magnetotherapy. **Communication**: EM waves in different types of communication – Electromagnetic Spectrum

Total:45

TEXT BOOK:

1. Sadiku Matthew N.O., "Principles of Electromagnetics", 6th Edition, Oxford University Press, New Delhi, 2021.

REFERENCES:

1. HaytJr W.H., Buck J.A., JaleelAkhtar M., "Engineering Electromagnetics" 9th Edition McGraw Hill Education, India, 2020.
2. Meenakumari,R., Subasri,R., "Electromagnetic Fields", 2nd Edition, New Age International Publishers, Chennai, 2007.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	distinguish the various coordinate systems and charge distribution	Applying (K3)
CO2	apply Gauss's law for the evaluation of EFI for different configurations and its application in capacitor	Applying (K3)
CO3	infer about the MFI and inductance for different configurations	Applying (K3)
CO4	recap the electromagnetic waves with its parameters and the sources of EMI with its control techniques to reduce EMI	Understanding (K2)
CO5	Describe the applications of EMF in various domains namely domestic, industry, transport, medical and communication.	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	2	3
CO2	3	2	1						1			1	2	3
CO3	3	2	1						1			1	2	3
CO4	3	2	1						1			1	2	3
CO5	3	2							1			1	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	10	30	60				100
CAT2	10	40	50				100
CAT3	20	80					100
ESE	5	50	45				100

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

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", 11^{th} 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)

22EET31 - DC MACHINES AND TRANSFORMERS

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

Preamble	This course aims in imparting knowledge on construction and working principle of DC machines. It also aims in imparting fundamental knowledge of transformer construction, types, operation and testing concepts required for electrical engineers.	
Unit – I	**Principles of Electromechanical Energy Conversion:**	**9+3**
Review of Magnetic Circuits – Magnetic Circuit Calculations and Magnetization Curves – Energy in Magnetic field System: Energy and Co-energy – Field Energy and Mechanical Force – Singly excited and doubly excited system – Forces/Torques Calculation – Case Study: Solenoid with Control Circuit of Automobile Application.		
Unit – II	**DC Generators:**	**9+3**
Constructional Details – Working Principle – Types of Armature Winding and Configurations – Short Circuit Coil –EMF Equation – Methods of Excitation – Characteristics of Series and Shunt Generators – Armature Reaction and Commutation – Losses, Efficiency and Power Stages in DC Generator – Condition for Maximum Efficiency – Applications.		
Unit – III	**DC Motors:**	**9+3**
Principle of Operation – Back EMF and Torque Equations – Types of DC Motors – Characteristics of Series, Shunt and Compound Motors – Applications – Starters – Speed Control Methods – Testing of DC Machines – Lock Torque Measurement – Testing Standards – IEC, NEMA.		
Unit – IV	**Transformers:**	**9+3**
Constructional Details – Types – Principle of Operation – EMF Equation – Transformation Ratio – Phasor Diagram – Transformer on No Load and Load – Equivalent Circuit – OC and SC Test – Regulation and Efficiency – Parallel Operation – Auto Transformer – Saving of Copper – High Frequency Transformer.		
Unit – V	**Transformer Testing and Practice:**	**9+3**
Losses and Efficiency in Transformers – Condition for Maximum Efficiency – Polarity Test, Load Test – Phasing out Test – Sumpner's Test – IEC/IEEE Standard Practices of Testing transformers – Separation of Losses – All day Efficiency – Instrument Transformers – Three Phase Transformers – Types of Connections.		
		Lecture:45, Tutorial:15, Total:60

TEXT BOOK:

1.	Rajput R.K.,"Electrical Machines", 6th Edition, Laxmi Publications, New Delhi, 2018.

REFERENCES:

1.	Kothari D.P. and Nagrath I.J., "Electric Machines", 5th Edition, Tata McGraw Hill Publishing Company, New Delhi, 2018.
2.	Bimbhra P.S., "Electrical Machinery", 7th Edition, Khanna Publishers, New Delhi, 2021.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	interpret the concepts of magnetic circuits and electromechanical energy conversion	Understanding (K2)
CO2	demonstrate the construction and working principle of DC machines	Applying (K3)
CO3	select suitable starters, speed control and testing methods applicable to DC motors	Understanding (K2)
CO4	determine the performance of transformers	Applying (K3)
CO5	examine the losses and efficiency of transformer by applying various testing methods and select the instrument transformers for relevant power measurement needs.	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
CO2	3	2	1				1		1			1	2	3
CO3	3	1					1		1			1	1	2
CO4	3	2	1	2								1	2	3
CO5	2	3	1	2	1							1	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	10	55	35	-	-	-	100
CAT2	10	55	35	-	-	-	100
CAT3	20	80	-	-	-	-	100
ESE	5	60	35	-	-	-	100

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

22EET32 – ANALOG ELECTRONICS							
Programme & Branch	**B.E & Electrical and Electronics Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Physics**	**3**	**PC**	**3**	**0**	**0**	**3**

Preamble	To examine the basic and design knowledge about electronic circuit analysis using BJT and op-amp which involves feedback, oscillator, high frequency amplifiers and its applications	
Unit – I	**Semiconductor devices and transistor biasing:**	**9**
Semiconductor Devices: Diode Current Equation –Special Purpose Diodes: Zener diode, Varactor Diode, Tunnel Diode–Applications of Diodes: Clipper and Clamper –Operation and Characteristics of UJT – UJT as Relaxation Oscillator. **Transistor Biasing and Stability**: VI Characteristics of Common Emitter BJT – Transistor Biasing- Operating Point – Stability and Stability Factor: Fixed Bias Circuits and Voltage Divider Bias		
Unit – II	**Differential, Tuned and Power Amplifiers:**	**9**
Differential, Tuned and Power Amplifiers: Differential Amplifier using BJT– Differential and Common Mode Gain, CMRR – Characteristics of Tuned Amplifiers – Frequency Response of Single and Double Tuned Amplifier –Power Amplifiers: Class B Push Pull Amplifiers.		
Unit – III	**Feedback Amplifiers and Oscillators:**	**9**
Feedback Amplifiers and Oscillators: Principle, Advantages of Negative Feedback Amplifiers – Types of Feedback Connections: Voltage / Current, Series/ Shunt Feedback –Classification of Oscillators – Stability of Feedback Circuits using Barkhausen Criteria – Phase Shift and Hartley Oscillators		
Unit – IV	**Op-amp Applications:**	**9**
Introduction to op-amp – Applications : Instrumentation Amplifier –V/I and I/V Converter – Voltage to frequency converter – Comparator – Square Wave Generator –– Schmitt Trigger – VCO – PLL: Basic principle – Design and Development of Temperature Controlled Circuit using Op-amp as ONOFF - Filters: LPF, HPF (first order).		
Unit – V	**Special Purpose Ics:**	**9**
Timer (IC 555): Functional block, Characteristics of 555 Timer – Application (PWM) – AD623 Instrumentation Amplifier and its application – IC voltage regulators – LM78XX, LM79XX- Fixed voltage regulators – application as Linear power supply – LM317, 723 Variable voltage regulators, switching regulator – SMPS.		
		Total:45

TEXT BOOK:

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

REFERENCES:

1.	Roy Choudhry D. and Shail Jain, “ Linear Integrated Circuit “, 5th Edition, New Age International, New Delhi, 2018.
2.	Salivahanan S. and Suresh Kumar N., “Electronic Devices and Circuit “, 4th Edition, Tata McGraw Hill Publishing Company, New Delhi, 2017.
3.	Sedra and Smith, “Microelectronics”, 7th Edition, Oxford University Press, 2017.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	describe the operation of semiconductor devices, transistor biasing and stability	Understanding (K2)
CO2	explain the working and characteristics of differential, tuned and power amplifiers	Understanding (K2)
CO3	illustrate the operation of feedback amplifiers and oscillators	Understanding (K2)
CO4	design and implement the linear applications of Op-Amp	Applying(K3)
CO5	examine and identify the IC's for 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
CO2	3	2	1	1	2				1			1	2	1
CO3	3	2	1	1	2				1			1	2	1
CO4	2	3	2	1	2				1			1	3	2
CO5	2	3	2	1	2				1			1	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	30	70	-	-	-	-	100
CAT2	30	70	-	-	-	-	100
CAT3	10	30	60	-	-	-	100
ESE	5	60	35	-	-	-	100

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

22EET33 – DIGITAL ELECTRONICS

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

Preamble	This course aims to impart knowledge on the design of combinational and sequential logic circuits that aids the students to perform the analysis, design of various digital electronic circuits and programming it using Verilog Hardware Description Language in Gate Level modeling

Unit – I	**Review of Number Systems and Logic Simplification**	**9**

Review of number systems – Number Base conversion – Boolean Algebra– Boolean Laws– De Morgan's Theorem– Boolean Equation – SOP and POS representations and conversions – Logic simplification using Boolean Algebra– Four variable K map – Logic Simplification using K Maps – Don't Cares – NAND and NOR implementation– RTL DTL, TTL, ECL and CMOS Gates

Unit – II	**Combinational Circuits**	**9**

Design Procedure – Binary Addition – Binary Subtraction – Decoders – Encoders – Multiplexers – Demultiplexers – Code Conversion: Gray to Binary, Binary to gray, BCD to Binary, Binary to BCD – Magnitude comparators: 1 bit, 2 bit. SPLDs –ROM– PLA – PAL.

Unit – III	**Synchronous Sequential Circuits**	**9**

Latches and Flip-flops – Conversion of one type of flip-flop to another type – Operating characteristics of Flip-flops – Analysis of Synchronous sequential circuits: State Table, State Diagram, State Equation – Design procedure of Synchronous sequential circuits – State reduction of synchronous sequential circuits – Synchronous counters

Unit – IV	**Asynchronous Sequential Circuits**	**9**

Design procedure of Asynchronous sequential circuits – Fundamental mode sequential circuits – Design Procedure for Fundamental mode Asynchronous sequential circuits – Cycles and Races – Hazards: Static Hazards – Dynamic Hazards – Hazard free Realization – Essential Hazards–Ripple Counter.

Unit – V	**HDL**	**9**

Verilog HDL – Overview – Hierarchical Modelling Concepts –Basic Concepts – Modules and Ports - Gate level modeling.
VHDL-Entity Declaration – Architecture Body – Configuration Declaration – Structural Modeling – Component Declaration – Component Instantiation.
Gate level modeling of Adders, subtractors, Decoders, Encoders, Multiplexers, Demultiplexers using Verilog and VHDL.

Total:45

TEXT BOOK:

1.	Soumitra Kumar Mandal, "Digital Electronics Principles and Applications", Eleventh Reprint Edition, Tata McGraw Hill, New Delhi, 2017, for Units I, II, III, IV.
2.	Samir Palnitkar, "Verilog HDL: Guide to Digital Design and Synthesis", Second Edition, Pearson Education, New Delhi, 2017 for Unit V.

REFERENCES:

1.	AnandKumar.A, "Fundamentals of Digital Circuits" 4th Edition, Prentice Hall of India, Chennai, 2016
2.	Morris Mano.M, "Digital Design with an Introduction to the Verilog HDL, VHDL, and System Verilog", 6th Edition, Pearson Education, New Delhi, 2018.
3.	Jayaram Bhasker, "A VHDL Primer", PTR Prentice Hall, New Jersey 07632, 2006.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	discuss number systems, Boolean rules & laws, logic families and Reduce the Boolean expression.	Understanding (K2)
CO2	illustrate combinational logic circuits using logic gates.	Applying (K3)
CO3	design synchronous sequential circuits using flip-flops.	Analyzing (K4)
CO4	implement asynchronous logic circuits and demonstrate hazards.	Applying (K3)
CO5	develop Verilog and VHDL model of combinational circuits using Gate level modelling.	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
CO2	3	2	1						1			1	1	2
CO3	3	3	2	1					1			1	1	2
CO4	3	2	1	1					1			1	1	2
CO5	3	2	1	1	2				1			1	1	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	40	50	-	-	-	100
CAT2	10	30	50	10	-	-	100
CAT3	10	20	70	-	-	-	100
ESE	5	20	55	20	-	-	100

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

22EET34 - GENERATION, TRANSMISSION AND DISTRIBUTION							
Programme & Branch	**B.E & Electrical and Electronics Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Electromagnetic Theory**	**3 / 5**	**PC**	**3**	**0**	**0**	**3**

Preamble	This course is aimed to introduce the fundamental concepts and principles in generation, transmission, and distribution of electric power	
Unit – I	**Generation:**	**9**
Structure of power system – Indian energy scenario – Load duration curve – Demand factor – Plant capacity – Plant Use factor – Tariff – Types – Conventional source of electrical energy – schematic arrangement of thermal, hydroelectric and nuclear power generation		
Unit – II	**Electrical Design of Transmission Lines:**	**9**
Parameters of Transmission Line – Skin and Proximity Effects – Inductance and Capacitance of Single and Three Phase Transmission Lines with Single Circuit – Double Circuit (Solid conductor): Symmetrical and Unsymmetrical Spacing and Transposition		
Unit – III	**Analysis of Transmission Lines:**	**9**
Equivalent Circuits, Transmission Efficiency and Voltage Regulation of Short Line, Medium Line (PI model) – Ferranti Effect – Surge Impedance – Surge Impedance Loading – Corona: Phenomena of Corona – Factors Affecting Corona – Disruptive Critical Voltage – Visual Critical Voltage		
Unit – IV	**Mechanical Design of Transmission Lines:**	**9**
Insulators: Types, Voltage Distribution in Insulator String and Grading, Improvement of String Efficiency – Sag and Tension: Classification of Towers – Towers at Equal Heights – Towers at Unequal Heights		
Unit – V	**Distribution Systems:**	**9**
Components of Distribution System – Types – DC Distribution: DC Distributor – Concentrated and Uniform Loading. AC Distribution: AC Distributor: Concentrated Load – Kelvin's Law – Underground Cables: Constructional Features of LT and HT Cables – Cable Faults and Testing		
		Total:45

TEXT BOOK:

1.	Gupta J.B, "A Course in Power Systems", 11th Edition, S.K.Kataria & Sons, New Delhi, 2015.

REFERENCES:

1.	Wadhwa C.L., "Electrical Power Systems", 7th Edition, New Age International Publishers, New Delhi, 2017.
2.	Kothari D.P & Nagrath I.J, "Power System Engineering", 3rd Edition, Mc Graw Hill Education (indai) Pvt Ld, New Delhi, 2019.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	explain the various types of generation systems	Understanding (K2)
CO2	calculate the transmission network parameters for various configurations	Applying (K3)
CO3	analyze the performance characteristics of the given transmission line and explain the effect of corona	Applying (K3)
CO4	calculate string efficiency of the insulators and Sag of a overhead line for various conditions	Applying (K3)
CO5	calculate the voltage at a point on the given type of distribution system and explain the constructional features of cables	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	3
CO2	3	2	1		1	1						1	1	1
CO3	3	2	1	2	1	1						1	3	1
CO4	3	2	1			1						1	1	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	10	60	30	-	-	-	100
CAT2	10	30	60	-	-	-	100
CAT3	10	30	60	-	-	-	100
ESE	5	35	60	-	-	-	100

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

22MNT31 - ENVIRONMENTAL SCIENCE							
(Common to All Engineering and Technology 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						2	1
CO2	2	1					3						2	1
CO3	3	2	1				3						2	1
CO4	3	2	1				3						2	1
CO5	3	1											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	25	35	40				100
CAT2	25	35	40				100
CAT3	NA						
ESE	NA						

* ±3% may be varied (CAT 1, 2 – 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 – கணினித்தமிழ் 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 கல்வியில் 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)**

22EEL31 – DC MACHINES AND TRANSFORMERS LABORATORY

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

Preamble	This laboratory gives a practical exposure to the students to learn the characteristics of transformers and DC machines that are used nowadays in electrical systems. The students also learn to select the suitable DC electrical machines for an application based on its characteristics and they can able to apply the standard testing procedures of DC machines and transformers

LIST OF EXPERIMENTS / EXERCISES:

1.	Load characteristics of DC series motor.
2.	Speed control of DC shunt motor.
3.	Open circuit and load characteristics of DC shunt generator.
4.	Swinburne’s test.
5.	Performance test on DC Compound motor.
6.	OC and SC test of1-phase transformers.
7.	Separation of losses in 1-phase Transformer.
8.	Sumpner's test.
9.	Load test on three phase transformer.
10.	Computer aided analysis of electrical machines.

Total:30

REFERENCES/ MANUAL /SOFTWARE:

1.	Laboratory Manual
2.	ANSYS Software

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	execute the various methods of speed control in DC machines	Applying(K3), Precision (S3)
CO2	perform suitable tests and analyze the performance of rotating machines and transformers	Applying(K3), Manipulation (S2)
CO3	analyze the machines and estimate the parameters using computer aided 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	1					1			1	3	2
CO2	2	3	2	2	1				1			1	3	2
CO3	2	3	2	2	1				1			1	3	2

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

22EEL32 – ANALOG AND DIGITAL ELECTRONICS LABORATORY							
Programme & Branch	**B.E & Electrical and Electronics Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**3**	**PC**	**0**	**0**	**2**	**1**

Preamble	This laboratory gives a practical exposure to the students to design, implement and analyze the characteristics and applications of analog and digital circuits.

LIST OF EXPERIMENTS / EXERCISES:

1.	Design and implementation of clipper and clamper circuit using PN junction diode (Discrete components/ Simulation software)
2.	Design of audio amplifier using common emitter BJT with voltage divider bias (Discrete components/ Simulation software)
3.	Design of RC phase shift oscillators using BJT.
4.	Design of integrator and differentiator circuit using op-amp.
5.	Design a monostable multivibrator using Op-Amps /IC 555
6.	Design of active filters for the given specifications and obtain their frequency response characteristics
7.	Design and implementation of adders and subtractors (Discrete components/Verilog HDL/VHDL).
8.	Simulation of code converters and flip-flops using Verilog HDL/ VHDL.
9.	Design and implementation of synchronous up and down counters using flip flops.
10.	Study of implementation of combinational/sequential circuit using FPGA.

Total:30

REFERENCES/ MANUAL /SOFTWARE:

1.	Laboratory Manual
2.	Xilinx vivado design tool

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	build and execute oscillators and multivibrators using BJT	Understanding (K2), Imitation(S1)
CO2	construct and implement the linear and nonlinear applications of op-amps	Applying(K3), Manipulation (S2)
CO3	design and simulate the combinational and sequential circuits using Logic gates and HDL.	Analyzing (K4), 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	2	1	1					1				2	3
CO2	3	2	1	1					1				2	3
CO3	2	3	2	2	1	2			1				2	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	PSO 1	PSO 2
CO1									2	3		3	2	1
CO2									2	2		2	2	1
CO3									2	2		2	2	1

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

22EET35 - ELECTRIC CIRCUIT THEORY

Programme & Branch	**BE – Electrical and Electronics Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**3**	**PC**	**3**	**1**	**0**	**4**

Preamble	This course aims to impart knowledge on analysis of electric AC and DC circuits.	
Unit – I	**DC Circuits and Graph Theory:**	**9**
DC CIRCUITS: Types of sources- Dependent and Independent sources - Source transformation - Current and Voltage division rule - Mesh and nodal analysis. **Graph Theory:** Introduction - Tree and Co-tree - Twigs and Links - Incidence Matrix (A)-Tie-set and cut-set matrix.		
Unit - II	**Single Phase and Three Phase Circuits:**	**9**
Single Phase Circuits : Power, power factor, impedance triangle, voltage triangle and power triangle of RL and RC circuits – Mesh and nodal analysis. **Three Phase Circuits:** Star-Delta transformation - Star and Delta systems – Line and Phase Quantities - Three Phase Power - Balanced and Unbalanced Circuit – Three wire and Four wire systems.		
Unit - III	**Network Theorems:**	**9**
DC and AC: Superposition Theorem – Thevenin‘s Theorem – Norton‘s Theorem – Maximum Power Transfer Theorem -Reciprocity Theorem - Millman's Theorem-Application to DC and AC circuits.		
Unit - IV	**Resonance and DC Transients:**	**9**
Resonance circuits: Resonant Frequency, Current and Voltage Variations, Bandwidth, Q factor for series resonance circuits-Basic concept of simple parallel resonance circuit. **DC Transients:** natural and forced response of RL, RC and RLC circuits		
Unit - V	**Two-Port Networks and Coupled Circuits:**	**9**
Two-Port Networks: Impedance Parameter –Admittance Parameter –ABCD Parameters – T and π Representation. **Coupled Circuits**: Mutual inductance – Dot Convention – Coefficient of Coupling – Analysis of Simple Coupled Circuits.		
		Total:45

TEXT BOOK:

1.	Sudhakar A. and Shyammohan S. Palli, “Circuits and networks- Analysis and Synthesis”, 5th Edition, Tata McGraw Hill Publishing Company, New Delhi, 2017.

REFERENCES:

1.	Charles K. Alexander , Matthew N.O. Sadiku , “Fundamentals of Electric Circuits”, 7th Edition, Tata McGraw Hill Publishing Company, New Delhi, 2022
2.	AbhijitChakrabarti, “Circuit Theory Analysis and Synthesis”, 7th Revised Edition, Dhanapat Rai & Co., New Delhi, 2018.
3.	Robert L. Boylestad, “Introductory Circuit Analysis”, 13th Edition, Pearson Education, India, 2018

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	evaluate DC electric circuits using dependent and independent sources.	Applying (K3)
CO2	differentiate balanced and unbalanced loads in three phase AC circuits.	Applying (K3)
CO3	analyze DC and AC networks using various theorems.	Analyzing (K4)
CO4	explain resonant and DC transients using R,L,C elements	Applying (K3)
CO5	interpret the concept of coupled circuits and two port 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	1	1	1				1			1	3	2
CO2	3	2	1	1					1			1	3	2
CO3	2	3	2	2					1			1	3	2
CO4	3	2	1	1					1			1	3	2
CO5	3	2	1	1					1			1	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	10	25	65	-	-	-	100
CAT2	10	20	30	30	-	-	100
CAT3	10	45	40	-	-	-	100
ESE	5	20	57	18	-	-	100

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

22EET36 - MEASUREMENTS AND INSTRUMENTATION							
Programme & Branch	**B.E &Electrical and Electronics Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**3**	**PC**	**3**	**0**	**0**	**3**

Preamble	This course aims in imparting knowledge of Basic principles of Electrical Measurements, construction and working principle of different Electromechanical Instruments. It also aims in imparting fundamental knowledge of measurement of Power, Energy, Resistance, Impedance and different Electronic measuring instruments.	
Unit – I	**Basics of Measurements:**	**9**
Importance of Measurement – Purpose of Measurement – Methods of Measurement – Functional blocks of a Measurement System – Static and Dynamic Characteristics. Types of Instruments-Types of Errors – Operating Forces in Analog Instruments.		
Unit – II	**Electromechanical Instruments:**	**9**
Permanent Magnet Moving Coil (PMMC): Construction and Working Principle – Torque Equation and Problems – Ammeter Shunts – Voltmeter Multipliers (Simple Problems) – Moving Iron Instruments: General Torque Equation – Classification – Construction, Working – Construction and Working of CT and PT – Calibration		
Unit – III	**Measurement of Power, Power factor and Energy**	**9**
Electrodynamometer Wattmeter: Construction –Theory- Low Power factor Wattmeter– Three Phase Wattmeter –Three phase power measurement by two wattmeter method - Power Factor Meters: Single Phase Electrodynamometer Power Factor Meter – Single Phase Induction Type Energy Meters: Construction – Theory of Operation – Phantom Loading.		
Unit – IV	**Measurement of Resistance and Impedance**	**9**
Classification of Resistances – Kelvin‘s Double Bridge – A.C Bridges: Introduction – Sources and Detectors – Measurement of Self Inductance & Capacitance: Maxwell‘s Inductance Bridge – Capacitance Bridge – Schering Bridge – Wien‘s Bridge – Meggar (Earth tester).		
Unit – V	**Electronic Measuring Instruments**	**9**
Digital Multi meters –Function generators, Weston Type Frequency Meter – Digital Recording Systems-digital Data Acquisition system –Single Phase Digital Energy Meter-Intelligent Panel Meters.		
		Total: 45

TEXT BOOK:

1.	Sawhney A.K., “Electrical and Electronic Measurements and Instrumentation”, 19th Revised Edition, Dhanpath Rai& Co., New Delhi, 2021

REFERENCES:

1.	Gupta J.B., “A Course in Electronic and Electrical Measurements and Instrumentation”,13th Edition, S.K.Kataria& Sons, New Delhi, 2013.
2.	Edward William Golding and Frederick Charles Widdis, “Electrical Measurements and Measuring Instruments”, 6th Edition, Reem Publications, New Delhi, 2011.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	explain the functional blocks of measurement system and the static and dynamic characteristics of instruments.	Understanding(K2)
CO2	outline the concepts of different measuring Instrument and Calibrate different Instruments.	Applying (K3)
CO3	explain the concepts of instruments used for measuring electrical parameters	Understanding(K2)
CO4	make use of the bridges for measurement of Resistance, Capacitance and Inductance	Applying (K3)
CO5	identify an appropriate digital instrument for measurement of electrical parameters	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	3	1
CO2	3	1	2	2								2	3	1
CO3	3	2							1			2	2	1
CO4	3	2	1	1								2	3	2
CO5	3	2	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	60	20				100
CAT3	20	60	20				100
ESE	15	55	30				100

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

22EEL33 - CIRCUITS AND MEASUREMENTS LABORATORY							
Programme & Branch	**BE – Electrical and Electronics Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**3**	**PC**	**0**	**0**	**2**	**1**

Preamble	This course helps the students to demonstrate current and voltage in electric circuits and measurement of various electrical parameters.

LIST OF EXPERIMENTS / EXERCISES:

1.	Verification of super position theorem / maximum power transfer theorem.
2.	Determination of Three phase power measurement by two wattmeter method
3.	Design and simulation of series / parallel resonance circuit for a given frequency. (discrete components/simulation software)
4.	Measurement of self inductance, mutual inductance and coefficient of coupling.
5.	Calibration of Energy Meter
6.	Extension of DC voltmeter and DC ammeter ranges
7.	Calibration of current transformer and potential transformer
8.	Measurement of DC resistance by Wheatstone and Kelvin double bridge
9.	Measurement of inductance and capacitance using Maxwell‘s bridge
10.	PCB board implementation of DC/AC circuits.
	Total:30

REFERENCES/ MANUAL /SOFTWARE:

1.	Laboratory Manual
2.	Multisim software

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	demonstrate the verification of network theorems and measurement of three phase power.	Applying(K3), Precision (S3)
CO2	design and simulate resonant and transients using software tools as well as implement various DC and AC circuits.	Applying (K3), Manipulation (S2)
CO3	Demonstrate the measurement of R,L and C parameters using bridges and calibrate energy meter, CT and PT.	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	2		1		2	1		1	3	2
CO2	3	2	1	1	3		1		2	1		1	3	2
CO3	3	2	1	1		1	1		2	1		1	3	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	1
CO2	3	3	2										3	1
CO3	3	3	2											1
CO4	3	2	1										1	1
CO5	3	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	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)

22ITC41 - PROGRAMMING IN PYTHON

(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**	**4**	**ES**	**3**	**0**	**2**	**4**

Preamble	This course introduces the core Python programming. It emphasizes developing Python programs with alldata types, functions, classes, objects, and NumPy	
Unit – I	**Introduction:**	**9**
Problem-solving strategies – program design tools – Types of errors – Testing and Debugging- Basics: Literals – variables and identifiers – data types - input operation – comments – reserved words – indentation – Operators and Expressions – Decision Control Statements: Introduction – conditional statement – iterative statements – Nested Loops – break, continue and pass statements — else in loops.		
Unit – II	**Lists, Tuples and Dictionary:**	**9**
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, add and modify, delete, sort, looping, nested, built-in methods — list vs tuple vs dictionary.		
Unit – III	**Strings and Regular Expressions:**	**9**
Strings: Concatenation, append, multiply on strings – Immutable – formatting operator – Built-in string methods and functions – slice operation – functions – operators – comparing – iterating – string module – Regular Expressions **–** match, search, sub, findall and finditer functions – flag options.		
Unit – IV	**Functions and Modules:**	**9**
Functions: Introduction - definition – call – variable scope and lifetime – return statement – function arguments – lambda function – documentation strings – programming practices recursive function- Modules: Modules – packages – standard library methods – function redefinition.		
Unit – V	**Object Orientation:**	**9**
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 NumPy Arrays. **MatplotLib:** Line plots – Scatter Plots		

LIST OF EXPERIMENTS / EXERCISES:

1.	Programs using conditional and looping statements
2.	Implementation of list and tuple operations
3.	Implementation of dictionary operations
4.	Perform various string operations
5.	Use regular expressions for validating inputs
6.	Demonstration of different types of functions and parameter passing
7.	Develop programs using classes and objects
8.	Perform computation on NumPy arrays
9.	Draw different types of plots using Matplotlib

Lecture:45, Practical:30, Total:75

TEXT BOOK:

1.	Reema Thareja., “Python Programming using problem solving approach”, 3rd impression, Oxford University Press., New Delhi, 2017.

REFERENCES/ MANUAL / SOFTWARE:

1.	Nageswara Rao, “Core Python Programming”, 2nd Edition, DreamTech Press, New Delhi, 2018.
2.	Jake Vander Plas,” Python Data Science Handbook Essential Tools for Working with Data”, O’Reilly publishers,1st Edition, 2016.

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)

22EET41 – SYNCHRONOUS AND INDUCTION MACHINES							
Programme & Branch	**B.E & Electrical and Electronics Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**DC Machines and Transformers**	**4 / 5**	**PC**	**3**	**1**	**0**	**4**

Preamble	This course aims in imparting knowledge on construction and working principle of AC machines and some special electrical machines. It also explores on various methods of speed control of AC machines.	
Unit – I	**Alternator:**	**9+3**
Introduction to Rotating MMF – Construction and Operation Details – Types of Rotors – Concentrated and Distributed Windings – EMF Equation – Synchronous Reactance – Armature Reaction – Voltage Regulation: EMF, MMF and ZPF Methods – Synchronizing and Parallel Operation – Synchronizing Power – Power Output Equations – Change of Excitation and Mechanical Input – Case Study: Integrated Starter Generator for Hybrid Electric Vehicle – Claw Pole Alternator		
Unit – II	**Synchronous Motor:**	**9+3**
Principle of Operation – Torque Equation – Starting Methods – Operation on Infinite Bus bars – V and Inverted V Curves – Input and Output Power Equations – Power/Power Angle Relations – Hunting – Causes & Prevention –Applications: Synchronous Condenser – Power factor correction.		
Unit – III	**Three Phase Induction Motor:**	**9+3**
Construction and Operation Details – Types of Rotors – Squirrel Cage and Slip Ring – Slip –Torque Equations – Slip Torque Characteristics – Losses and Efficiency – Load Test – No Load and Blocked Rotor Tests – Equivalent Circuit – Circle Diagram – Separation of No Load Losses – Crawling and Cogging – Double Cage Rotors – Induction Generator – Submersible Motor.		
Unit – IV	**Starting and Speed Control of Three Phase Induction Motor:**	**9+3**
Need for Starters – Types of Starters – Rotor Resistance, Autotransformer, Star-Delta and DOL Starters – Speed Control by Varying Voltage, Frequency, V/F Control, Poles and Rotor Resistance – Slip Power Recovery Scheme.		
Unit – V	**Single Phase Induction Motors and Special Machines:**	**9+3**
Construction and Operation Details – Double Revolving Field Theory – Equivalent Circuit – Simple Problems Starting Methods: Split Phase, Capacitor Start, and run, Shaded Pole – Applications – Servo Motor, Stepper Motor and Universal Motor		
		Lecture:45, Tutorial:15, Total:60

TEXT BOOK:

1.	Rajput R.K.,"Electrical Machines", 6th Edition, Laxmi Publications, New Delhi, 2018.

REFERENCES:

1.	Kothari D.P. and Nagrath I.J, "Electric Machines", 5th Edition, Tata McGraw Hill Publishing Company, New Delhi, 2018.
2.	Gupta J.B., "Electrical Machines", 4th Edition, S.K. Kataria& Sons, New Delhi, Reprint 2014.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	explain the constructional, working and behavior of alternator	Applying (K3)
CO2	compute the constructional, working performance of synchronous motor	Applying (K3)
CO3	analyze the operation and performance characteristics of induction machines	Applying (K3)
CO4	apply starting and speed control methods to AC motors	Applying (K3)
CO5	demonstrate the operation of single phase induction machine and special electrical 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										1	1	2
CO2	3	2	1	1			1		1			1	2	3
CO3	2	3	2	2	1		1		1			1	3	2
CO4	3	2	1	1								1	2	3
CO5	3	2	1	1								1	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	10	55	35	-	-	-	100
CAT2	10	55	35	-	-	-	100
CAT3	10	65	25	-	-	-	100
ESE	5	60	35	-	-	-	100

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

22EET42 – CONTROL SYSTEMS								
Programme & Branch	**B.E & Electrical and Electronics Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**4 / 5**	**PC**	**3**	**1**	**0**	**4**

Preamble	The aim of the subject is to give an adequate exposure to transfer function model, stability analysis, compensator, controller design and PLC programming.	
Unit – I	**Systems and Representation:**	**9+3**
Basic Elements in Control Systems: Open and Closed Loop Systems – Transfer Function models and state space models(phase variable) of Electrical and Mechanical Systems with single and two degree of freedom –Electromechanical systems-Gear trains- Block Diagram Reduction Techniques using Signal Flow Graphs.		
Unit – II	**Time Domain Analysis:**	**9+3**
Standard Test Signals – Steady State Error and Error Constants – Type and Order of Systems – Time Domain Specifications – Effects of Addition of Poles and Zeros – Dominant Poles – Concept of stability-Bounded - Input Bounded Output Stability with pendulum example -Routh Hurwitz Stability Criterion.		
Unit – III	**Frequency Response:**	**9+3**
Frequency Domain Specifications - Bode Plot – Polar Plot – Nyquist Stability Criterion – Correlation betweenFrequency Domain and Time Domain		
Unit – IV	**Controller and Compensator Design:**	**9+3**
Controllers – P,PI& PID - Root Locus Plots of Typical Systems – Root Locus Analysis - Design of Lag, Lead Compensator using Root Locus Plots.		
Unit – V	**Introduction to Programmable Logic Controller**	**9+3**
Overview of Programmable Logic Controller - Architecture-Fundamentals of Logic – Program Scan– Relay-Type Instructions-Branch and Internal relay instructions – Entering the Ladder diagram-Programming Timers – Programming Counter		
		Lecture:45, Tutorial:15, Total:60

TEXT BOOK:

1.	Nagarath, I.J. &Gopal, M., “Control Systems Engineering”, 7th Edition, New Age International Pvt.Ltd, New Delhi, 2021 for Units I,II,III and IV.
2.	Frank D. Petruzella, “Programmable Logic Controllers”, 5th Edition, McGraw-Hill Edition, New Delhi, 2019 for Unit V.

REFERENCES:

1.	Katsuhiko Ogata, “Modern Control Engineering”, 5thEdition, Pearson Education, New Delhi, 2015
2.	Norman S. Nise, “Control Systems Engineering”, 4thEdition, Wiley India Ed, 2018.
3.	Webb John W. and Reis Ronald A., “Programmable Logic Controllers”, 5th Edition, Prentice Hall Publications, New Delhi, 2005.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	develop mathematical model of electrical , mechanical systems	Applying (K3)
CO2	analyze various steady state errors and time domain specifications for the continuous systems	Analyzing(K4)
CO3	examine the stability of the systems using various techniques	Analyzing(K4)
CO4	design appropriate compensator and controller for the given specifications	Applying (K3)
CO5	develop PLC ladder logic programming for industrial 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							1			1	2	1
CO2	3	2	1	1	1				1			1	3	2
CO3	3	2	1	1	1	1			1			1	3	2
CO4	3	2	1	1	1				1			1	3	2
CO5	3	1				1			1			1	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	5	30	30	35	-	-	100
CAT2	5	30	30	35	-	-	100
CAT3	10	30	60	-	-	-	100
ESE	5	30	30	35	-	-	100

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

22EET43 – MICROCONTROLLERS AND ITS INTERFACING

Programme & Branch	B.E – Electrical and Electronics Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	**Digital Electronics**	**4**	**PC**	**3**	**0**	**0**	**3**

Preamble	To get acquaintance with the architecture of 8085 processor and 8051 controller, apply the embedded programming concepts for interfacing peripherals with the controller and to understand 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 – Archite0ure – Memory Organization–Special Function Registers – Program Counter – PSW register – Stack – Instruction set – Addressing modes.		
Unit – III	**8051 Programming:**	**9**
I/O Ports – Timer (Mode1) / 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	**Interfacing I/O Peripherals with 8051:**	**9**
Programming in Embedded C: LED – Push button switch – Necessity of Relay and Opto-coupler – Keypad – LCD – Seven segments LED – A/D and D/A converters – Temperature sensor - DC Motor – Stepper motor.		
Unit – V	**Case Study Applications:**	**9**
Microcontroller based Washing machine Control – Central Heating System Using a Super Loop – RS232 Serial communication: MAX 232 for I/O text message communication – Microcontroller based Calculator with extended features using MAX232. Simple Street Light control system, Water Level Indicator and Burglar Alarm System – Home Automation & Security systems Mobile phone controlled ROBOT (Block diagram with programming approach).		
		Total:45

TEXT BOOK:

1. Soumitra Kumar Mandal, "Microprocessors and Microcontrollers Architecture, Programming and System Design 8085,8086 and 8051", McGraw Hill Education , ISBN- 13 978-0071329200, 2017 for Unit I.
2. Muhammad Ali Mazidi, Janice Gillispie Mazidi & Rolin D. McKinlay, "The 8051 Microcontroller and Embedded Systems Using Assembly and C", 2nd Edition, Pearson Education, New Delhi, 2013 for Units II, III, IV and V.

REFERENCES:

1. Manish K. Patel, “The 8051 Microcontroller based Embedded systems”, Tata McGraw Hill Education (India) Pvt. Limited, 2017.
2. Subrata Ghoshal, “8051 Microcontrollers, 2/e: Internals, Instructions, Programming &Interfacing”, 2nd Edition, Pearson Education, 2014.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	explain the basic concepts of 8085 microprocessor	Understanding (K2)
CO2	summarize the basic concepts of 8051 microcontroller	Understanding (K2)
CO3	develop embedded c programs for 8051	Applying (K3)
CO4	interface peripheral devices with 8051 microcontroller	Applying (K3)
CO5	recognize microcontroller based case study 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	2				2	1	3	3
CO3	3	2	1	1	1	1		1		1	1	1	1	3
CO4	3	2	1	1	1	1	2				2	1	1	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	10	40	50	-	-	-	100
CAT3	10	30	60	-	-	-	100
ESE	10	40	50	-	-	-	100

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

22EEL41 - SYNCHRONOUS AND INDUCTION MACHINES LABORATORY

Programme & Branch	B.E & Electrical and Electronics Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	**Nil**	**4 / 5**	**PC**	**0**	**0**	**2**	**1**

Preamble	This laboratory gives a practical exposure to the students to gain knowledge on Alternators, Induction Motors and Synchronous Motors. The students learn to perform the speed control of an Induction motor. Also they can able to utilize the software for analysis of AC machines.

LIST OF EXPERIMENTS / EXERCISES:

1.	Regulation of three-phase alternator by EMF method.
2.	Regulation of three-phase alternator by MMF method.
3.	Load test on Alternator.
4.	Synchronizing and load/power sharing of alternators.
5.	V and inverted V curves of three phase synchronous motor.
6.	Load test on single phase and three phase cage induction motors.
7.	Speed control of three phase induction motor.
8.	No load and blocked rotor test on induction motors (1Φ equivalent circuit) – Virtual Lab.
9.	Performance study of induction generator.
10.	Analysis of AC machines using software tools.

Total:30

REFERENCES/ MANUAL /SOFTWARE:

1.	Laboratory Manual
2.	Virtual Laboratory

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	evaluate the performance and select the rotating machines based on their characteristic curves of AC machines	Analyzing (K4), Manipulation (S2)
CO2	predict the regulation and demonstrate the synchronization of two alternators for its power sharing	Applying (K3), Precision (S3)
CO3	utilize the knowledge on computer-aided engineering design of AC machines	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	2	3	2	2	1				1			1	3	2
CO2	3	2	1	1					1			1	2	3
CO3	3	2	1	1					1			1	2	3

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

22EEL42 - CONTROL SYSTEMS LABORATORY

Programme & Branch	**B.E & Electrical and Electronics Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**4 / 5**	**PC**	**0**	**0**	**2**	**1**

Preamble	This course is designed to impart practical knowledge about the analysis of control systems in time and frequency domain.

LIST OF EXPERIMENTS / EXERCISES:

1.	Determination of transfer function parameters of DC servomotor.
2.	Determination of transfer function parameters of AC servomotor.
3.	DC servo motor position control using PID controller.
4.	DC motor position control using lead and lag compensator.
5.	Strain measurement using strain gauge.
6.	PLC ladder logic diagram for DOL starter.
7.	Logical programming, timer and counter functions of PLC
8.	Ladder logic based conveyer belt control using programmable logic controller
9.	Analysis of time and frequency domain analysis using MATLAB.
10.	Design and implementation of compensators via root locus using MATLAB.

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	determine the transfer function of AC and DC servo motor and measure various physical parameters using sensors.	Analyzing (K4), Manipulation (S2)
CO2	develop, compile and debug basic and advanced PLC programs	Analyzing (K4), Manipulation (S2)
CO3	analyze time domain and frequency domain specifications.	Analyzing (K4), 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	2	1	1		1			1			1	2	3
CO2	2	3	2	2	1	1			1			1	3	2
CO3	2	3	2	2	2	1			1			1	3	2

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

22GCL41 - 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 up gradation-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	**Grammar, Vocabulary, Listening, Speaking, Reading and Writing:**						**30**	
Grammar: Parts of speech - Tenses - Articles and Prepositions - Vocabulary: Synonyms & Antonyms - Analogies - Syllogism - Spelling test - Cloze test - Concord - Spotting Errors - Listening: Listening to TED talks, ESL & ESOL Videos - Podcasts - Speaking : Mock Interviews - Personality traits - Better pronunciation - Extempore talk - Reading: Reading with stress, pauses, slurs and fillers - Soft skills - Writing: Job application letter & resume - Video resume – Different types of writing - Jumbled sentences - Professional e-mail writing - Business letters - One page essay - Report writing - Editing & proofreading – Writing skills for IELTS								
							Total:45	

TEXT BOOK:

1.	R.S. Aggarwal, "Quantitative Aptitude", 7^{th} Edition, S. Chand Publication, 2022.
2.	R.S. Aggarwal, "A Modern Approach to Logical Reasoning", S. Chand Publication, 2022 edition.
3.	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 English language skills 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				3	3		3		3	2	2	1
CO2	3	2				3	3		3		3	2	2	1
CO3		2					3	3		3	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	20	50	30				100
CAT2		50	50				100
CAT3		50	50				100
Assessment Test		50	50				100

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

22EEL43 – MICROPROCESSORS AND MICROCONTROLLERS INTERFACING LABORATORY							
Programme & Branch	**B.E & Electrical and Electronics Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**4**	**PC**	**0**	**0**	**2**	**1**

Preamble	This laboratory gives a practical exposure in designing and developing interfacing circuits for 8051 microcontrollersto interface off-chip peripherals.

LIST OF EXPERIMENTS / EXERCISES:

1.	Arithmetic operations using 8085 microprocessors.
2.	Embedded C Programming and interfacing using 8051 Microcontroller: Arithmetic operations using KEIL compiler
3.	Interfacing of switches and LEDs with 8051 Microcontroller.
4.	Interfacing of seven segment LED with 8051 Microcontroller.
5.	Interfacing of keypad matrix with 8051 Microcontroller.
6.	Interfacing of Relay and LCD with 8051 Microcontroller.
7.	Interfacing of DC Motorwith 8051 Microcontroller system.
8.	Interfacing of Stepper Motor with 8051 Microcontroller system.
9.	Case study1: Design and develop a simple project using 8051 Microcontroller.
10.	Case study2: Design and develop a simple closed loop application using 8051 Microcontroller.

Total:30

REFERENCES/ MANUAL /SOFTWARE:

1.	Laboratory Manual.
2.	Microcontroller Programming Software for 89C51 Microcontroller and Dumper kits.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	demonstrate the instructions in 8085 microprocessors.	Applying (K3), Precision (S3)
CO2	develop interfacing circuits for interfacing peripherals with 8051 microcontroller.	Applying (K3), Precision (S3)
CO3	design and develop microcontroller based embedded systems 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	2	1	3	1	2		1	2	3	2	1	1	3
CO2	3	2	1	3	1	2		1	2	3	2	1	1	3
CO3	3	3	2	3	2	2		1	2	3	2	1	2	3

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

22EET51- POWER SYSTEM ANALYSIS							
Programme & Branch	**B.E & Electrical and Electronics Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Generation, Transmission and Distribution,**	**5 / 6**	**PC**	**3**	**1**	**0**	**4**

Preamble	This course imparts knowledge about the modeling of power system components, load flow analysis and stability analysis. The course also describes the various types of faults occurs in power system	
Unit – I	**Modeling of Power System:**	**9+3**
Introduction-per unit quantities -selection of base quantities-changing the base of per unit quantities-Modelling of power system components-one line diagram- impedance and reactance diagram-per unit impedances of a generator, transformer, synchronous machines, transmission lines, motor-per phase representation- introduction to smart grid, micro grid and power market.		
Unit – II	**Load Flow studies:**	**9+3**
Formation of Bus admittance matrix, network incidence matrix and Y-bus, node elimination, classification of buses-Formulation of load flow problem-, Gauss-Siedel method-Newton- Raphson method, Numerical solution of power flow problem by GS method (upto three buses),		
Unit – III	**Symmetrical Faults in Electrical systems:**	**9+3**
Need for short circuit study –Types of faults- Bus Impedance matrix - Bus building algorithm (without mutual coupling)-Symmetrical fault analysis through bus impedance matrix- fault calculation using Thevenin's Theorem –Post fault bus voltages –Fault level-short circuit MVA		
Unit – IV	**Unsymmetrical Faults in Electrical systems:**	**9+3**
Synthesis of unsymmetrical phasors from their symmetrical components- sequence impedance of synchronous machine, transmission lines and transformers - sequence network of power system. single line-to -ground fault, line-to- line fault, double line-to- ground fault.		
Unit – V	**Stability Analysis:**	**9+3**
Introduction to power system stability –Rotor dynamics and the Swing equation–power angle equation-equal area criterion of stability-applications of equal area criterion-multimachine stability studies: classical representation step by step solution of the swing curve-transient stability studies-factors affecting transient stability.		
		Lecture : 45, Tutorial : 15, Total:60

TEXT BOOK:

1. Grainger John J. & Stevenson W.D, "Power System Analysis", 1st Edition, Tata McGraw- Hill, New Delhi, 2017.

REFERENCES:

1. Nagrath I.J. & Kothari D.P, "Modern Power System Analysis", 5th Edition, Tata McGraw- Hill, New Delhi, 2022.
2. Wadhwa C.L , "Electrical Power Systems", 6th Edition, New Age International Publishers Pvt. Ltd, New Delhi, 2018.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	Model various power system components	Applying (K3)
CO2	Evaluate the bus powers, line flows and line losses using various power flow methods	Applying (K3)
CO3	Calculate the symmetrical fault currents	Applying (K3)
CO4	Analyze the different types of unsymmetrical faults	Applying (K3)
CO5	Predict the stability of the power system	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			1	1	1				1	2	2
CO2	3	2	3	3	2	1	1	1				1	3	3
CO3	3	2	2	2	3	1	1	1	1			1	3	3
CO4	3	2	2	2	2	1	1	1	1			1	3	2
CO5	3	2	3	3	2	1	1	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	20	70				100
CAT2	10	20	70				100
CAT3	10	40	50				100
ESE	10	20	70				100

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

22EET52 – POWER ELECTRONICS

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

Preamble	This course is designed to impart knowledge about the characteristics of power semiconductor devices, working principle of rectifier, chopper, DC to AC converter and AC to AC converter

Unit – I	**Unit Title:** Power Semi-Conductor Devices:	**9**

Introduction – Power Diode – Power BJT – Power MOSFET - GaN, SiC Devices –IGBT - SCR- TRIAC – GTO - Construction, Principle of operation, Static and Dynamic characteristics - Thyristor Protection – Series and parallel connections of thyristors - commutation methods – Data sheet interpretation

Unit – II	**Unit Title:** AC to DC Converters:	**9**

Single phase and three phase controlled rectifiers with R, RL Loads- multi pulse diode rectifiers– Effect of source inductance – Estimation of performance parameter: RMS load voltage, RMS load current, Power Factor and Distortion Factor- power factor improvement – PWM Rectifier- Battery charging circuits.

Unit – III	**Unit Title:** DC to DC Converters:	**9**

Principle of Step Up and Down Chopper – Chopper Control Strategies – Quadrant of Operation: single quadrant, two quadrant and four quadrant DC Choppers –Switch mode Voltage regulators: Buck, Boost, Buck – Boost – Cuk Regulator – SMPS.

Unit – IV	**Unit Title:** DC to AC Converters:	**9**

Single Phase Bridge Inverters – Three Phase Bridge Inverters: 180^o and 120^o Mode of operation – voltage control of single phase inverter - PWM Inverters: Single, Sinusoidal and Multiple PWM technique – Reduction of harmonics in the inverter output voltage – CSI: Single phase CSI – Introduction to MLI - UPS.

Unit – V	**Unit Title:** AC Voltage Controllers and Cycloconverters:	**9**

Principle of AC voltage controller – Control Strategies: Phase control, PWM control, Integral cycle control – Single Phase AC Voltage Controllers – Cycloconverters: Principle of cycloconverter (operation) – Single Phase to Single Phase Cycloconverter: step down and step up , Midpoint and Bridge – Three Phase to Single Phase Cycloconverter – OLTC.

Total:45

TEXT BOOK:

1.	Bimbhra P.S., "Power Electronics", 6th Edition, Khanna Publishers, New Delhi, 2018

REFERENCES:

1.	Singh M.D. and Khanchandani, "Power Electronics", 2nd Edition, Tata McGraw-Hill, New Delhi, 2017.
2.	Rashid M.H., "Power Electronics: Circuits Devices and Applications", 4th Edition, Pearson Education, New Delhi, 2017.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	choose various power semiconductor devices based on their construction, operation and characteristics	Understanding (K2)
CO2	explain the working principle of single phase and three phase rectifier and compute its performance parameter	Applying (K3)
CO3	classify and explain the operation of DC to DC converters	Understanding (K2)
CO4	inspect the operation of different type of inverters	Applying (K3)
CO5	categorize different type of AC voltage controllers and cycloconverters	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	3	1					1			1	3	2
CO2	3	2	3	1	1	1			1			1	2	3
CO3	3	1	3	1	1	1			1			1	2	3
CO4	3	2	3	1	1	1			1			1	1	3
CO5	3	1	3	1	1	1			1			1	2	3

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

ASSESSMENT PATTERN - THEORY

Test / Bloom’s Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	60	20				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)

22EET53 – EMBEDDED SYSTEM DESIGN							
Programme & Branch	**B.E & Electrical and Electronics Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Microcontrollers and Its Interfacing**	**5**	**PC**	**3**	**0**	**0**	**3**

Preamble	This course imparts knowledge about the Building Blocks of Embedded System along with various networking protocolsand provides a brief idea of IoT architecture and its related protocols towards building an IoT infrastructure.

Unit – I	**Introduction to Embedded Systems:**	**9**
Introduction to Embedded Systems – Structural units in Embedded processor, selection of processor & memory devices – DMA – Memory management methods – Timer and Counting devices, Watchdog Timer, Real Time Clock, In circuit emulator, Target Hardware Debugging.		
Unit – II	**Embedded Networking Protocols:**	**9**
Embedded Networking: Introduction, I/O Device Ports & Buses – Serial Bus communication protocols: RS232 standard – RS422 – RS 485 – CAN Bus – Serial Peripheral Interface (SPI) – Inter Integrated Circuits (I2C) – Need for device drivers.		
Unit – III	**ARM Processor and Programming:**	**9**
ARM7 Processor - Introduction - RISC features - Levels in architecture, Functional description - processor and memory organization - Data alignment and byte ordering - ARM Instruction Set Architecture (ISA) - pipelining – Simple Assembly Language Programming – Architectural support: High Level Languages - System development – Operating systems.		
Unit – IV	**ARM7TDMI based SoC:**	**9**
LPC2148: Peripherals, Memory mapping for data, code and peripherals, pin configuration, pin connect block, GPIO Peripheral - Nested vectored interrupt controller & Interrupts in LPC2148 - ADC, DAC and RTC in LPC2148 - Timer in LPC2148 and its various modes of operations.		
Unit – V	**ARM7 protocols and Operating Systems:**	**9**
LPC2148: UART protocol and its implementation in LPC2148 - SPI protocol and its implementation in LPC2148 - I2C protocol and its implementation in LPC2148. RTOS Introduction: RTOS Necessity - Operating system services - CPU metrics - RTOS Task scheduling models - OS security issues - Design cycle in the development phase for an embedded system - Issues in Embedded System Design		
		Total:45

TEXT BOOK:

1.	Kamal R, “Embedded systems: architecture, programming and design”, second edition, Tata McGraw-Hill Education, New Delhi, 2011 for Units I,II.
2.	Wayne Wolf, “Computers as Components: Principles of Embedded Computing System Design”, Morgan Kaufman Publishers, San Francisco, second edition, 2008, for Units III, IV V.

REFERENCES:

1.	Furber SB, “ARM system-on-chip architecture”, second edition, Pearson Education; 2000.
2.	Chattopadhyay S, “Embedded System Design”, second edition, PHI Learning Pvt. Ltd.; 2013.
3.	UM10139 – lpc214x User manual - https://www.nxp.com/docs/en/user-guide/UM10139.pdf

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	explain the basic building blocks of embedded systems.	Understanding (K2)
CO2	identify and distinguish the various communication protocols of embedded system.	Applying (K3)
CO3	understand the architecture of ARM7 processor and its programming.	Understanding (K2)
CO4	Interface the peripherals of ARM7 processor with the external world.	Applying (K3)
CO5	Understand various on chip communication protocols of ARM7 and RTOS concepts.	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	1	1	1		1		1	1	1	1	2
CO2	3	2	1	1	1	1	2				2	1	2	3
CO3	3	1	2	1	1	1		1		1	1	1	1	1
CO4	3	2	2	2	1	1	2				2	1	3	2
CO5	3	1	2	1	1	1		1		1	1	1	1	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	30	50	20				100
ESE	10	55	35				100

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

22EEC51 – SIGNALS AND SYSTEMS							
Programme& Branch	**B.E & Electrical and Electronics Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**NIL**	**5 / 4**	**PC**	**2**	**0**	**2**	**3**

Preamble	This course helps the students to impart the knowledge on various types of signals and systems with their mathematical representations, various transformation techniques and their computations.	
Unit - I	**Continuous Time Signals and Systems**	**6**
Standard continuous time signals –Classification of continuous time signals -Mathematical operation on continuous time signals– Classification of continuous time systems – Sampling and Aliasing.		
Unit - II	**Discrete Time Signals and Systems**	**6**
Standard discrete time signals-Classification of discrete time signal-Mathematical operation on discrete time signal- Classification of discrete time systems – Linear convolution of discrete time signals using matrix method-Circular convolution using matrix method.		
Unit - III	**Z Transform**	**6**
Z-transform of DT signals and systems – Region of convergence – Properties of Z transform and ROC- Inverse Z transform using partial fraction method - Relation between Laplace transform and Z transform.		
Unit - IV	**Fourier Transform**	**6**
Fourier transform of CT signals – Relation between Fourier and Laplace transform – Fourier transform of discrete time signals – Properties of DTFT – Relation between Fourier transform and Z-transform.		
Unit - V	**DFT and FFT**	**6**
Discrete Fourier Transform of discrete time signals – Fast Fourier Transform – Decimation In Time (DIT) radix-2 FFT – Decimation In Frequency (DIF) radix-2 FFT – computation of DFT and inverse DFT using FFT.		

List of Experiments:

1.	Generation and analysis of continuous time signals using MATLAB.
2.	Generation and analysis of discrete time signals using MATLAB.
3.	Verification of sampling theorem using MATLAB.
4.	Verification of linear and time varying system using MATLAB.
5.	Verification of linear convolution using MATLAB.
6.	Verification of circular convolution using MATLAB.
7.	Determination of FFT of a discrete time signal using MATLAB.
8.	Simulation of any real time signal processing applications using MATLAB.

Lecture: 30, Practical :30, Total: 60

TEXT BOOK:

1.	Nagoor Kani. A, “Signals and Systems”, 2nd Reprint, Tata McGraw-Hill Education, New Delhi, 2010.

REFERENCES:

1.	Salivahanan. S, “Digital Signal Processing”, 4th Edition, Tata McGraw Hill Education, New Delhi, 2019
2.	John. G.Proakis, Dimitris. G. Manolakis, “Digital Signal Processing: Principles, Algorithms and Applications”, 5th Edition, Pearson Education, India, 2021.
3.	Laboratory Manual
4.	MATLAB software

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	classify the various types of continuous signals and systems with mathematical background	Applying (K3) Manipulation (S2)
CO2	compare various types of discrete time signals and systems and execute various signals and signal processing algorithms using MATLAB	Applying (K3) Manipulation (S2)
CO3	interpret the importance of Z-transform in DT signal processing and verify sampling theorem using MATLAB	Understand (K2) Manipulation (S2)
CO4	discuss CT and DT signals in frequency domain and simulate MATLAB code for any real time signal processing applications	Understand (K2) Precision (S3)
CO5	apply DFT using FFT on various discrete time signals	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	2	1	1	3				1			1	2	3
CO2	3	2	1	1	3				1			1	2	3
CO3	3	2	1	1	3				1			1	2	3
CO4	3	2	1	1	3				1			1	3	2
CO5	3	2	1	1	3				1			1	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	10	30	60				100
CAT2	10	30	60				100
CAT3	10	60	30				100
ESE	5	50	45				100

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

22EEL51 – EMBEDDED SYSTEM LABORATORY

Programme & Branch	**B.E & Electrical and Electronics Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Microcontrollers and Its Interfacing**	**5**	**PC**	**0**	**0**	**2**	**1**

Preamble	This laboratory gives a practical exposure in designing and developing interfacing circuits for 8051 microcontroller and for LPC124X processor.

LIST OF EXPERIMENTS / EXERCISES:

1.	Arithmetic operations using 8085 microprocessors.
2.	Interfacing of switches and LEDs with 8051 Microcontroller.
3.	Interfacing of seven segment LED with 8051 Microcontroller.
4.	Interfacing of keypad/LCD with 8051 Microcontroller.
5.	Interfacing of DC Motor/Stepper Motor with 8051 Microcontroller system.
6.	Interfacing of switches and LEDs with ARM LPC214X processor.
7.	Interfacing of DC Motor/Stepper Motor with ARM LPC214X processor.
8.	Interfacing of Serial communication with ARM LPC214X processor.
9.	Case study1: Design and develop a simple project using 8051 Microcontroller.
10.	Case study2: Design and develop a simple project with ARM LPC214X processor.

Total:30

REFERENCES/ MANUAL /SOFTWARE:

1.	Laboratory Manual.
2.	Microcontroller Programming Software for 89C51 Microcontroller and LPC 2148 processor and Dumper kits.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	demonstrate the instructions in 8085 microprocessors.	Applying (K3), Precision (S3)
CO2	design interfacing circuits with 8051 microcontroller and with ARM LPC214X processor.	Applying (K3), Precision (S3)
CO3	develop microcontroller based embedded systems 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	2	1	3	1	2		1	2	3	2	1	1	3
CO2	3	2	1	3	1	2		1	2	3	2	1	1	3
CO3	3	3	2	3	2	2		1	2	3	2	1	2	3

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

22EEL52 – POWER ELECTRONICS LABORATORY							
Programme& Branch	**B.E & Electrical and Electronics Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**5**	**PC**	**0**	**0**	**2**	**1**

Preamble	This course is designed to impart practical knowledge about the various devices, Power electronics converters and controllers.

LIST OF EXPERIMENTS / EXERCISES:

1.	Steady state characteristics of SCR.
2.	Single Phase half controlled and fully controlled rectifiers with R and RL loads
3.	Three Phase fully controlled rectifiers with motor load
4.	Step down and step-up converter
5.	Three Phase inverters – 180° and 120° mode of operation.
6.	Three Phase AC voltage controller with R and RL loads
7.	Simulation of DC converters (Single phase, three phase-controlled converters and choppers).
8.	Simulation of AC converters (Inverter and AC voltage regulator).
9.	PWM signal generation using DSPACE.
10.	Design of converter

Total:30

REFERENCES/ MANUAL /SOFTWARE:

1.	Laboratory Manual
2.	MATLAB Software
3.	DSPACE, PSIM software and Power quality analyzer

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	examine and estimate the performance of AC and DC converters	Analyzing (K4), Manipulation (S2)
CO2	demonstrate and execute the performance of Inverter and AC voltage controller	Analyzing (K4), Manipulation (S2)
CO3	design and build a suitable power converter	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	2	3	2	2	1			1	2	3	3	2	3	2
CO2	3	3	2	2	1			1	2	3	3	2	3	3
CO3	3	2	1	1				1	2	3	3	2	2	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)

22EET61 – POWER SYSTEM PROTECTION AND SWITCHGEAR

Programme & Branch	B.E & Electrical and Electronics Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	**Generation, Transmission and Distribution**	**6 / 7**	**PC**	**3**	**0**	**0**	**3**

Preamble	This course covers the power system protection and switchgear terminologies and gives a brief insight about the various types of relays, circuit breakers and protective schemes adapted for the protection of alternator, motor, transformer and transmission lines. It also covers the modern and advanced relay systems.	
Unit – I	**Introduction:**	**9**
Protective Relays: Need for Protection – Zones of Protection – Power System Earthing –Types of Earthing – Classification of Relay: Electromagnetic Relays, Over Current Relays – Over Voltage Relays – Distance Relay: Impedance, Reactance, Mho Relay – Differential Relays – Negative Phase Sequence Relay – Relay Coordination.		
Unit – II	**Protection of Power Equipment:**	**9**
Generator protection: Stator Protection: Percentage Differential Protection – Stator Inter-turn Protection -– Stator Overheating Protection. Rotor Protection: Earth Fault Protection – Loss of Excitation – Rotor Overheating Protection. Transmission Line Protection: Protection of Feeder and Ring Main System – Pilot Wire Protection – Carrier Current Protection – Transformer Protection: Incipient Fault Protection – Differential Protection – Over Fluxing Protection. HVDC Protection: DC and AC side protection.		
Unit – III	**Theory of Circuit Interruption:**	**9**
Physics of arc Phenomena and arc Interruption – Methods of arc Extinction – Theories of arc Interruption – Arc Voltage – Restriking Voltage and Recovery Voltage – Expression for Restriking Voltage and Rate of Rise of Restriking Voltage – Current Chopping –Interruption of Capacitive Currents – Resistance Switching.		
Unit – IV	**Circuit Breakers:**	**9**
Classification of Circuit Breakers – Circuit Breaker Operating Mechanism: Oil, Air Blast, SF6, Vacuum – DC Circuit Breaker – Selection of C.B. – Comparative Merits of Different Circuit Breakers – Testing of C.B: Type Test and Routine Test – Direct Testing – Indirect Testing.		
Unit – V	**Advanced Relays:**	**9**
Introduction of Microprocessor Based Protective Relay – Static Relays – Phase, Amplitude Comparators – Synthesis of Various Relays using Static Comparators – Block Diagram of Numerical Relay: Power System Data flow – Automated Substation – Block diagram of Digital Signal Processing based relay – Role of DSP in relaying – Sampling Theorem – Anti-aliasing filtering – Arc Flash Relays –Green Switchgear.		
		Total:45

TEXT BOOK:

1.	Gupta J.B, "A Course in Power Systems", 11th Edition, S.K.Kataria & Sons, New Delhi, 2017.

REFERENCES:

1.	Paithankar Y.G & Bhide S.R, “Fundamentals of Power System Protection”, 2nd Edition, Prentice–PHI Learning Private Limited, 2010
2.	Badri Ram & Vishwakarma D.N, "Power System Protection and Switchgear", 2nd Edition, Tata McGraw Hill, New Delhi, 2011.
3.	Madhava Rao T.S, “Digital/Numerical Relays”, 1st Edition, Tata McGraw Hill, 2005.
4.	Prof. S.A. Soman, “Power System Protection”, NPTEL, IIT Bombay, 2009.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	Understand the basic concepts of earthing and working of various protective relays.	Understand (K2)
CO2	Apply and select the various protective schemes for generator, motor, transformer and transmission line protections.	Apply (K3)
CO3	Analyze the phenomenon of arc, interruption and restriking voltages.	Analyze (K4)
CO4	Explain, compare and select the various types of circuit breakers for specific applications.	Understand (K2)
CO5	Understand the different types of advanced relays and protective systems.	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	1				1			1			1	3	1
CO2	3	2	1	1	1	1			1			1	3	2
CO3	3	2	1	1	1	1			1			1	3	2
CO4	3	1	1	1		1			1			1	2	1
CO5	3	1			1	1	1		1			1	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	60	25	--	--	--	100
CAT2	10	40	25	20	--	--	100
CAT3	20	80	--	--	--	--	100
ESE	10	50	20	20	--	--	100

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

22EET62 – ELECTRIC DRIVES AND CONTROL								
Programme& Branch	**B.E & Electrical and Electronics Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Synchronous and Induction Machines, Power Electronics, Control Systems**	**6**	**PC**	**3**	**0**	**0**	**3**

Preamble	This course aims in imparting knowledge about various DC and AC drives and selection of drives for various applications	
Unit – I	**Introduction to Electric Drives:**	**9**
Elements of Electrical drives– Choice of Electrical drives -Torque balance equation of Drive system – speed torque conventions and multi quadrant operation – components of load torque – nature and classification of load torque – Modes of operation – Speed control and drive classification – classes of motor duty – determination of motor rating - Braking Methods		
Unit – II	**Converter/Chopper Fed DC Motor Drives:**	**9**
Introduction to DC motor and their performance -Speed Control of DC Motors – Ward–Leonard Scheme – Drawbacks – single phase and three phase half & fully controlled rectifier control of dc separately excited motor – Dual converter fed DC separately excited motor fed from fully controlled rectifier – Class A, B, C, D & E chopper controlled separately excited DC drives.		
Unit – III	**Induction Motor Drives:**	**9**
Three phase induction motor Stator voltage control – Variable frequency control of phase induction motor: VSI based V/f control, CSI based control – closed loop speed control and converter rating– Rotor resistance control and slip power recovery schemes of Three phase induction motor.		
Unit – IV	**Synchronous Motor Drives:**	**9**
Types-synchronous motor variable speed drives – variable frequency control – modes of variable frequency control – self-controlled synchronous motor drive employing load commutated thyristor inverter – self-controlled synchronous motor drive employing a cycloconverter – Permanent magnet synchronous motor (PMSM) drives - Electric Traction drive components.		
Unit – V	**BLDC, Stepper Motor Drives and Applications:**	**9**
Brushless DC motor drives – Variable reluctance and permanent magnet stepper motor Drives – Solar and Battery powered Drives – Drives for specific applications: EV Drives - Wind mill - textile mills – cranes and hoist drives – Steel rolling mills.		
		Total:45

TEXT BOOK:

1.	Dubey G.K. "Fundamentals of Electrical Drives", 2nd Edition, Narosa Publishing House, New Delhi, 2019.

REFERENCES:

1.	Vedam Subrahmanyam "Electric Drives: Concepts and Applications", 2nd Edition, McGraw-Hill, New Delhi, 2010.
2.	Singh M.D. and Kanchandani, "Power Electronics", 2nd 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	Analyze the motor load characteristics	Applying (K3)
CO2	Apply power converters for speed control of DC drives	Applying (K3)
CO3	Understand the operation and control of Induction motor drives	Understanding (K2)
CO4	Analyze the performance of synchronous motor drives	Applying (K3)
CO5	Understand the operation of special electrical machines and control schemes for various 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	2	1	1	1	1	1		1			1	2	3
CO2	3	2	1	1	1	1	1		1	1		1	2	3
CO3	3	2	1		1							1	1	2
CO4	3	2	1	1	1	1	1		1	1		1	2	3
CO5	3	2	1	1	1							1	2	3

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

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	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)

22EEL61 – POWER SYSTEM LABORATORY

Programme& Branch	B.E & Electrical and Electronics Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	**Generation Transmission and Distribution, Power System Analysis**	**6**	**PC**	**0**	**0**	**2**	**1**

Preamble	This course is designed to impart practical knowledge about the various transmission line components and carryout various power system studies

LIST OF EXPERIMENTS / EXERCISES:

1.	Experimental analysis of transmission line.
2.	Analysis of Ferranti effect.
3.	Analysis of Surge impedance loading for medium transmission line.
4.	Formation of bus admittance matrix.
5.	Load flow analysis using Gauss Seidal method.
6.	IDMT Characteristics of over current relay/overvoltage relay.
7.	Characteristics of Negative sequence/Differential relay.
8.	Measurement of breakdown voltage of liquid dielectric.
9.	Experimental Investigation of Dielectric Constants in Liquid Insulators.
10.	Measurement of insulation resistance.

Total:30

REFERENCES/ MANUAL /SOFTWARE:

1.	Laboratory Manual
2.	MATLAB, Mi-power Software

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	Compute the line parameters and evaluate the performance indices.	Applying (K3), Manipulation (S2)
CO2	Determine the time current characteristics of analog/digital/numerical relays.	Analyzing (K4), Manipulation (S2)
CO3	Analyze the performance of various liquid dielectrics.	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	2	3	3		1	1		1	1	2	1	3	2
CO2	3	3	2	2	2	1	1		1	1	3	1	2	3
CO3	3	2	1	1		1	1		1	1		1	3	2

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

22EEL62 – ELECTRIC DRIVES LABORATORY

Programme & Branch	B.E & Electrical and Electronics Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	**Nil**	**6**	**PC**	**0**	**0**	**2**	**1**

Preamble	This course is designed to impart knowledge about the various drives.

LIST OF EXPERIMENTS / EXERCISES:

1.	Simulation of closed loop control of converter fed DC motor drive using MATLAB software.
2.	Simulation of closed loop control of chopper fed DC motor drive using MATLAB software.
3.	Simulation of VSI fed Three phase induction motor drive using MATLAB software.
4.	Simulation of Three phase synchronous motor drive using MATLAB software.
5.	Speed control of DC motor drive using Three phase Rectifier.
6.	Speed control of Three phase induction motor drive using PWM inverter.
7.	FPGA based drive for induction motor.
8.	DSP based Speed control of BLDC motor drive.
9.	Speed control of PMSM Drive in open and closed loop.
10.	DSP based chopper drive for DC Motor (Programming and Implementation).

Total:30

REFERENCES/ MANUAL /SOFTWARE:

1.	Laboratory Manual
2.	MATLAB Software

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	examine the performance of DC and AC drives using software tool	Analyzing (K4) Manipulation (S2)
CO2	demonstrate the speed control of DC and AC motor using conventional techniques	Applying (K3) Manipulation (S2)
CO3	execute the modern digital control techniques for the speed control of DC motor, AC motor and special electrical machines	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	2	1	1	1		1	1			3	3
CO2	3	2	1	1		1	1		1	1			2	3
CO3	3	2	1	1		1	1		1	1			2	3

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

22GCT31- 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**	**BS**	**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 – 60 marks & ESE – 100 marks)							

22EEP61 – PROJECT WORK I

Programme & Branch	**B.E & Electrical and Electronics Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**6**	**EC**	**0**	**0**	**8**	**4**

Total:120

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	identify a real-world problem and develop the design solutions	Applying (K3)
CO2	select the proper components as per requirements of the design/system	Applying (K3)
CO3	apply the new tools, algorithms, methodologies that contribute to obtain the solution of the project	Analyzing (K4)
CO4	analyze the findings and execute the project with developed prototype as a team	Analyzing (K4)
CO5	defend the findings and conclude with oral/written reports.	Evaluating (K5)

Mapping of Cos with POs and PSOs

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

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

22EEL63 – POWER ELECTRONICS AND DRIVES LABORATORY							
Programme& Branch	**B.E & Electrical and Electronics Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**5**	**PC**	**0**	**0**	**2**	**1**

Preamble	This course is designed to impart practical knowledge about the various Power Electronics converters, controllers and various drives

LIST OF EXPERIMENTS / EXERCISES:

1.	Simulation of closed loop control of converter/ chopper fed DC motor drive using software.
2.	Simulation of VSI fed Three phase induction motor/ synchronous motor drive using software.
3.	Speed control of DC motor drive using Three phase Rectifier.
4.	Speed control of Three phase induction motor drive using PWM inverter in 180° and 120° mode of operation..
5.	Step down and step-up converter
6.	Single Phase half controlled and fully controlled rectifiers with R and RL loads
7.	FPGA based drive for induction motor.
8.	DSP based Speed control of BLDC motor drive.
9.	Speed control of PMSM Drive in open and closed loop.
10.	PWM signal generation using DSPACE.
	Total:30

REFERENCES/ MANUAL /SOFTWARE:

1.	Laboratory Manual
2.	MATLAB Software
3.	DSPACE, PSIM software and Power quality analyzer

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	examine and estimate the performance of AC and DC converters	Analyzing (K4), Manipulation (S2)
CO2	demonstrate the speed control of DC and AC motor using conventional techniques	Analyzing (K4), Manipulation (S2)
CO3	execute the modern digital control techniques for the speed control of DC motor, AC motor and special electrical machines	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	2	3	2	2	1	1	1	1	2	3	3	2	3	2
CO2	3	3	2	2	1	1	1	1	2	3	3	2	3	3
CO3	3	2	1	1		1	1	1	2	3	3	2	2	3

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

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)

22EEP71 – PROJECT WORK – II PHASE – I

Programme & Branch	**B.E & Electrical and Electronics Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**6**	**EC**	**0**	**0**	**10**	**5**

Total:150

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	identify a real world problem and develop the design solutions	Applying (K3)
CO2	select the proper components as per requirements of the design/system	Applying (K3)
CO3	apply the new tools, algorithms, methodologies that contribute to obtain the solution of the project	Analyzing (K4)
CO4	analyze the findings and execute the project with developed prototype as a team	Analyzing (K4)
CO5	defend the findings and conclude with oral/written reports.	Evaluating (K5)

Mapping of Cos with POs and PSOs

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

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

22EEP81 – PROJECT WORK – II PHASE – II							
Programme & Branch	**B.E & Electrical and Electronics Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**6**	**EC**	**0**	**0**	**8**	**4**

Total:120

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	identify a real world problem and develop the design solutions	Applying (K3)
CO2	select the proper components as per requirements of the design/system	Applying (K3)
CO3	apply the new tools, algorithms, methodologies that contribute to obtain the solution of the project	Analyzing (K4)
CO4	analyze the findings and execute the project with developed prototype as a team	Analyzing (K4)
CO5	defend the findings and conclude with oral/written reports.	Evaluating (K5)

Mapping of Cos with POs and PSOs

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

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

22EEE01 – POWER SEMICONDUCTOR DEVICES

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

Preamble	The objective of this course is to study and analyze the characteristics of power semiconductor devices. This course also provides working operation of various firing and protecting circuits and its signification.

Unit – I	**Power Semiconductor Diodes:**	**9**

Introduction– power diode characteristics – power diode types: General purpose diodes, fast recovery diodes and schottky diodes – performance parameters – Effects of forward and reverse recovery time – series connected diodes –parallel connected diodes.

Unit – II	**Power Transistors:**	**9**

Introduction – Bipolar junction transistor: performance parameters, based drive control – Power MOSFET: Performance parameters, Gate drive – series and parallel operation – di/dt and dv/dt limitation – Isolation of gate and base drives: pulse transformers and optocouplers – GaN, SiC Devices.

Unit – III	**Power Thyristors:**	**9**

Introduction – two transistor model of thyristor – di/dt and dv/dt protection – Thyristor types: Phase control thyristors, fast switching thyristors, Gate turn Off thyristors, Bidirectional Triode Thyristors, Reverse conducting thyristors and light activated silicon-controlled rectifiers – Performance parameters: SCR and GTO – series and parallel operation of thyristors.

Unit – IV	**Thyristors Firing and Commutation Techniques:**	**9**

Thyristors firing circuits – natural commutation – forced commutation: self-commutation, impulse commutation, resonance pulse commutation, complementary commutation, load side and line side commutation – commutation circuit design – commutation capacitors.

Unit – V	**Protection of Power Electronics Devices and Circuits:**	**9**

Introduction – cooling and heat sinks – snubber circuits – reverse recovery transients – supply and load side transients – voltage protection by selenium diodes and metal oxide varistors – current protections: fusing – fault current with AC source – fault current with DC source.

Total:45

TEXT BOOK:

1.	Rashid M.H., “Power Electronics Circuits, Devices and Applications ", 3rd Edition, Pearson Education., New Delhi, 2003.

REFERENCES:

1.	B. Jayant Baliga, “Gallium Nitride and Silicon Carbide Power Devices”, New Edition, World Scientific Publishing Co Pte Ltd , 2017.
2.	Ned Mohan, Undeland and Robbin, “Power Electronics: converters, Application and design”, 3rd Edition, John Wiley and sons, 2007
3.	Tsunenobu Kimoto and James A. Cooper , Fundamentals of Silicon Carbide Technology: Growth, Characterization, Devices, and Applications, First Edition, John Wiley and sons, 2014

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	explain the basic principle and operation of Diode.	Understanding (K2)
CO2	explain the basic principle and operation of transistor	Understanding (K2)
CO3	explain the principle and operation of power thyristors	Understanding (K2)
CO4	Select the thyristor firing and commutation techniques	Applying (K3)
CO5	Develop firing and protection circuits of power semiconductor	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	3	3
CO2	3	2				1						1	2	2
CO3	3	2	2			1						1	2	2
CO4	3	2	2			1						1	2	2
CO5	3	3	2			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	60	20				100
CAT3	20	60	20				100
ESE	20	40	40				100

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

22EEE02 – ARTIFICIAL INTELLIGENCE APPLICATIONS TO POWER SYSTEMS							
Programme & Branch	**B.E & Electrical and Electronics Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Power System Analysis**	**5**	**PE**	**3**	**0**	**0**	**3**

Preamble	This course explores the concepts of application of artificial intelligence to power system problems	
Unit – I	**Introduction to power system operation:**	**9**
Introduction to terminologies: Reactive power planning, Generation Planning, load shedding, Economic load dispatch – ED problem with smooth cost functions – Equal incremental cost – lambda iteration method with and without loss		
Unit – II	**Introduction to AI:**	**9**
Artificial intelligence, computational intelligence, Evolutionary algorithms - evolutionary programming – evolutionary strategy – genetic algorithm – particle swarm optimization		
Unit – III	**Evolutionary algorithm for Reactive Power Planning:**	**9**
Optimal reactive power planning problem – Objective function – P – Q decomposition – Flow chart – case study		
Unit – IV	**Particle Swarm Optimisation for ED problem:**	**9**
Nature inspired techniques – ED problem with smooth cost functions – Modification in PSO with regard to economic dispatch problem – updation of parameters – case study		
Unit – V	**Applications:**	**9**
Radial Basis function – RBFNN for distribution system automation - decision tree for DSA – case study		
		Total:45

TEXT BOOK:

1.	Edited by Mircea Eremia, Chen-ching Liu and Abdelaty Edris, Advanced Solutions in Power Systems – HVDC, FACTS and Artificial Intelligence, IEEE press series on Power Engineering, 2016.

REFERENCES:

1.	Weerakorn Ongsakul and Dieu Ngoc Vo, Artificial intelligence in Power System optimization –– CRC Press, 2013
2.	Wolfgang Ertel, Introduction to Artificial Intelligence, Springer Cham- 2nd Edition, 2018

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	Describe the various power system operation	Understanding (K2)
CO2	Discuss the artificial intelligence techniques	Understanding (K2)
CO3	Apply evolutionary technique to power system problem	Applying (K3)
CO4	Perceive the nature inspired technique and its application to economic dispatch problem	Applying (K3)
CO5	Understand the AI techniques to simple power system problems	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	2
CO2	3	2	1		1	1			1			1	2	1
CO3	1	3	2			1	1	1	1			1	3	1
CO4	3	1	2		1	1	1	1	1			1	1	3
CO5	3	2	1		1	1			1			1	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	75					100
CAT2	20	40	40				100
CAT3	10	45	45				100
ESE	5	60	35				100

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

22EEE03 – RENEWABLE ENERGY SYSTEM

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

Preamble	This course confers the new methodologies and recent technologies for effective utilization of renewable energy sources and various nuances behind renewable energy conversion process.	
Unit – I	**Principles of renewable energy**	**9**
Introduction- Energy and sustainable development - Fundamentals - Importance of renewable sources of energy, Sustainable Design and development, Types of RE sources, Limitations of RE sources, technical implications- Present Indian and international energy scenario of conventional and RE sources.		
Unit – II	**Solar Energy**	**9**
Solar radiation at the earth’s surface – Solar radiation measurements– Solar energy collectors: flat plate and concentrating collectors. Solar electric power generation: Solar Photo-Voltaics – Applications of solar energy: solar pumping and solar cooking.		
Unit – III	**Wind Energy**	**9**
Basic components of a wind energy conversion system – Classification. Wing Energy Collectors: horizontal axis and vertical axis machines – Performance of wind machines– Generating system – Energy storage – Applications of wind Energy – Interconnected systems – Safety systems – Environmental aspects.		
Unit – IV	**Bioenergy, Geothermal Energy and Ocean Energy**	**9**
Bioenergy: Biomass conversion technologies – Biogas generation – Classification of biogas plants – Ethanol production. Geothermal Energy: Geothermal sources – Prime movers for geothermal energy conversion. Ocean Energy: Basic principle of tidal power–Components – Operation methods, Ocean waves – Energy and power from waves.		
Unit – V	**Additional Alternate Energy Sources and Chemical Energy Sources**	**9**
MHD power generation – Thermoelectric power generation. Chemical energy sources: Hydrogen production – Storage – Transportation and utilization – Hydrogen as an alternative fuel for motor vehicles – Fuel cell – Principle – Types.		
		Total:45

TEXT BOOK:

1.	Rai G.D., "Non-Conventional Energy Sources", 6th Edition, Khanna Publishers, New Delhi, 2017.

REFERENCES:

1.	Kothari D.P, Singal K.C & Rakesh Ranjan. "Renewable Energy Sources and Emerging Technologies", 2nd Edition, PHI Learning Pvt. Ltd., New Delhi, 2011.
2.	John Twidell & Tony Weir. "Renewable Energy Resources", 3rd Edition, Routledge, New York, 2015.
3.	Shobh Nath Singh, “Non-conventional Energy resources” Pearson Education, 2015.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	understand the various renewable Energy Sources and technologies.	Understanding (K2)
CO2	understand the working and applications of solar energy systems	Understanding (K2)
CO3	explain the working and applications of wind energy systems	Understanding (K2)
CO4	express the principle of the bio-energy production techniques and operation of geothermal energy and ocean energy sources	Understanding (K2)
CO5	explain the operation of additional alternate energy sources	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			1	1					1	2	3
CO2	3	2	2			1	1					1	2	3
CO3	3	2	2			1	1					1	2	3
CO4	3	2	2			1	1					1	3	2
CO5	3	2	1	1		1	1					1	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	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)

22EEE04 – MODELING OF ELECTRICAL MACHINES

Programme & Branch	**B.E & Electrical and Electronics Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Synchronous and Induction Machines, Control Systems**	**5**	**PE**	**3**	**0**	**0**	**3**

Preamble	This course aims in imparting knowledge on Modeling of AC and DC Machines based on generalized theory

Unit – I	**Principles of Electromechanical Energy Conversion**	**9**
Introduction – Energy in Magnetic System – Field Energy and Mechanical Force – Multiple Excited Magnetic Field Systems – Forces/Torques in system with permanent Magnets –Energy Conversion via Electric Field – Dynamic Equations of Electromechanical Systems.		
Unit – II	**Generalized Theory**	**9**
Basic two pole machines – Kron‘s Primitive Machine- Invariance of Power – Transformations from Three Phase to Two Phase – Transformation from Rotating axes to Stationary axes - Electrical Torque– Restriction of the Generalized Theory of Electrical Machines		
Unit – III	**DC Machines**	**9**
Separately Excited D.C Generators and Motors – Steady State and Transient Analysis - Interconnection of Machines – Ward-Leonard System of Speed Control - Transfer Function of D.C Series, Shunt, Compound Machines.		
Unit – IV	**Poly-phase Synchronous Machines**	**9**
General Machine Equations-Three Phase Synchronous Machine - Steady state analysis– Transient analysis (qualitative Approach) - Concepts of Synchronous machine reactance – Concepts of Synchronous Machine Dynamics.		
Unit – V	**Induction Machines**	**9**
Transformations - performance equations – Steady State Analysis – Analysis of Equivalent Circuit - Torque Slip Characteristics – Induction Machine Dynamics- Introduction to Ansys software and design of induction motor		
		Total:45

TEXT BOOK:

1.	Bimbhra P.S., Generalized Theory of Electrical Machines‖, 5th Edition, Khanna Publishers Ltd., 2021.

REFERENCES:

1.	Krishnan R., Electric Motor Drives: Modeling, Analysis, and Control‖, 1st Edition, PHI Learning, 2015.
2.	Kothari D.P., Nagrath I.J., Electrical Machines‖, 4th Edition, McGraw Hill Book Company, 5th Reprint 2012.
3.	Bimal K. Bose, Modern Power Electronics and AC Drives‖, 1st Edition, PHI Learning, 2017.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	apply the basic principles of electromechanical energy conversion	Applying (K3)
CO2	determine the equivalent circuit parameters and model the electrical machines	Applying (K3)
CO3	analyze the steady state and transient characteristics of DC machines	Analyzing (K4)
CO4	design the mathematical model of polyphase synchronous machines	Applying (K3)
CO5	analyze the steady state characteristics of induction machines	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**	**1**	**1**	**2**					1			1	**1**	**3**
CO2	**3**	**3**	**2**	**2**					1			1	**2**	**3**
CO3	**3**	**3**	**2**	**2**					1			1	**3**	**3**
CO4	**3**	**3**	**3**	**2**					1			1	**3**	**3**
CO5	**3**	**3**	**2**	**2**					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	10	40	40	10			100
CAT3	10	40	40	10			100
ESE	10	20	50	20			100

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

22EEE05 – VLSI DESIGN

Programme & Branch	**B.E & Electrical and Electronics Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Digital Electronics**	**5**	**PE**	**3**	**0**	**0**	**3**
Preamble	To expose the knowledge of VLSI System Design in terms of modeling of MOS transistors, designing CMOS logic circuits with its fabrication techniques and programming various digital logic circuits using Verilog Hardware Description Language in different modeling						
Unit – I	**Introduction**						**9**
CMOS Logic – CMOS Fabrication and Layout – Physical Design – Design Verification – Fabrication, packaging and Testing							
Unit – II	**MOS Transistor Theory**						**9**
Introduction – MOS transistor operating regions – Long Channel VI characteristics – Non ideal I-V effects - DC transfer characteristics							
Unit – III	**CMOS Processing Technology**						**9**
Introduction – CMOS technologies – Stick Diagram – Layout diagram – Layout Design Rules – CMOS Process Enhancement – Technology related CAD Issues – Manufacturing Issues							
Unit – IV	**VERILOG HDL–I**						**9**
VLSI Design Flow – Dataflow modelling – Continuous Assignments – Delays – Expressions, operators, operands – Operator Types – Dataflow modelling Examples – Behavioural modelling – Structured Procedures - Procedural Assignments –Timing controls – Conditional statements - Multiway branching -Loops - Behavioural modelling Examples							
Unit – V	**VERILOG HDL–II**						**9**
Tasks and Functions – Difference between tasks and functions – Tasks – Functions – Useful Modelling Techniques – Switch level modelling Elements - Switch level modelling Examples							
							Total:45

TEXT BOOK:

1.	Neil H. E. Weste & David Money Harris, “CMOS VLSI Design A Circuits and Systems Perspective” Fourth Edition, Pearson education, New Delhi, 2017, for Units I, II, III
2.	Samir Palnitkar, “Verilog HDL: Guide to Digital Design and Synthesis”, Second Edition, Pearson Education, New Delhi, 2017, for Units IV, V.

REFERENCES:

1.	Pucknell, Douglas A & Eshragian, K., “Basic VLSI Design”, Third Edition, Prentice Hall India, Pvt Ltd, 2015.
2.	A.Albert Raj & T.Latha, “VLSI Design”, Prentice Hall India Learning Private Limited, 2008.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	Comprehend the principles of CMOS Logic and its physical design process.	Understanding (K2)
CO2	Explain MOS transistor characteristics.	Applying (K3)
CO3	Describe CMOS fabrication techniques, layout design rules and different manufacturing issues	Understanding (K2)
CO4	Apply Verilog HDL modeling for different digital logic circuits in dataflow modelling and behavioural modelling.	Applying (K3)
CO5	Model different digital logic circuits using Verilog HDL in Switch level modeling.	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	2
CO2	3	2	1	1	1							1	3	1
CO3	3	2	1	1	1							1	3	1
CO4	3	3	3	1	3				2		2	2	3	3
CO5	3	3	3	1	3				2		2	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	70	20				100
CAT2	10	60	30				100
CAT3	10	30	60				100
ESE	10	40	50				100

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

22EEE06 – INDUSTRY 4.0 FOR ELECTRICAL ENGINEERS

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

Preamble	To impart basic idea in Industry4.0. To provide students with good depth of knowledge of designing Industrial 4.0 Systems for various application. Learn the design and analysis of Industry 4.0 systems for Energy and smart vehicular applications.

Unit – I	**INTRODUCTION TO INDUSTRY 4.0**	**9**

Introduction, Historical Context, General framework, Application areas, Dissemination of Industry 4.0 and the disciplines that contribute to its development, Artificial intelligence, The Internet of Things and Industrial Internet of Things, Additive manufacturing, Robotization and automation, Current situation of Industry 4.0. Introduction to Industry 4.0 to Industry 5.0 Advances

Unit – II	**CYBER PHYSICAL SYSTEM**	**9**

Introduction to Cyber Physical Systems (CPS), Architecture of CPS- Components, Data science and technology for CPS, Emerging applications in CPS in different fields. Security and utility.

Unit – III	**SMART ENERGY SOURCES AND ADVANCES**	**9**

Energy Storage for Mitigating the Variability of Renewable Electricity Sources-Types of electric energy storage. Electric Vehicles as Energy Storage: V2G Capacity Estimation. Model based Engineering.

Unit – IV	**SMART GRID**	**9**

Smart grid definition and development Smart Grid, Understanding the Smart Grid, Smart grid solutions, Design challenges of smart grid and Industry 4.0.

Unit – V	**SMART APPLICATIONS**	**9**

Understanding Smart Appliances -Smart Operation-Smart Monitoring-Smart Energy Savings-Smart Maintenance, Case study-Smart Cars, Self-Driving Cars, Introducing Google‘s Self-Driving Car.

Total:45

TEXT BOOK:

1. Jean-Claude André, Industry4.0, Wiley-ISTE, July2019, ISBN: 781786304827, 2019 for Units I, II.
2. Diego Galar Pascual, Pasquale Daponte, Uday Kumar, –Handbook of Industry4.0 and SMART System, Taylor and Francis,2020. for Units III, IV, V.

REFERENCES:

1. Miller M, Theinternet of things: How smart TVs, smart cars, smart homes, and smart cities are changing the world, Pearson Education, 2015, ISBN:9780134021300.
2. Pengwei Du and Ning Lu, —Energy storage for smart grids: planning and operation for renewable and variable energy resources VERs, Academic Press, 2018, Reprint edition, ISBN-13:978-0128100714.
3. Hossam A. Gabbar, —Smart Energy Grid Engineering, Academic Press, 2017, ISBN 978- 0-12-805343-0.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	Understand the basic concepts of Industry 4.0 and the other related fields	Understanding (K2)
CO2	Understand cyber physical system and the emerging applications	Understanding (K2)
CO3	Analyze the different energy storage systems	Applying (K3)
CO4	Analyze a smart grid system	Applying (K3)
CO5	Implement the industry 4.0 to solve engineering 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				1	1		1			1	1	3
CO2	3	2	1	1		1	1		1			1	2	3
CO3	3	2	1	1		1	1		1			1	2	3
CO4	3	1				1	1		1			1	1	3
CO5	3	2	1	1		1	1		1			1	2	3

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

ASSESSMENT PATTERN - THEORY

Test / Bloom’s Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	80					100
CAT2	10	70	20				100
CAT3	10	60	30				100
ESE	10	70	20				100

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

22EEE07 – ADVANCED POWER ELECTRONIC CIRCUITS							
Programme& Branch	**B.E & Electrical and Electronics Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Power Electronics**	**6**	**PE**	**3**	**0**	**0**	**3**

Preamble	This course is designed to impart knowledge about the configuration, control strategies and back to back converter for power electronics circuits.

Unit - I	**Configuration of Power Electronics Circuit**	**9**
Neutral point clamped configuration: Three level and Five level configurations – cascade configuration: single and two H bridge converter – PWM Implementation of single and two H bridge converter – flying capacitor configuration: three phase FC converter.		
Unit - II	**Optimized PWM approach**	**9**
Introduction – two leg and three leg converter Model, PWM implementation, Analog and digital implementation – space vector modulation – other configuration with CPWM: three leg and four converter – Nonconventional topologies with CPWM: Z-Source converter.		
Unit - III	**Control strategies for Power Converters**	**9**
Introduction – basic control principles – hysteresis control – linear control with DC variable: P, PI and PID controller for RL load – linear control with ac variable – cascade control strategies: rectifier circuit for voltage and current control.		
Unit - IV	**Single Phase to Single Phase Back-to-Back Converters**	**9**
Introduction – Full Bridge converter: Model, PWM strategy, control approach – topology with component count reduction: Model – PWM strategies - Topologies with increased number of switches: converter in series and parallel.		
Unit – V	**Design of converter**	**9**
Introduction – Full Bridge converter: Model, PWM strategy, control approach, DC link capacitor voltage, and capacitor bank design – topology with component count reduction – Topologies with increased number of switches: converter in series and parallel - other back-to-back converters.		
		Total:45

TEXT BOOK:

1.	Euzeli dos Santos, Edison R. da Silva, "Advanced Power Electronics Converters", 1st Edition, John Wiley and sons, 2014

REFERENCES:

1.	Rashid M.H., "Power Electronics Circuits, Devices and Applications ", 4th Edition, Pearson Education., New Delhi, 2014.
2.	Ned Mohan, Tore M. Undeland & William P.Robbins, "Power Electronics: converters, Application and Design", 3rd Edition, John Wiley and sons, 2007
3.	MD Singh and K.B Khanchandani, "Power Electronics", 2nd Edition, McGraw Hill, 2013.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	Classify different configuration of power electronics circuit	Understanding (K2)
CO2	Explain various PWM topologies for power converters	Understanding (K2)
CO3	Explain the Control strategies of power converters	Understanding (K2)
CO4	Construct Various single phase to single phase back-to-back converter	Applying (K3)
CO5	Build different types of switched mode converters	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	3	1
CO2	3	2				1			1			1	1	2
CO3	3	2	2			1			1			1	2	1
CO4	3	2	2			1			1			1	2	2
CO5	3	3	2			1			1			1	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	20	80					100
CAT2	20	80					100
CAT3	20	60	20				100
ESE	20	40	40				100

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

22EEE08 – SUBSTATION ENGINEERING AND AUTOMATION							
Programme & Branch	**B.E & Electrical and Electronics Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Generation, Transmission & Distribution**	**6**	**PE**	**3**	**0**	**0**	**3**

Preamble	The course aims in imparting knowledge of substation and its components	
Unit – I	**Introduction**	**9**
General background – Need Determination – Budgeting – Financing – Traditional and Innovative Substation Design – Site selection and Acquisition – Design, Construction and Commissioning Process		
Unit – II	**Gas and Air Insulated Substations**	**9**
Sulphur Hexafluoride – Construction and Service life : Circuit breaker, CT's and PT's, Surge arrester, grounding, Testing, Installation, Operation and Interlocks - Air Insulated Substations: Single Bus arrangement – Double bus breaker arrangement – Ring bus arrangement – comparison of configurations		
Unit – III	**High Voltage Switching Equipment**	**9**
Introduction – Ambient Conditions – Disconnect switches – Load break switches – High Speed Grounding switches – Power Fuses – Circuit Switchers – Circuit Breakers		
Unit – IV	**High Voltage Power Electronic Substations**	**9**
HVDC Converters – FACTS Controllers – Converter Technologies: For smart power and grid access – Control and Protection System – Losses and Cooling – Civil Works – Reliability and Availability – Outlook and Future Trends		
Unit – V	**Substation Integration and Automation**	**9**
Open systems - Operational vs Non-operational data – Dataflow – Dataflow – Asset management – Redundancy – System components - Cyber security – Automation applications – Protocol fundamentals – Synchro phasors		
		Total: 45

TEXT BOOK:

1.	John D. Mc Donald, "Electric Power Substations Engineering ", CRC Press Third edition, 2012.

REFERENCES:

1.	S.Rao, "Electrical Substation Engineering and Practice EHV-AC, HVDC and SF6 – GIS", Khanna Publishers, Third Edition, 2015.
2.	James A. Momoh, "Electric Power Distribution, Automation, Protection, and Control", CRC Press,Taylor and Francis Group, 2007.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	Review the basics of substations and its components	Understanding (K2)
CO2	Discuss the different types of substations	Understanding (K2)
CO3	Infer high voltage switching equipment.	Understanding (K2)
CO4	Discuss the different types of Power Electronic Converters in Substations	Understanding (K2)
CO5	Develop the different controls and Automation in substations	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
CO2	3	2					1		1			1	2	1
CO3	3	2					1		1			1	2	1
CO4	3	2	1	1	1		1		1			1	3	2
CO5	3	2					1		1			1	2	1

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

ASSESSMENT PATTERN

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	30	70					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)

22EEE09 – DESIGN, INSTALLATION AND COMMISSIONING OF SOLAR AND WIND ENERGY SYSTEMS							
Programme & Branch	**B.E & Electrical and Electronics Engineering**	**Sem**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Applied Physics**	**6**	**PE**	**3**	**0**	**0**	**3**

Preamble	This course aims in imparting the concepts and nuances of solar and wind energy systems along with its design procedures.

Unit – I	**Solar PV Design and Integration:**	**9**
Types of solar PV systems: stand alone, grid connected and hybrid systems. Design methodology for solar PV system: Approximate design of solar PV system- solar PV system design chart – Look up table for solar PV system design.		
Unit – II	**Stand Alone Solar PV Systems:**	**9**
Introduction – Parameters of batteries: Terminal voltage-SoC and DoD, C-rating – Battery efficiency – Temperature – Life cycle – Shelf life - Selection of battery- Battery bank installation and commissioning- Charge controllers – Wire sizing – Junction box.		
Unit – III	**Grid Connected Solar PV Systems:**	**9**
Introduction – Configuration of grid connected solar PV systems- Components of grid connected solar PV systems: Solar PV Array - Array Combiner Box - DC Cabling - DC Distribution Box - Grid-connected Inverter - AC Cabling - AC Distribution Box. Grid-connected PV System Design for Small Power Applications - Steps of System Design.		
Unit – IV	**Dynamic Considerations in Wind Turbine Design:**	**9**
Power output from an ideal turbine – Aerodynamics – Power output from practical turbines – Energy production and capacity factor – Methods of generating synchronous power – DC shunt generator with battery load – AC generators		
Unit – V	**Installation and Commissioning of WECS:**	**9**
Site preparation – Methods of generating synchronous power - Synchronous generator- Electrical network – Selection of low voltage and distribution voltage equipments: Circuit breakers, Wire sizes, Transformers, Voltage drop – Losses- Wind farm costs.		
		Total:45

TEXT BOOK:

1.	Chetan Singh Solanki, "Solar Photovoltaic Technology and Systems – A Manual for Technicians, Trainees and Engineers", 1st Edition, PHI learning Private Limited, New Delhi, 2013 for Units I, II, III.
2.	Gary L. Johnson, "Wind Energy Systems", Electronic Edition, Manhatan, KS, 2006 for Units IV, V.

REFERENCES:

1.	Chetan Singh Solanki, "Solar Photovoltaics – Fundamentals, Technologies and Applications”, 2nd Edition, PHI learning Private Limited, New Delhi, 2011.
2.	Spera, D.A., "Wind Turbine Technology: Fundamental concepts of Wind Turbine Engineering", 2nd Edition, ASME, New York, 2009.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	apply the design procedures for solar PV systems towards installation	Applying (K3)
CO2	outline the components of standalone PV systems and its installation	Applying (K3)
CO3	outline the configuration of grid connected PV systems and its installation	Understanding (K2)
CO4	analyze the design considerations for WECS	Understanding (K2)
CO5	identify the installation methods for WECS	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					1	3	3
CO2	2	3	2	2	1	1	1					1	3	3
CO3	3	2	1	1		1	1					1	3	3
CO4	2	3	2	2	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	50	30				100
CAT2	20	60	20				100
CAT3	30	70	-				100
ESE	10	60	30				100

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

22EEE10 – SPECIAL ELECTRICAL MACHINES

Programme & Branch	B.E & Electrical and Electronics Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	**Synchronous and Induction Machines**	**6**	**PE**	**3**	**0**	**0**	**3**

Preamble	This course imparts knowledge about the construction and working principle of various special electrical machines and provides brief idea about their applications.

Unit – I	**Permanent Magnet Synchronous Motors:**	**9**

Permanent Magnet Motors – Classifications – PMSM: Constructional features - Principle of operation – EMF and torque equations– Phasor diagram – Locus diagram and torque speed characteristics – Closed loop control - Applications: PMSM for Railway vehicles.

Unit – II	**Permanent magnet brushless D.C Motors:**	**9**

Principle of operation – Types – Comparison between conventional DC and PMBLDC – Electronic commutation – EMF and torque equations – Sensors for Rotor position – Closed loop control – Motor characteristics and control – Applications: PMBLDC for Plug in Electric Vehicles.

Unit – III	**Synchronous Reluctance Motors:**	**9**

Constructional features – Synchrel – Types: Axial and Radial motors – Operating principle – Reluctance torque – Phasor diagram - Characteristics – control of synchrel motor – Applications: SRM for Electric ships – Introduction to Vernier motor – Permanent Magnet vernier motor.

Unit – IV	**Switched Reluctance Motors:**	**9**

Constructional features – Principle of operation – Torque prediction – Inductance profile –Types of Power controllers and converter topologies used – Current control schemes – Torque Speed Characteristics – Hysteresis and PWM control – Closed loop control – Applications: SRM for Hybrid electric vehicles.

Unit – V	**Stepper Motors:**	**9**

Constructional features – Principle of operation – Variable reluctance motor – Hybrid motor – Single and multi stack configurations – Theory of torque predictions – Linear and non-linear analysis – Characteristics – Drive circuits – Applications: Stepper Motor for Computer printers – Microprocessor based control.

Total:45

TEXT BOOK:

1. Janardanan E.G, "Special Electrical Machines", 1st Edition, PHI Learning Private Ltd, New Delhi, 2014.

REFERENCES:

1. Kenjo T, "Stepping Motors and Their Microprocessor Controls", 3rd Edition, Oxford University Press, New Delhi, 2009
2. Miller T.J.E, "Brushless Permanent Magnet and Reluctance Motor Drives", 1st Edition, Clarendon Press, United States, 1989.
3. Kenjo T. and Nagamori S., —Permanent Magnet and Brushless DC Motors‖, 1 st Edition, Clarendon Press, London, 1988.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	explain the construction, operation and performance of permanent Magnet synchronous motor.	Understanding (K2)
CO2	identify and distinguish the conventional DC and PMBLDC motors based on its performance	Applying (K3)
CO3	distinguish Synchrel and switched reluctance motors based on its performance	Applying (K3)
CO4	demonstrate the performance of stepper motor and characterize its curves	Applying (K3)
CO5	choose special drives 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				1						1	1	2
CO2	3	2	1	1		1						1	2	3
CO3	3	2	1	1		1						1	2	3
CO4	3	2	1	1		1						1	2	3
CO5	3	2	1	1		1						1	2	3

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

ASSESSMENT PATTERN - THEORY

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

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

22EEE11 – SENSORS AND ACTUATORS

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

Preamble	This course helps the students to impart the knowledge to interface various sensors and actuators in embedded applications.

Unit – I	**Inductive Transducers**	**9**

Introduction: Difference between sensor, and transducer- Principles- Classification of sensors- Static and Dynamic characteristics of sensors – Environmental parameters – Characterization
Inductive transducers: - Principle of operation, construction details, characteristics and applications of LVDT, Induction potentiometer, variable reluctance transducer- Inductive proximity sensor

Unit – II	**Capacitive & Radiation Sensors**	**9**

Capacitive transducers: - The parallel plate Capacitive sensor – Serrated plate Capacitive sensor – Variable Permittivity Sensor – Electro static transducer
Radiation Sensors: Types of photosensistors/photo detectors**:** The Photo emissive Cell and the Photomultiplier - The Photoconductive Cell- Photovoltaic and Photo junction Cells - Position-sensitive Cell**.** Fibre optic sensors: Liquid level sensing – Fluid flow sensing

Unit – III	**Thermal and Magnetic Sensors**	**9**

Thermal Sensors: Gas Thermometric Sensors - Acoustic Temperature Sensor - Resistance Change Type Thermometric Sensors-Thermoemf Sensors
Magnetic Sensors: Sensors and the principles – Magneto Resistive sensors – Hall effect Sensors – Inductance and Eddy current sensors – Angular/Rotary movement sensors – Switching magnetic sensors

Unit – IV	**Smart sensors and Applications of sensors**	**9**

Smart Sensors: Introduction, Primary Sensors, Excitation, Amplification, Filters, Converters, Standards for Smart Sensor Interface, MEMS
Sensors Applications: On-Board Automobile Sensors – Home Appliance sensors-Aerospace sensors-Medical Diagnostic sensors-Sensors for environmental monitoring.

Unit – V	**Actuators**	**9**

Thermo Mechnaical Actuators -Optical Actuators - Capacitive Actuators -Magneto strictive Actuators -Motors as actuators: Operation principles-BLDC Motors-AC motors-Stepper Motors-Linear Motors-Piezo electric actuators

Total:45

TEXT BOOK:

1.	Patranabis, Sensors and Transducers, 2nd Edition, PHI, 2022, for Units I, II, III and IV.
2.	Nadhan Ida, Sensors, Actuators, and Their Interfaces: A Multidisciplinary Introduction, Sci Tech Publishing, 2013 for Unit V.

REFERENCES:

1.	De Silva and Clarence W, Sensors and Actuators Engineering System Instrumentation, 2nd Edition, CRC Press, 2015.
2.	Jacob Fraden, Handbook of Modern sensors: Physics, Design and Applications, 5th Edition, Springer, 2015.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	explain the theory and working behind the inductive transducers	Understanding (K2)
CO2	Describe the construction and working of Capacitive and Radiation sensors	Understanding (K2)
CO3	Elaborate the various types of thermal and magnetic sensors and its principle of operation	Understanding (K2)
CO4	demonstrate the working of various types of sensors used in real world applications	Applying (K3)
CO5	Illustrate the working principle of Actuators and electrical actuating 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	2	1			1						1	3	2
CO2	3	2	1			1						1	3	2
CO3	3	2	1			1						1	3	2
CO4	3	2	1			1						1	3	2
CO5	3	2	1			1						1	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	15	85					100
CAT2	15	85					100
CAT3	10	60	30				100
ESE	10	70	20				100

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

22EEE12 – AVIONICS							
Programme & Branch	**B.E & Electrical and Electronics Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**6**	**PE**	**3**	**0**	**0**	**3**

Preamble	This course aimed to introduce the fundamental concepts and principles of avionic systems	
Unit – I	**Introduction To Avionics:**	**9**
History -Flying blind -Radio comes to age - Beginning of the National Airspace Systems -Navigation Principles -Regulatory and advisory agencies-National air space systems.		
Unit – II	**Terrestrial Enroute Radio Navigation:**	**9**
Non directional beacon and direction finding – direction finding receivers - Automatic Direction Finding -Errors in Direction Finding - Static Dischargers - VOR: VHF Omni-Range - Signal Integrity - Errors in VOR Navigation - Doppler VOR - VOR Ground Station - VOR Receiver - VOR Test Equipment- DME: Distance Measuring Equipment- DME Ground Station		
Unit – III	**Terrestrial Landing Aids**	**9**
ILS: Instrument Landing System – Marker Beacons- Glide Slope -ILS Errors - Microwave Landing System (MLS)- Comparison of ILS and MLS - Radar Altimeter - FM CW Radar Altimeter - Ground Proximity Warning System		
Unit – IV	**Satellite Navigation**	**9**
Introduction -GPS: Global Positioning System -GPS Clocks - Earth Model -Space Vehicle - GPS Signals - GPS Signals in Space - GPS Receivers -GPS Accuracy - GPS Navigation		
Unit – V	**Airborne Communications Systems**	**9**
Introduction - VHF AM Communications - VHF Communications Hardware - High Frequency Communications – ACARS – SELCAL -Search and Rescue Beacons - Digital Communications and Networking -VHF Digital Communications - Data Link Modes		
		Total:45

TEXT BOOK:

1.	Albert Helfrick.D., Principles of Avionics, Avionics Communications Inc., 4th Edition, 2017.

REFERENCES:

1.	Collinson.R.P.G. Introduction to Avionics, Springer; 3rd ed. 2014
2.	Middleton, D.H., Ed., Avionics systems, Longman Scientific and Technical, Longman Group UK Ltd., England, 1989
3.	Spitzer, C.R. Avionics Development and Implementation, CRC Press, 1st Edition, 2018

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	Apply the basics of avionics subsystems architecture.	Understanding (K2)
CO2	Distinguish between the needs of civil and military avionics systems	Understanding (K2)
CO3	Acquire knowledge on display technologies.	Understanding (K2)
CO4	Build Digital avionics architecture.	Applying (K3)
CO5	Design and analyze navigation and air data system	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1		1			1			1	1	2
CO2	3	3	2	2		1			1			1	2	2
CO3	3	2	1	1		1			1			1	1	2
CO4	3	3	2	1		1			1			1	1	1
CO5	3	2	2	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	20	80					100
CAT2	20	80					100
CAT3	20	60	30				100
ESE	20	60	30				100

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

22EEE13 – DESIGN OF POWER CONVERTERS							
Programme & Branch	**B.E & Electrical and Electronics Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Power electronics**	**7**	**PE**	**3**	**0**	**0**	**3**

Preamble	This course is designed to impart knowledge about the characteristics of selection of power semiconductor devices, working principle, design calculation and implementation challenges in the field of power electronic converters.
Unit - I	**AC to DC converter** **9**
	Introduction– Design calculation of: Half bridge controlled rectifier with R load – Full Bridge Controlled rectifier with RL load - analysis of CCM and DCM – surge protection circuit – load short protection circuit
Unit - II	**Isolated converters** **9**
	Buck Converter: Duty cycle determination – Open Loop CCM to DCM transition – calculation of critical inductance – Closed loop CCM & DCM – Output capacitor sizing – case study Flyback converter: Open Loop CCM & DCM duty cycle determination – calculation of critical inductance – Peak voltage mode CCM & DCM in closed loop – Peak current mode CCM & DCM in closed loop - Output capacitor sizing – case study.
Unit - III	**Non-Isolated converters** **9**
	Boost Converter: Duty-Cycle Determination- Critical Inductance - Peak Current Mode Closed-Loop Steady State in CCM & DCM - DCM Output Capacitor Size - CCM Output Capacitor Size - Effects of Converter Non-idealities - Switch Utilization Factor – case study.
Unit - IV	**DC to AC converters** **9**
	Practical aspects in building three phase Inverter : design calculation – selection of power devices – protection circuits – system protection management – reduction of common mode EMI – thermal management – carrier based PWM implementation: gate driver faults – dead time control
Unit - V	**Parallel and Interleaved Power Converters** **9**
	Comparison between High-Power Devices &Multiple Parallel Lower-Power Devices - Hardware Constraints in Paralleling IGBTs - Gate Control Designs for Equal Current Sharing - Advantages and Disadvantages of Paralleling Inverter - Interleaved Operation of Power Converters - Circulating Currents - Selection of the PWM Algorithm
	Total:45

TEXT BOOK:

1. Keng. C. Wu, "Switch Mode Power Converters",1st Edition, Elsevier Academic Press, UK, 2006 for Units I, II, III.
2. Dorin O. Neacsu, "Power Switching Converters-Medium and High Power", 1st Edition, CRC Press, USA, 2006 for Units IV, V.

REFERENCES:

1. Issa Batarseh & Ahmad Harb, "Power electronic circuit analysis and design", 2nd Edition, Springer Publications, 2018

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	design rectifier circuit with protection circuits.	Applying (K3)
CO2	design isolated converters with capacitor sizing in CCM & DCM operation	Applying (K3)
CO3	design non-isolated converters with capacitor sizing in CCM & DCM operation	Applying (K3)
CO4	analyze the practical aspects in inverter design	Understanding (K2)
CO5	understand the paralleling concepts of power converters.	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	2
CO2	3	2	1	1		1			1		1	1	2	3
CO3	3	1				1			1		1	1	2	3
CO4	3	2	1	1		1			1		1	1	1	2
CO5	3	1				1			1		1	1	2	3

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

ASSESSMENT PATTERN - THEORY

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

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

22EEE14 – RESTRUCTURED POWER SYSTEM

Programme & Branch	**B.E & Electrical and Electronics Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Generation, Transmission and Distribution, Power System Analysis**	**7**	**PE**	**3**	**0**	**0**	**3**

Preamble	The objective of the course is to impart knowledge about the restructured power system, electric utility markets, pricing of transmission network and reforms in Indian power sector. The course will also bring out the differences between the conventional power system operation and the restructured power system.	
Unit – I	**Overview Of Key Issues in Electric Utilities Restructuring**	**9**
Introduction-Restructuring Models-Independent System Operator (ISO)-Power Exchange (PX)-Market Clearing Price (MCP)-Market Operations-Market Power-Stranded Costs-Transmission Pricing-Congestion Pricing-Management of Inter-Zonal/Intrazonal Congestion		
Unit – II	**ELECTRIC UTILITY MARKETS IN THE UNITED STATES & OUTSIDE THE UNITED STATES**	**9**
California Markets-New York Market-PJM Interconnection-ERCOT ISO-New England ISO-Midwest ISO- Nord Pool (The Nordic Power Exchange)-Australia National Electricity Market-Restructuring In Canada-Electricity Industry in England and Wales		
Unit – III	**OASIS: OPEN ACCESS SAME-TIME INFORMATION SYSTEM**	**9**
Introduction-FERC Order-Structure of OASIS-Implementation of OASIS Phases-Posting of Information-Transfer Capability on OASIS-Transmission Services-Methodologies to Calculate ATC-Experiences with OASIS in Some Restructuring Models		
Unit – IV	**TAGGING ELECTRICITY TRANSACTIONS & TRANSACTION INFORMATION SYSTEM**	**9**
Introduction-Definition of Tagging-Historical Background on Tagging-How Does a Tagging Process Work?-Identifying Tags-Data Elements of a Tag-Communication during Failure Recovery-Transaction States-Implementation, Curtailment, and Cancellation of Transactions		
Unit – V	**ELECTRIC ENERGY TRADING**	**9**
Introduction-Essence of Electric Energy Trading-Energy Trading Framework: The Qualifying Factors-Derivative Instruments of Energy Trading-Portfolio Management-Energy Trading Hubs-Brokers in Electricity Trading-Green Power Trading		
		Total:45

TEXT BOOK:

1.	Mohammad Shahidehpour, Muwaffaq Alomoush, "Restructured Electrical Power Systems: Operation, Trading and Volatility", 1st Edition, Taylor & Francis , New York, 2015.

REFERENCES:

1.	Loi Lei Lai, "Power System Restructuring and Deregulation", 1st Edition, John Wiley and Sons, New York, 2018.
2.	Mohammad Shahidehpour, Hatim Yamin, Zuyi Li, "Market Operations in Electric Power Systems", 1st Edition, John Wiley and Sons, New York, 2015.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	explain the key issues in electric utilities restructuring	Understanding (K2)
CO2	discuss the concept of electric utility markets world wide	Applying (K3)
CO3	discuss the concept of open access same-time information system	Understanding (K2)
CO4	describe Transaction Information System	Understanding (K2)
CO5	Interpret and analyze the Electric Energy Trading	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		1	1				1	1	1	2
CO2	3	3	3	2		1	1				1	1	2	3
CO3	3	2	1	2		1	1				1	1	3	2
CO4	3	1	2	2		1	1				1	1	1	3
CO5	3	2	1	1		1	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	20	80					100
CAT2	20	70	10				100
CAT3	20	80					100
ESE	20	80					100

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

22EEE15 – ENERGY STORAGE SYSTEMS AND CONTROLLERS

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

Preamble	This course aimed to introduce the fundamental concepts and principles of various energy storage systems that aids in various real time applications.	
Unit – I	**Introduction to Energy Storage Systems**	**9**
Overview of energy storage systems (ESS) - Historical context of ESS - Drivers for ESS deployment - Classification of ESS technologies - Battery: Components of Cells and Batteries – Classification - Operation of a Cell - Theoretical Cell Voltage, Capacity and Energy		
Unit – II	**Battery Design and Selection of Batteries**	**9**
Designing to Eliminate Potential Safety Problems - Battery Safeguards when Using Discrete Batteries - Battery Construction – Design of Rechargeable Batteries - Major Considerations in Selecting a Battery - Battery Applications		
Unit – III	**Secondary Batteries**	**9**
Introduction - Performance, charging and discharging- storage density, energy density, classical batteries -Lead Acid, Nickel-Cadmium- Lithium Battery: Construction, operation and Working Principle of Lithium-ion, Lithium/Iron Sulphide Batteries		
Unit – IV	**Other Energy Storage Technologies**	**9**
Ultracapacitors: Features- Basic Principles of Ultracapacitors - Hydrogen Storage Systems: Types of fuel cells - Proton Exchange Membrane Fuel Cells, Alkaline Fuel Cells, Molten Carbonate Fuel Cells, and phosphoric fuel cell		
Unit – V	**Controllers for Energy Storage Systems**	**9**
Principles of charge controllers -Types of charge controllers-Charging strategies for energy storage systems, Battery Management Systems (BMS): Principles of BMS-Functions and components of BMS-Battery safety and performance-BMS integration with other controllers		
		Total:45

TEXT BOOK:

1.	David Linden, Thomas B. Reddy, "Handbook of Batteries", 4th Edition, McGraw-Hill, New Delhi, 2011.

REFERENCES:

1.	Mehrdad Ehsani, YiminGao, Ali Emadi, "Modern Electric, Hybrid Electric and Fuel Cell Vehicle", 2nd Edition, CRC Press, New Delhi, 2018.
2.	Nihal Kularatna, Kosala Gunawardane, “Energy Storage Devices for Renewable Energy-Based Systems”, 2nd Edition, Elseivier, 2021
3.	Sandeep Dhundhara, Yajvender Pal Verma , “Energy Storage for Modern Power System Operations”, Wiley, 2021

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	understand the basics of energy storage systems and battery.	Understanding (K2)
CO2	summarize the construction and selection of battery.	Understanding (K2)
CO3	describe the construction and working principle of secondary batteries.	Understanding (K2)
CO4	explain the construction and working principle of Ultra capacitor and Fuel cell	Applying (K3)
CO5	identify the different types of controllers used in energy storage systems and their roles in managing the flow of energy.	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	2
CO2	3	2	2				1				1	1	3	2
CO3	2	1	3				1				1	1	3	2
CO4	3	2	1				1				1	1	3	3
CO5	2	1	3				1				1	1	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	30	70	-	-	-	-	100
CAT2	30	70	-	-	-	-	100
CAT3	30	50	20	-	-	-	100
ESE	10	70	20	-	-	-	100

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

22EEE16 – ADVANCED ELECTRIC DRIVES AND CONTROL

Programme & Branch	**B.E & Electrical and Electronics Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Microcontrollers and its interfacing, Electric Drives and Control**	**7**	**PE**	**3**	**0**	**0**	**3**

Preamble	This course aimed to introduce advanced control techniques to optimize the performance of electric drives	
Unit – I	**Control of Electrical Drives:**	**9**
Modes of operation – speed control and drive types – closed loop control drive – current limit control – Closed loop torque control and speed control – Closed loop speed control of multi motor drives – Speed sensing – Current sensing – Phase-locked-loop (PLL) control – Closed-loop position control.		
Unit – II	**Control Techniques for Electrical Drives:**	**9**
Basic Features of an Electric Drive – Block Diagram Representation of Drive Systems – Transfer Functions of armature and field control DC motor – Transient Response of Closed Loop Drive Systems – Frequency Response Approach – Stability of Controlled Drives – Performance indices of control system and Compensation.		
Unit – III	**Microprocessors Based Control Techniques:**	**9**
Dedicated Hardware Systems versus Microprocessor Control – Application Areas and Functions of Microprocessors in Drive Technology – Control of Electric Drives Using Microprocessors for induction motor and DC motor.		
Unit – IV	**Traction Drives:**	**9**
Electric Traction Services – Electric trains – Nature of Traction Load – Main Line and Suburban Train Configurations – Calculations of Traction Drive Rating and Energy Consumption – Important Features of Traction Drives – Traction Motors – Conventional DC and AC Traction drives – Diesel Electric Traction.		
Unit – V	**Energy Conservation in Electrical Drives:**	**9**
Measures for Energy Conservation in Electrical Drives – Use of Efficient Semiconductor Converters – Use of Efficient motors – Use of Variable Speed Drives – Energy Efficient Operation of Drives – Improvement of Power Factor – Electrical Drive Systems and Components		
		Total:45

TEXT BOOK:

1.	Dubey G.K, "Fundamentals of Electrical Drives", 2nd Edition, Narosa Publishing House, New Delhi, 2019 for Units I, IV, V.
2.	Vedam Subrahmanyam, "Electric Drives: Concepts and Applications", 2nd Edition, McGraw-Hill, New Delhi, 2010 for Units II, III.

REFERENCES:

1.	Krishnan.R., Electric Motor Drives: Modeling, Analysis & Control, 1st Edition, PHI Pvt. Ltd, New Delhi, 2015
2.	Bose B.K, "Power Electronics and Variable Frequency Drives: Technology and Applications", 1st Edition, Wiley India Pvt. Ltd., New Delhi, 2013.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	Understand the control requirement of open and closed loop electric drives	Understanding (K2)
CO2	Make use of control system concepts for drives control techniques	Applying (K3)
CO3	Formulating the control stages for microprocessor orient control methods	Understanding (K2)
CO4	Explain the control of Traction Drives	Applying (K3)
CO5	Understand energy consumption at all stages of electric drives	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	2	3
CO2	3	2	1			1	1		1	1		1	2	3
CO3	3	3	1									1	3	2
CO4	3	2	1	1		1	1		1	1		1	2	3
CO5	3	2	1	1								1	2	3

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

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	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)

22EEE17- EMBEDDED COMPUTING SYSTEMS

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

Preamble	This course imparts knowledge to the students about the concepts of embedded system hardware, software, system design, development, implementation and testing	
Unit – I	**Introduction to Embedded Systems:**	**9**
A review of embedded system concepts, Current Technologies, Integration in system Design, Embedded system design flow, hardware design concepts, software development, processor in an embedded system and other hardware units, introduction to processor based embedded system design concepts.		
Unit – II	**Embedded System Hardware**	**9**
Embedded hardware building blocks, Embedded Processors – ISA architecture models, Internal processor design, processor performance, Board Memory – ROM, RAM, Auxiliary Memory, Memory Management of External Memory, Board Memory and performance. Embedded board Input / output – Serial versus Parallel I/O, interfacing the I/O components, I/O components and performance, Board buses – Bus arbitration and timing, Integrating the Bus with other board components, Bus performance		
Unit – III	**Embedded System Software**	**9**
Device drivers, Device Drivers for interrupt-Handling, Memory device drivers, On-board bus device drivers, Board I/O drivers, Explanation about above drivers with suitable examples. Embedded operating systems – Multitasking and process Management, Memory Management, I/O and file system management, OS standards example – POSIX, OS performance guidelines, Board support packages, Middleware and Application Software – Middle ware, Middleware examples, Application layer software examples.		
Unit – IV	**Embedded System Design, Development, Implementation and Testing**	**9**
Embedded system design and development lifecycle model: creating an embedded system architecture (Upto stage 4) introduction to embedded software, Debugging tools, System Boot-Up		
Unit – V	**Embedded System Design-Case Studies**	**9**
Case studies- Processor design approach of an embedded system – Power PC Processor based and Micro Blaze Processor based Embedded system design on Xilinx platform-NiosII Processor based Embedded system design on Altera, -Software Coding of a PID Controller		
		Total:45

TEXT BOOK:

1.	Tammy Noergaard “Embedded Systems Architecture: A Comprehensive Guide for Engineers and Programmers”, Elsevier (Singapore) Pvt. Ltd. Publications, 2012 for Units I, II, III and IV.
2.	Frank Vahid, Tony D. Givargis, “Embedded system Design: A Unified Hardware/Software Introduction”, John Wily & Sons Inc.2002 for Unit V

REFERENCES:

1.	Peter Marwedel, “Embedded System Design”, Science Publishers, 2007.
2.	Chattopadhyay S, “Embedded System Design”, second edition, PHI Learning Pvt. Ltd.; 2023.
3.	Kamal R, “Embedded systems: architecture, programming and design”, second edition, Tata McGraw-Hill Education, New Delhi, 2011.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	explain the basic concept of embedded system design overflow	Understanding (K2)
CO2	understand the hardware units utilized for embedded system design namely memory, I/O devices etc.	Understanding (K2)
CO3	Illustrate the concepts of device drivers and operating system used in designing the embedded system	Understanding (K2)
CO4	explain the concepts involved in embedded system design, development, implementation and testing	Understanding (K2)
CO5	apply the embedded design concepts for developing various real time 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		1	1	1	1	2
CO2	3	2	1	1		1	2				2	1	2	3
CO3	3	1			1	1		1		1	1	1	1	2
CO4	3	2	1	1	1	1	2				2	1	2	3
CO5	3	1				1		1		1	1	1	1	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	40	40				100
ESE	10	70	20				100

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

22EEE18 – PLC AND SCADA SYSTEM							
Programme & Branch	**B.E & Electrical and Electronics Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**7**	**PE**	**3**	**0**	**0**	**3**

Preamble	This course imparts knowledge about basic concepts of programmable logic controllers, programming languages, advanced PLC programming, process of SCADA system and also apply this knowledge to develop automation system in industrial applications.	
Unit – I	**PLC Overview**	**9**
Introduction to Programmable Logic Controller – Architecture – Principle of operation – I/O Modules: Discrete, Analog, Special – I/O Specifications – CPU – Memory design and types – Programming devices – Recording and Retrieving data – PLC programming languages. Introduction to Human Machine Interfaces (HMI).		
Unit – II	**Basic PLC Programming:**	**9**
Fundamentals of Logic – Program Scan – Relay-Type Instructions – Instruction addressing – Branch and Internal relay instructions Entering the Ladder diagram – Electromagnetic Control relays – Contactors – Motor Starters – Manual operated switches and mechanically operated switches.		
Unit – III	**Advanced PLC Programming:**	**9**
Programming Timers – Programming Counters – Math Instructions – Sequencer and Shift Register Instructions. PLC Applications: VFD based motor control system – Traffic light control system		
Unit – IV	**SCADA:**	**9**
Introduction to SCADA – A brief history of SCADA – Real-time systems – Remote control – Communications: communication system components – protocol-modems – Remote terminal units (RTUs) – Master terminal units (MTUs)		
Unit – V	**Applications of SCADA:**	**9**
Applications: Real time Revisited – Accounting and grade of data – Scanning and communications – Automatic control. Applications – SCADA for Power Utility Network		
		Total:45

TEXT BOOK:

1.	Frank D. Petruzella, "Programmable Logic Controllers", 5th Edition, Tata McGraw-Hill , New Delhi, 2019 for Units I, II, III.
2.	Stuart A. Boyer, “SCADA: Supervisory Control and Data Acquisition”, 4th Edition, ISA Press, USA, 2016 for Units IV, V.

REFERENCES:

1.	Webb John W & Reis Ronald A, "Programmable Logic Controllers - Principles and Applications", 5th Edition, PHI Learning Private Limited, New Delhi, 2002.
2.	Bolton W, “Programmable Logic Controllers”, 5th Edition, Elsevie , New York, 2009

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	identify the PLC hardware and programming languages for various applications	Understanding (K2)
CO2	develop PLC ladder logic programming for industrial problems	Applying (K3)
CO3	design a PLC system, component, or process to meet a set of specifications	Applying (K3)
CO4	impart the knowledge about SCADA and understand the components of SCADA	Understanding (K2)
CO5	apply PLC and SCADA in real time applications to meet industrial automation	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	3
CO2	3	2	1	1	1							1	2	3
CO3	3	2	1	1	1	1						1	2	3
CO4	3	1							1				1	3
CO5	3	2	1	1		1	1					1	2	3

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

ASSESSMENT PATTERN - THEORY

Test / Bloom’s Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	30	50	20				100
CAT2	20	50	30				100
CAT3	10	50	40				100
ESE	10	50	40				100

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

22EEE19 – PULSE GENERATING CIRCUITS FOR POWER CONVERTERS							
Programme & Branch	**B.E & Electrical and Electronics Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Power Electronics**	**7**	**PE**	**3**	**0**	**0**	**3**

Preamble	This course brings the fundamentals of pulse width modulation techniques and the various types. It is certainly needed for the development of pulses required for the power converters.

Unit – I	**Fundamentals of PWM:**	**9**
Fundamental Concepts of PWM – Evaluation of PWM Schemes – Double Fourier Integral Analysis of a Two-Level PWM waveform – Naturally Sampled PWM – PWM Analysis by Duty Cycle Variation – Regular Sampled PWM – Direct modulation.		
Unit – II	**Modulation of Single Phase VSI:**	**9**
Topology of a Single Phase Inverter – Three level Modulation of a Single Phase Inverter – Analytic Calculation of Harmonic Losses – Sideband Modulation – Switched Pulse Position – Switched Pulse Sequence.		
Unit – III	**Modulation of Three Phase VSI:**	**9**
Topology of a Three Phase VSI – Three Phase Modulation with Sinusoidal References – Third Harmonic Reference Injection – Analytic Calculation of Harmonic Losses – Discontinuous Modulation Strategies – Triplen Carrier Ratios and Sub harmonics.		
Unit – IV	**Space Vector Modulation Strategies:**	**9**
Space Vector Modulation – Phase Leg References – Naturally Sampled SVM – Analytical Solution for SVM Harmonic Losses for SVM – Placement of the Zero Space Vector – Discontinuous Modulation – Phase Leg References for Discontinuous PWM – Analytical Solutions for Discontinuous PWM – Single Edge SVM		
Unit – V	**Programmed Modulation Strategies and Multilevel Converters:**	**9**
Optimized spaced vector PWM – Harmonic elimination PWM – Performance index for optimality – optimum PWM – Minimum loss PWM – Multilevel converter alternatives – Harmonic Elimination applied to multilevel inverters – Minimum Harmonic distortion.		
		Total:45

TEXT BOOK:

1.	Grahame Holmes.D & Thomas A. Lipo, "Pulse Width Modulation for Power Converters: Principles and Practice", IEEE Press Series on Power Engineering, Wiley, 2003.

REFERENCES:

1.	Mohammed H. Rashid, "Power Electronics: Circuits, Devices and Applications", 4th Edition, Eastern Economy Edition, USA , 2004.
2.	Dorin O. Neacsu, "Power-Switching Converters: Medium and High Power", 2nd Edition, CRC Press, United States,2006.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	explain the fundamental concepts of pulse width modulation techniques	Understanding (K2)
CO2	make use of inverter topologies in applying PWM techniques for single phase VSI	Understanding (K2)
CO3	make use of inverter topologies in applying PWM techniques for three phase VSI	Understanding (K2)
CO4	summarize the space vector modulation techniques and its advantages	Understanding (K2)
CO5	explain the strategies involved for harmonic elimination using PWM	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		1							1	2	2
CO2	3	2	2		1						1	1	2	1
CO3	3	2	2		1						1	1	2	1
CO4	3	2	2	1	1						1	1	2	1
CO5	3	2	2	1							1	1	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	40	60					100
CAT2	40	60					100
CAT3	40	40	20				100
ESE	26	54	20				100

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

22EEE20 – HIGH VOLTAGE ENGINEERING							
Programme & Branch	**B.E & Electrical and Electronics Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Electromagnetic Theory & Generation, Transmission and Distribution**	**7**	**PE**	**3**	**0**	**0**	**3**
Preamble	The course is designed to understand various phenomena related to breakdown study and withstand characteristics of insulating materials. The course also describes the generation and measurement of DC, AC and Impulse voltages as well various testing techniques.						
Unit – I	**Overvoltage Phenomenon in Power Systems:**						**9**
Causes for over voltages – lightning phenomenon, lightning arrester - Over voltages due to switching surges, System faults and other abnormal conditions- Travelling waves on transmission lines (lines terminated with open-end, short-circuited end, apparatus).							
Unit – II	**Electrical Breakdown in Gases, Solids and Liquids:**						**9**
Ionization processes – Townsends Criterion - Paschen's law- Breakdown in non-uniform fields, corona discharge and its effects– Vacuum breakdown. Conduction and breakdown in pure and commercial liquids. Intrinsic breakdown in solids - Electromechanical breakdown - Thermal breakdown - Breakdown in composite dielectrics.							
Unit – III	**Generation of High Voltages and High Currents:**						**9**
Generation of high DC voltages, alternating voltages, impulse voltages and impulse currents – Tripping and control of Impulse Generators.							
Unit – IV	**Measurement of High Voltage and High Currents:**						**9**
High Resistance with series ammeter – Dividers, Resistance, Capacitance and Mixed dividers – Peak Voltmeter, Generating Voltmeters – Capacitance Voltage Transformers, Electrostatic Voltmeters – Sphere Gaps – High current shunts- Digital techniques in high voltage measurement.							
Unit – V	**High Voltage Testing of Electrical Power Apparatus:**						**9**
Testing of Insulator, Bushings, Isolators, Transformers, and Surge Diverters – Partial Discharge measurement –Tan delta measurement, Radio interference measurement -International and Indian Standards. Introduction to electromagnetic interference and compatibility.							
							Total:45
TEXT BOOK:							
1.	Naidu M.S. and Kamaraju V, "High Voltage Engineering", 6th Edition, McGraw-Hill, New York, 2020.						
REFERENCES:							
1.	Kuffel E, Zaengl, W.S. and Kuffel J, "High Voltage Engineering Fundamentals", 2nd Edition, Butterworth-Heinemann, Burlington, 2008.						
2.	Wadhwa C.L, " High Voltage Engineering", 3rd Edition, New Age Publishers, New Delhi, 2012.						
3.	Ravindra Arora, Bharat Singh Rajpurohit , “Fundamental of High Voltage Engineering”, 1st Edition, Wiley, 2019.						

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	explain the concepts of over voltage phenomenon	Understanding (K2)
CO2	discuss the conduction and breakdown in gases, liquids and solid dielectrics	Understanding (K2)
CO3	model the various generation circuits of high voltage and high currents.	Applying (K3)
CO4	identify the various measurement techniques of high voltage and high currents.	Applying (K3)
CO5	explain the testing procedure of power apparatus	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			1	1	3
CO2	3	1					1		1			1	1	3
CO3	3	2	1	1			1		1			1	2	3
CO4	3	2	1	1			1		1			1	2	3
CO5	3	1					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	20	80					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)

22EEE21 – ELECTRIC VEHICLE TECHNOLOGY

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

Preamble	This course is aimed to introduce the fundamental concepts and principles of various Electric Vehicles and Hybrid Electric Vehicles with an insight into Power electronic converters for battery charging.

Unit – I	**Electric and Hybrid Electric Vehicles:**	**9**

Configuration of Electric Vehicles, Performance of Electric Vehicles, Traction motor characteristics, Tractive effort and Transmission requirement, Vehicle performance, Tractive effort in normal driving, Energy consumption Concept of Hybrid Electric Drive Trains, Architecture of Hybrid Electric Drive Trains, Series Hybrid Electric Drive Trains, Parallel hybrid electric drive trains.

Unit – II	**Design of Electric and Hybrid Electric Vehicles:**	**9**

Series Hybrid Electric Drive Train Design: Operating patterns, control strategies, Sizing of major components, power rating of traction motor, power rating of engine/generator, design of PPS; Parallel Hybrid Electric Drive Train Design: Control strategies of parallel hybrid drive train, Maximum State-of-Charge of Peaking Power Source (Max. SOC-of-PPS) Control Strategy, design of engine power capacity, design of electric motor drive capacity, transmission design, energy storage design.

Unit – III	**Energy storage for EV and HEV:**	**9**

Electrochemical Batteries, Battery Technologies, Ultracapacitors, Ultra-High-Speed Flywheels, Hybridization of Energy Storages, Fuel Cell Technologies: Proton Exchange Membrane Fuel Cells, Alkaline Fuel Cells, Fuel Supply.

Unit – IV	**Power Electronic Converter for Battery Charging:**	**9**

Charging methods for battery, Termination methods, charging from grid, The Z-converter, Isolated bidirectional DC-DC converter, Design of Z converter for battery charging, High-frequency transformer based isolated charger topology.

Unit – V	**Electric Propulsion:**	**9**

EV consideration, DC motor drives and speed control, chopper control of DC Motors, Induction motor drives, Permanent Magnet Brushless DC Motor Drives, Switch Reluctance Motor Drive for Electric Vehicles, Configuration and control of Drives.

Total:45

TEXT BOOK:

1.	M. Ehsani, Y. Gao, S. Gay and Ali Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory and Design", 1st Edition, CRC Press, USA, 2010.

REFERENCES:

1.	Iqbal Hussain, "Electric and Hybrid Vehicles: Design Fundamentals", 2nd Edition, CRC Press, USA, 2011.
2.	Sheldon S. Williamson, " Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles ", 1st Edition, Springer New York Heidelberg Dordrecht London, 2013.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	evaluate the various aspects and performance of Electric and Hybrid Electric vehicles.	Understanding (K2)
CO2	conceptualize the principles of Energy storage for EV and HEVs.	Understanding (K2)
CO3	illustrate the concepts & Principles of Electric propulsion.	Understanding (K2)
CO4	design and develop the electric vehicles with suitable control strategies	Applying (K3)
CO5	interpret different power converter topologies used for electric vehicle application.	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
CO2	3	2											1	3
CO3	3	2								1			1	3
CO4	3	2	2			1	1						1	3
CO5	3	2	1	1			1					1	2	3

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

ASSESSMENT PATTERN – THEORY

Test / Bloom’s Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	80					100
CAT2	20	80					100
CAT3	10	50	40				100
ESE	10	50	40				100

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

22EEE22 – FINITE ELEMENT ANALYSIS OF ELECTRICAL MACHINES

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

Preamble	This course provides an in-depth understanding of finite element analysis as applied to electrical machines. The students will learn the fundamental principles of FEA and how it can be used to simulate and analyze the behavior of electrical machines.	
Unit – I	**Outline of Electromagnetic Fields and Principles of Finite Element Methods**	**9**
Vector Analysis - Electromagnetic Fields - Fundamental Equations. Field Problems with Boundary Conditions - Classical Method for the Field Problem Solution - Classical Residual Method - Classical Variational Method - The Finite Element Method		
Unit – II	**Analysis and Applications of the Finite Element Method to Two-Dimensional Fields**	**9**
Reduction of the Field Problem to a Two-Dimensional Problem - Boundary Conditions - Computation of the Solved Structure Applications: Introduction - Linear Interpolation of the Function φ- Simple Descriptions of Electromagnetic Fields -		
Unit – III	**The Single-Phase Transformer**	**9**
The Single-Phase Transformer - Equivalent Electric Circuit of the Transformer - Computation of the No-Load Inductances - Effect of the Nonlinear B-H Curve - Estimation of the Iron Losses - Determination of the Leakage Inductances		
Unit – IV	**Synchronous Generators**	**9**
Introduction - Computation of the No-Load Characteristic - Computation of the Direct-Axis Inductance - Computation of the Quadrature Axis Inductance - Self- and Mutual Inductances - Saturation Effect - Computation of Ld and Lq with any Current - Computation of the Machine Characteristics		
Unit – V	**Self-Starting Single-Phase Synchronous Motors**	**9**
Introduction - Definition of the Motor Model - Computation of the Electrical Parameters - Computation of the Torque- Analysis of the Dynamic Performance - Two-Dimensional Linear Interpolation		
		Total:45

TEXT BOOK:

1.	Nicola Bianchi, “Electrical Machine Analysis Using Finite Elements”, 1st Edition, CRC Press, Taylor and Francis, 2017

REFERENCES:

1.	S. J. Salon, “Finite Element Analysis of Electrical Machine”, Kluwer Academic Publishers, Boston, MA, 2009.
2.	P. P. Silvester, R. L. Ferrari, “Finite Element Analysis and Design of Electromagnetic Devices”, Cambridge University Press, Cambridge, England, 3rd Edition, 2006.
3.	J. P. A. Bastos, N. Sadowsky, “Electromagnetic Modelling By Finite Element Methods”, Marcel-Decker, 2003.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	Apply basic electromagnetic field equations to electrical machine design	Understanding (K2)
CO2	Learn the importance of finite element method through field equations	Understanding (K2)
CO3	Determine various losses in Single phase transformer	Applying (K3)
CO4	Compute various parameters of synchronous generator	Applying (K3)
CO5	Compute various parameters of synchronous motor	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			1			1			1	2	1
CO2	3	3	2			1			1			1	2	1
CO3	3	3	2			1			1			1	2	1
CO4	3	3	2			1			1			1	2	1
CO5	3	3	2			1			1			1	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	20	80					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)

22EEE23 – DIGITAL TWIN TECHNOLOGY							
Programme & Branch	**B.E & Electrical and Electronics Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**7**	**PE**	**3**	**0**	**0**	**3**

Preamble	This course aim to impart knowledge on digital twin concepts, advantages and their applications in manufacturing, production and process industry.	
Unit – I	**Introduction**	**9**
Digital twin – Definition, types of Industry and its key requirements, Importance, Application of Digital Twin in process, product, service industries, History of Digital Twin, DTT role in industry innovation, Technologies/tools enabling Digital Twin		
Unit – II	**Manufacturing and Production**	**9**
Introduction to the impact of the digital twin, cyber-physical systems, process automation and optimization, predictive maintenance and anomaly detection on the manufacturing ecosystem and its application		
Unit – III	**Digital Twin in a Process Industry**	**9**
Basics of Process Industry, Trends in the process industry, control system requirements in a process industry, Digital Twin of a plant, Digital Thread in process Industry, Data collection and analysis for process improvements, process safety, Automation simulation, Digital Enterprise		
Unit – IV	**Healthcare**	**9**
Introduction to healthcare and bioengineering applications of digital twins. The bioprocess and its potential, industrial-scale bioreactors and biomanufacturing, hospital administration in industry 4.0, epidermic control prediction, and cloud computing for radiotherapy systems		
Unit – V	**Advantages of Digital Twin**	**9**
Improvement in product quality, production process, process Safety, identify bottlenecks and improve efficiency, achieving flexibility in production, continuous prediction and tuning of production process through Simulation, reducing the time to market.		
		Total:45

TEXT BOOK:

1.	Andrew Yeh Chris Nee, Fei Tao, and Meng Zhang, “Digital Twin Driven Smart Manufacturing”, Elsevier Science., United States, 2019

REFERENCES:

1.	Alp Ustundag and Emre Cevikcan, “Industry 4.0: Managing The Digital Transformation”, Springer Series in Advanced Manufacturing., Switzerland, 2017
2.	Alasdair Gilchrist, “Industry 4.0: The Industrial Internet of Things”, Apress., United States ,2015
3.	Ibrahim Garbie, “Sustainability in Manufacturing Enterprises, Concepts, analyses and assessments for Industry 4.0”, Springer., Switzerland, 2016

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	Acquire knowledge on digital twin and its importance.	Understanding (K2)
CO2	Understand the impact of digital twin in industrial sectors	Understanding (K2)
CO3	Explore the use of digital twin in process industries	Understanding (K2)
CO4	Analyse the use of digital twin in healthcare and medicine	Understanding (K2)
CO5	Discover the advantages of digital twin.	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	1	2	3
CO2	3	2	1	1	1	1					1	1	2	3
CO3	3	2	1	1	1	1					1	1	3	2
CO4	3	2	1	1	1	1					1	1	2	1
CO5	3	2	1	1	1	1					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	20	80					100
CAT2	20	80					100
CAT3	20	80					100
ESE	20	80					100

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

22EEE24 – SOFT COMPUTING AND INTELLIGENT CONTROLLERS							
Programme & Branch	**B.E & Electrical and Electronics Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**7**	**PE**	**3**	**0**	**0**	**3**

Preamble	This course serves as a guide to explore computer methodology and algorithms that improves automatically through experience.	
Unit – I	**ARTIFICIAL NEURAL NETWORKS – I**	**9**
Introduction to Soft computing – Neural Networks – Model – activation functions – Linear separability. Supervised learning: Architecture and algorithm **-** Perceptrons – Adaline and Madaline – Back propagation algorithm – Radial Basis Function Networks.		
Unit – II	**ARTIFICIAL NEURAL NETWORKS – II**	**9**
Unsupervised Learning and Other Neural Networks – Competitive Learning Networks – Kohonen Self Organizing Networks – Learning Vector Quantization – Hebbian Learning – Deep neural networks – Applications: Neural network classifier.		
Unit – III	**FUZZY LOGIC**	**9**
Introduction to Fuzzy Logic - Classical Sets and Fuzzy Sets - Fuzzy Relations- Membership functions – Fuzzification – Defuzzification - Fuzzy if-then Rules – Fuzzy Reasoning – Fuzzy Inference Systems – Mamdani Fuzzy Models –Sugeno Fuzzy Models – Comparison between Mamdani and Sugeno method – Fuzzy logic control systems		
Unit – IV	**GENETIC ALGORITHM - I**	**9**
Simple genetic algorithm – Operators of Genetic Algorithm (GA): Encoding- selection – crossover – mutation. Stopping condition of GA – Problem solving using genetic algorithm – Schema theorem - Real coded genetic algorithm - Advantages and limitations – Applications of GA - Genetic algorithm tools for control systems engineering -Genetic algorithm based fuzzy controller for speed control of brushless DC Motor.		
Unit – V	**GENETIC ALGORITHM - II**	**9**
Advanced Operators and Techniques in Genetic Algorithm: Diploidy, Dominance and Abeyance – Multiploid - Inversion and Reordering –introduction to Multi objective GA -Parallel and Distributed Genetic Algorithm - Hybrid Genetic Algorithm (HGA) – Adaptive Genetic Algorithm – Fast Messy Genetic Algorithm - Independent Sampling Genetic Algorithm - Genetic Programming-Primitives-Attributes-Steps-Applications.		
		Total:45

TEXT BOOK:

1.	Sivanandam S.N.,Deepa S.N., “Principles of soft computing”, 2nd Edition, Wiley India Pvt Ltd,New Delhi,2018.for Units I,II,III.
2.	Sivanandam S.N.,Deepa S.N., “Introduction to Genetic Algorithms”, Urheberrechtlich Geschutztes material, Springer-Verlag, Berlin Heidelberg,2008 for Units IV,V.

REFERENCES:

1.	Yegnanarayana, “Artificial Neural Networks”, Eastern economy, PHI learning Pvt Ltd, New Delhi, 2012.
2.	Timothy J Ross, “Fuzzy Logic with engineering applications”, 4th Edition, John Wiley & Sons, UK, 2016.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	Recognize neural networks to build intelligent systems.	Understanding (K2)
CO2	Apply neural networks to solve classification and regression problems.	Applying (K3)
CO3	Apply fuzzy principles to deal with vulnerability and tackle real time issues.	Applying (K3)
CO4	Apply genetic algorithms to obtain optimized results for a particular problem.	Applying (K3)
CO5	Apply advanced genetic operators and genetic programing to solve real world 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	2	2	2	2	1						1	2	3
CO2	3	2	1	1	2	1						1	3	2
CO3	3	2	1	1	2	1						1	3	2
CO4	3	2	1	1	2	1						1	2	3
CO5	3	2	1	1	2	1						1	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	10	70	20				100
CAT2	10	70	20				100
CAT3	10	70	20				100
ESE	10	70	20				100

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

22EEE25 – POWER ELECTRONIC INTERFACES TO RENEWABLE ENERGY							
Programme& Branch	**B.E & Electrical and Electronics Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Power Electronics**	**7**	**PE**	**3**	**0**	**0**	**3**

Preamble	This course aims to impart the students, in depth knowledge about the importance of power converters in renewable energy. The course covers design of solar photovoltaic, design of power converter for wind and hybrid system.

Unit - I	**Photovoltaic Inverter Structures**	**9**
Introduction - Inverter Structures Derived from H-Bridge Topology - Inverter Structures Derived from NPC Topology - Typical PV Inverter Structures - Three-Phase PV Inverters - Control Structures.		
Unit - II	**Grid Synchronization in Single-Phase Power Converters**.	**9**
Introduction - Grid Synchronization Techniques for Single-Phase Systems - Phase Detection Based on In Quadrature Signals - PLLs Based on In - Quadrature Signal Generation - PLLs Based on Adaptive Filtering.		
Unit - III	**Grid Converter Structures and requirements for Wind Turbine Systems**	**9**
Introduction - WTS Power Configurations - Grid Power Converter Topologies - WTS Control - Frequency and Voltage Deviation under Normal Operation - Active Power Control in Normal Operation - Reactive Power Control in Normal Operation.		
Unit - IV	**Grid Synchronization in Three-Phase Power Converters**	**9**
Introduction - The Three Phase Voltage Vector under Grid Faults: Unbalanced Grid Voltages during a Grid Fault - The Synchronous Reference Frame PLL under Unbalanced and Distorted Grid Conditions - The Decoupled Double Synchronous Reference Frame PLL: The Double Synchronous Reference Frame - Relationship between the DSOGI and the DDSRF.		
Unit - V	**Grid converter control for WTS**	**9**
Introduction – Model of the converter – AC voltage and DC voltage control - Voltage oriented control and direct power control - Stand-alone, Micro-grid, Droop Control and Grid Supporting.		
		Total:45

TEXT BOOK:

1.	Remus Teodorescu, Marco Liserre, Pedro Rodriguez, "Grid Converters for Photovoltaic and Wind Power Systems",1st Edition, Wiley, New Delhi, 2011.

REFERENCES:

1.	Chetan Singh Solanki, "Solar Photovoltaics: Fundamentals, Technologies and Applications", 3rd Edition, PHI Learning Pvt. Ltd, New Delhi, 2015.
2.	Mukund R Patel, "Wind and Solar Power Systems: Design, analysis and operation ", 2nd Edition, CRC Press, Boca Raton, 2005.
3.	B.H.Khan, "Non-conventional Energy sources", 2nd 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	Classify various type of photovoltaic inverter structure	Understanding (K2)
CO2	explain the grid synchronization for single phase converter	Understanding (K2)
CO3	explain the grid synchronization in for three phase converter	Understanding (K2)
CO4	Select the grid converter structures and requirements for wind turbine systems	Applying (K3)
CO5	Build the grid controlled converter for wind turbine 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				1	1		1			1	3	1
CO2	3	2				1	1		1			1	1	2
CO3	3	2	2			1	1		1			1	2	1
CO4	3	2	2			1	1		1			1	2	2
CO5	3	3	2			1	1		1			1	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	30	70					100
CAT2	20	80					100
CAT3	20	60	20				100
ESE	20	40	40				100

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

22EEE26 – SMART GRID								
Programme & Branch	**B.E & Electrical and Electronics Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Generation, Transmission and Distribution, Power Electronics**	**7**	**PE**	**3**	**0**	**0**	**3**

Preamble	The aim of the course is to provide basic concepts, various control and automation Technologies, power electronics applications of smart grid.	
Unit – I	**Introduction:**	**9**
Introduction: Need for implementing smart grid-Early Smart Grid Initiatives-Overview of the technologies required for the Smart Grid-Data Communication: Switching techniques – Communication channels – Layered architecture and protocols.		
Unit – II	**Information and Communication Technologies:**	**9**
Communication Technologies: Introduction–Communication technologies–standards for information exchange-Information security for smart grid: Encryption and decryption–Authentication–Cyber security standards.		
Unit – III	**Sensing, Measurement and Control:**	**9**
Introduction-Smart Metering-Evolution of electricity metering-Key components of smart metering-An overview of the hardware used-Communications infrastructure and protocols for smart metering-Demand-side integration.		
Unit – IV	**Automation Technologies:**	**9**
Distribution automation equipment: Substation automation equipment–Faults in the distribution system–Voltage regulation-Distribution management system: Data sources and external systems–Modelling and analysis tools– Applications.		
Unit – V	**Power electronics and energy storage in Smart Grid:**	**9**
Power electronics**:** Introduction–Renewable energy generation–Fault current limiting–Shunt compensation–Series compensation. Energy storage: Introduction-Energy storage technologies–Case study.		
		Total:45

TEXT BOOK:

1.	Janaka Ekanayake, Kithsiri Liyanage, JianzhongWu, Akihiko Yokoyama & Nick Jenekins, “Smart Grid: Technology and Applications”,1st Edition, John Wiley& Sons Ltd, United Kingdom, 2012.

REFERENCES:

1.	James Mamoh, “Smart Grid Fundamentals of Design and Analysis”, 1st Edition, IEEE Press, John Wiley and Sons, Canada, 2012.
2.	Richard DeBlasio; Cherry Tom, "IEEE Standards for the Smart Grid," 2008 IEEE Energy 2030 Conference, Atlanta, GA, USA, 2008, pp. 1-7, doi: 10.1109/ENERGY.2008.4780988.
3.	“NIST Framework and Roadmap for Smart Grid Interoperability Standards, Release 1.0,” http://www.nist.gov/public_affairs/relea ses/smartgrid_interoperability_final.pd

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	Explain the need for implementing smart grid and transmission system operation	Understanding (K2)
CO2	Identify the information and communication technologies in smart grid	Understanding (K2)
CO3	Apply the sensing, measurement and control techniques for smart grid applications	Applying (K3)
CO4	Evaluate the automation technologies in smart grid	Applying (K3)
CO5	Analyse the applications of power electronics and energy storage in smart grid	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		2							2	3	3
CO2	3		2		2							2	1	2
CO3	3	3	2		2			3				2	2	2
CO4	3	2	2		2			2				2	2	2
CO5	3	3	3		3			3				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	30	70					100
CAT2	30	40	30				100
CAT3	20	50	20	10			100
ESE	20	50	20	10			100

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

22EEE27 – MICROGRID

Programme & Branch	B.E & Electrical and Electronics Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	**Generation, Transmission and Distribution, Power Electronics**	**7**	**PE**	**3**	**0**	**0**	**3**

Preamble	The objective of the course is to impart knowledge about the renewable energy based microgrid technology, types and issues associated in their practical realization. The course will also elaborate the various protection, control and operational strategies used for practical microgrids.	
Unit – I	**The Microgrids Concept**	**9**
Introduction-The Microgrid Concept-Clarification of the Microgrid Concept-Operation and Control of Microgrids-Market Models for Microgrids-Status Quo and Outlook of Microgrid Applications		
Unit – II	**Microgrids Control Issues**	**9**
Introduction-Control Functions-The Role of Information and Communication Technology-Microgrid Control Architecture-Centralized and Decentralized Control-Forecasting-Centralized Control-Decentralized Control-State Estimation		
Unit – III	**Intelligent Local Controllers**	**9**
Introduction-Inverter Control Issues in the Formation of Microgrids-Control Strategies for Multiple Inverters-Implications of Line Parameters on Frequency and Voltage Droop Concepts-Development and Evaluation of Innovative Local Controls to Improve Stability		
Unit – IV	**Microgrid Protection**	**9**
Introduction-Challenges for Microgrid Protection-Adaptive Protection for Microgrids-Fault Current Source for Effective Protection in Islanded Operation-Fault Current Limitation in Microgrids		
Unit – V	**Case studies of Microgrid Projects**	**9**
Introduction-Overview of Microgrid Projects in Europe-Overview of Microgrid Projects in the USA-Overview of Japanese Microgrid Projects-Overview of Microgrid Projects in China-An Off-Grid Microgrid in Chile and India.		
		Total:45

TEXT BOOK:

1.	Nikos Hatziargyriou, “Microgrids: Architectures and Control,” 1st Edition, Wiley-IEEE Press, USA, March 2014.

REFERENCES:

1.	Magdi S. Mahmoud, “Microgrid: Advanced Control Methods and Renewable Energy System Integration”,Illustrated edition, Butterworth-Heinemann Publisher,United Kingdom, 2016
2.	Sharkh S.M., Abu-Sara M.A., Orfanoudakis G.I. &Hussain B., “Power Electronic Converters for Microgrids,” 1st Edition, Wiley – IEEE Press, USA, June 2014

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	know the basic concept of microgrid and its operation	Understanding (K2)
CO2	identify the various microgrid control issues	Understanding (K2)
CO3	design the intelligent local controllers for microgrid	Applying (K3)
CO4	identify and describe various protection schemes suitable for microgrid	Understanding (K2)
CO5	analyze the various case studies of microgrid projects	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	2	2
CO2	3	2				1			1			1	2	2
CO3	3	2	1	1		1			1			1	2	2
CO4	3	2				1			1			1	3	2
CO5	3	2	1	1		1			1			1	2	3

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

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	80					100
CAT2	20	40	40				100
CAT3	20	40	30	10			100
ESE	20	40	30	10			100

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

22EEE28 – ELECTRICAL MACHINE DESIGN							
Programme & Branch	**B.E & Electrical and Electronics Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Synchronous and Induction Machines**	**7**	**PE**	**3**	**0**	**0**	**3**

Preamble	This course aims in imparting knowledge to the students about fundamental aspects and consideration of different parameters for proper design of static and rotating dc and ac electrical rotating machines.	
Unit – I	**Introduction:**	**9**
Major considerations in Electrical Machine Design – Electrical Engineering Materials – Space factor – Choice of Specific Electrical and Magnetic loadings – Thermal considerations – Heat flow – Temperature rise and Insulating Materials – Rating of machines – Standard specifications		
Unit – II	**DC Machines :**	**9**
Output Equation – Main Dimensions – Choice of Specific Electric and Magnetic Loading – Magnetic Circuits Calculations – Carter's Coefficient – Net length of Iron – Real & Apparent flux densities –Selection of number of poles – Design of Armature – Design of commutator and brushes – performance prediction using design values.		
Unit – III	**Transformers:**	**9**
Output Equation – Main Dimensions – kVA output for single and three phase transformers – Window space factor – Design of core and winding – Overall dimensions – Operating characteristics – No load current – Temperature rise in Transformers – Design of Tank – Methods of cooling of Transformers.		
Unit – IV	**Induction Motors:**	**9**
Output equation of Induction motor – Main dimensions – Choice of Average flux density – Length of air gap- Rules for selecting rotor slots of squirrel cage machines – Design of rotor bars & slots – Design of end rings – Design of wound rotor – Magnetic leakage calculations – Leakage reactance of polyphase machines- Magnetizing current – Short circuit current – Operating characteristics- Losses and Efficiency.		
Unit – V	**Synchronous Machines:**	**9**
Output equation – choice of Electrical and Magnetic Loading – Design of salient pole machines – Short circuit ratio – shape of pole face – Armature design – Armature parameters – Estimation of air gap length – Design of rotor –Design of damper winding – Determination of full load field MMF – Design of field winding – Design of turbo alternators – Rotor design.		
		Total:45

TEXT BOOK:

1.	Sawhney A.K., "Electrical Machine Design", 3rd Edition, Dhanpat Rai& Co., New Delhi, 2017

REFERENCES:

1.	Mittle V.N. & Mittle A., "Design of Electrical Machines", 4thEdition, Standard Publications and Distributors, New Delhi, 2005.
2.	Agarwal R.K., "Principles of Electrical Machine Design", 4thEdition, S.K.Kataria& Sons, New Delhi, 2013.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped** **(Highest Level)**
CO1	classify and compare the various fundamental aspects and materials used for electrical machine	Understanding (K2)
CO2	identify the design parameter of dc motor by considering load requirement	Applying (K3)
CO3	identify the design parameter of transformer by considering load requirement	Applying (K3)
CO4	identify the design parameter of induction motor by considering load requirement	Applying (K3)
CO5	identify the design parameter of Synchronous machines by considering load requirement	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	3	2
CO2	3	1	1				1		1			1	2	3
CO3	3	2	1	1			1		1			1	2	3
CO4	3	2	1	1			1		1			1	2	3
CO5	3	2	1	1			1		1			1	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	10	40	50				100
CAT2	10	40	50				100
CAT3	10	40	50				
ESE	10	40	50				100

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

22EEE29 – DIGITAL IMAGE PROCESSING AND MULTI RESOLUTION ANALYSIS							
Programme & Branch	**B.E & Electrical and Electronics Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Signals and systems**	**7**	**PE**	**3**	**0**	**0**	**3**

Preamble	This course enables the students to learn and apply the various Digital Image Processing techniques on real time images.

Unit – I	**Digital Image Fundamentals:**	**9**
Elements of digital image processing systems, Elements of visual perception– Brightness– Contrast– Hue– Saturation– Mach band effect, Image sampling– Quantization, Basic relationship between pixels, Color image fundamentals – RGB– HSI models- Colour image quantization		
Unit – II	**Image Transforms:**	**9**
Need for transforms, DFT and its Properties: Separable – Spatial shift – Periodicity –Scaling – Orthogonality – Rotation, DCT, KLT, and SVD.		
Unit – III	**Image Enhancement and Image Restoration:**	**9**
Image Enhancement: Basic intensity transformations – Piecewise linear transformation functions, Histogram equalization, Spatial filtering: Smoothing and sharpening Filters, Frequency domain filtering: Smoothing and sharpening filters – Homomorphic filters **Image Restoration:** Degradation model – Noise distributions– Median – Geometric mean – Harmonic mean – Contra harmonic mean filters – Order Statistics filters – Inverse and wiener filtering – Constrained least square filtering- Performance metrics-BSNR-ISNR-Applications		
Unit – IV	**Image Segmentation, Representation & Description:**	**9**
Point, line and edge detection – Basics of intensity thresholding – Region based segmentation: Region growing – Region splitting and merging, Image representation: Chain codes, – Boundary descriptors – Regional descriptors		
Unit – V	**Wavelets And Multiresolution Processing:**	**9**
Subband coding – The Haar Transform – Multiresolution Expansion – Series Expansion – Scaling Function – Wavelet Function – Wavelet Transform in One Dimension- The Wavelet Series Expansion – The Discrete Wavelet Transform – The Continuous Wavelet Transform – The Fast Wavelet Transform – Wavelet transform in two dimensions– Applications in image denoising - Image fusion-Steganography		
		Total:45

TEXT BOOK:

1.	Rafael C Gonzalez and Richard E Woods, "Digital Image Processing",4th Edition, Pearson Education, Chennai,2016.

REFERENCES:

1.	Jayaraman S, Esakkirajan S and Veerakumar T, "Digital Image Processing",1st Edition 17th reprint, Tata McGraw Hill, New Delhi,2016
2.	Chanda B, Dutta Majumder D, "Digital Image Processing and analysis", 2nd Edition, PHI learning,New Delhi,2011.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	Illustrate the fundamental concepts of digital image processing, 2D sampling and Colour image models.	Applying (K3)
CO2	Apply DFT, DCT, KLT, SVD and Haar transformations on an image	Applying (K3)
CO3	Implement the image enhancement & image restoration techniques	Applying (K3)
CO4	Explain image segmentation, representation and description techniques for image classification	Understanding (K2)
CO5	Apply the multi resolution processing over images using wavelet transform.	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		
CO2	3	2	1	1							1	1		
CO3	3	3	3	1	2						1	1		
CO4	3	3	3	1	2						1	1		
CO5	3	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	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)

22EEE30 – INDUSTRIAL AUTOMATION								
Programme & Branch	**B.E & Electrical and Electronics Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**	
Prerequisites	**Electrical Measurements and Instrumentation**	**7**	**PE**	**3**	**0**	**0**	**3**	

Preamble	This course is aimed to impart knowledge on the technologies used for the automation in industries.	
Unit – I	**Introduction:**	**9**
Architecture of the basic three level Integrated Industrial Automation Systems – Field level for sensors actuators and smart devices, Control level for process and motion control functions, Distributed control system - Supervisory level for Data logging and Acquisition systems – DAS and SCADA for Management functions - Integrated automation through bus structure at the different levels.		
Unit – II	**Field Level Equipment-Sensors:**	**9**
Field level equipment – Sensors and measurement systems for Temperature, Pressure, Force, Displacement and speed measurement - Flow measurement techniques – Measurement of level, humidity, pH.		
Unit – III	**Field Level Equipment- Actuators:**	**9**
Introduction to Actuators – solenoids, on/off valves-Proportional Flow Control Valves – Hydraulic Actuator Systems – Principles, Components and Symbols – Pumps, fans and Motors – Pneumatic Control Systems – System Components-Integrated Control Systems using Smart sensors, Hart communication protocol.		
Unit – IV	**Process Controls:**	**9**
Introduction to process control – Automatic Process Control – Need for Automatic Process Control in Industry – Mathematical Modeling of Processes – First, Second and Higher Order Process Systems – Feed Forward Control – Cascade Control – Ratio Control – Selective Control Systems – Split-Range Control – Adaptive Controls – Inferential Control – Interacting Control Systems – Multi Variable Control.		
Unit – V	**PLC and HMI Controls:**	**9**
Introduction to PLC-s, PLC-s and Relay controls – PLC processor modules -input/output modules – Parallel /Local and Serial / Remote I/O modules-power supplies for I/O modules – Selection of PLC based on I/O counts and Scan times, PLC programming Languages – Ladder logic, functional block diagram-On/ Off logic functions, timer / counter, Register functions – control instructions – PID controls, Arithmetic and other Math instructions – sequencer Instructions.		
		Total:45

TEXT BOOK:

1.	Krishnaswamy K, “Process Control”, 2nd Edition, New Age International(P) Ltd, NewDelhi, 2015 for Units I, II, III, IV
2.	Frank D. Petruzella, “Programmable Logic Controllers”, 5th edition, McGraw Hill, New Delhi, 2019 for Unit V.

REFERENCES:

1.	NPTEL web book on Industrial Automation and controls by Mr. S.Mukhopadhyay and Mr.S.Sen of IIT, Kharagpur.
2.	Bill Drury, “The Control Techniques Drives and Controls Handbook”, 2nd Edition, IET Power and Energy Series, 2009.
3.	Lukas, Michael P., ― Distributed Control Systems‖, Van Nostrand Reinfold Company, 2002.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	understand the integrated industrial automation system	Understanding (K2)
CO2	utilize the Field level equipment-sensors for different industrial applications	Applying (K3)
CO3	utilize the Field level equipment-Actuators for different industrial applications	Applying (K3)
CO4	understand the Process controls in Industries	Understanding (K2)
CO5	apply the concepts of PLC in control oriented 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			1	1	3
CO2	3	2	1	1			1		1			1	2	3
CO3	3	2	1	1			1		1			1	2	3
CO4	3	1					1		1			1	1	3
CO5	3	2	1	1			1		1			1	2	3

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

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	50	30				100
CAT2	20	40	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)

22EEE31 – POWER QUALITY

Programme & Branch	**B.E & Electrical and Electronics Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Power electronics**	**8**	**PE**	**3**	**0**	**0**	**3**

Preamble	This course would make the students aware about the various issues affecting the power quality as well as techniques available to improve the quality of power

Unit – I	**Introduction to Power Quality:**	**9**
Definitions – power quality, voltage quality – power quality issues: short duration voltage variations, long duration voltage variations, transients, waveform distortion, voltage imbalance, voltage fluctuation, power frequency variations – power quality terms - Computer Business Equipment Manufacturers Associations (CBEMA) curve – ITI curves.		
Unit – II	**Voltage Sag and Over Voltages:**	**9**
Introduction – sources of sag and interruption – estimating voltage sag performance – fundamental principles of protection – solutions at end user level- motor starting sags. Transients: Definition– sources of transient over voltages – principles of over voltage protection – devices for over voltage protection – capacitor switching transients –lightning transients – transients from load switching.		
Unit – III	**Short Interruptions and Long Interruptions:**	**9**
Short Interruptions: Introduction – Origin of short interruptions: Voltage magnitude events due to re-closing, Voltage during the interruption – Monitoring of short interruptions, Adjustable speed drives, Electronic equipments – Single phase tripping: Voltage during fault and post fault period, Current during fault period. Long Interruptions: Definition – Failure, Outage, Interruption – Origin of interruptions – Causes of long interruptions – Principles of regulating the voltage – Voltage regulating devices.		
Unit – IV	**Harmonics:**	**9**
Introduction – definition and terms – harmonics, harmonics indices, inter harmonics, notching – voltage Vs current distortion – harmonics Vs transients – sources and effects of harmonic distortion – mitigation and control techniques – passive and active filters for harmonic reduction.		
Unit – V	**Power Quality Monitoring and Solutions:**	**9**
Introduction – Power quality monitoring, Monitoring considerations – brief introduction to power quality measurement equipments and power conditioning equipments - Spectrum analyzers, harmonic analyzers and Smart power quality monitors – assessment of power quality - application of intelligent systems – basic design of expert system - Power quality: Monitoring standards		
		Total:45

TEXT BOOK:

1.	Roger C. Dugan, Mark F. McGranaghan, H. Wayne Beaty, “Electrical Power Systems Quality”, 3rd Edition, McGraw-Hill, New York, Reprint 2013

REFERENCES:

1.	Kennedy Barry W., “Power Quality Primer”, 1st Edition, McGraw-Hill, New York, 2000.
2.	Bollen Math H.J., “Understanding Power Quality Problems: Voltage Sags and Interruptions”, 1st Edition, IEEE Press, New York, 2011.
3.	Sankaran C., “Power Quality”, 1st Edition, CRC Press, Washington D.C., 2019.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	understand the power quality issues in electrical distribution network	Understanding (K2)
CO2	evaluate the severity of voltage sag, voltage swell and transients over voltages in distribution networks	Understanding (K2)
CO3	Interpret the effect of short and long Interruptions	Applying (K3)
CO4	identify the harmonic problems and design circuits to mitigate harmonic issues	Applying (K3)
CO5	understand the importance of PQ monitoring and select equipment to measure power quality	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
CO2	3	2					1					1	1	2
CO3	3	2	1	1			1					1	2	3
CO4	3	2	1	1			1					1	2	3
CO5	3	2	1	1			1					1	2	3

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

ASSESSMENT PATTERN - THEORY

Test / Bloom’s Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	80					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)

22EEE32 – POWER SYSTEM SECURITY

Programme & Branch	**B.E & Electrical and Electronics Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Power System Protection and Switch gear & Power System Analysis**	**8**	**PE**	**3**	**0**	**0**	**3**

Preamble	This course covers the power system security analysis and gives a brief insight about the optimal power flow and power system Deregulations.

Unit – I	**Operations in Power System Security:**	**9**

Introduction – Factors affecting power system security – Contingency Analysis: Overview of security analysis – Linear Sensitivity factors – AC Power Flow security Analysis - AC Power Flow security Analysis with Contingency – Concentric Relaxation – Boundary area method.

Unit – II	**State Estimation**	**9**

Introduction – Methods of Least squares: Simple DC circuits – Maximum Likelihood Weighted Least Square Estimation: Matrix formulation – State Estimation by Orthogonal State Estimation: Orthogonal decomposition Algorithm – Detection and identification of Bad measurements – Network Observability and Pseudo measurements.

Unit – III	**Optimal Power Flow:**	**9**

Optimal Power Flow Formulation: Economic Load Dispatch (ELD), Optimal reactive Power Dispatch, Economic Emission Dispatch, Security Constrained Optimal Power Flow – Optimal Power Flow solution techniques – Lagrange Multiplier method – Linear Programming OPF – Interior Point Method.

Unit – IV	**Unit Commitment and Economic Dispatch:**	**9**

Unit Commitment: Introduction – Need for Unit Commitment – Objective Functions – Constraints in Unit Commitment: Spinning Reserve, Thermal unit Constraints, Fuel Constraints and Other Constraints, Hydro Constraints, – Unit Commitment Solution Methods: Priority List Method, Dynamic Programming methods – Economic Dispatch – Incremental cost without and with losses – Solution by Direct and λ iteration method.

Unit – V	**Power System Restructuring and Cyber Security – an Overview**	**9**

Introduction – Motivation for Restructuring of Power System – Electricity Markets Entities and Models – Benefits of Deregulation – Basic Terminologies – Deregulation – International Scenario – Milestones of Deregulation – Cyber Security in Power System: Introduction and initiatives – Areas Vulnerable to Cyber Attacks – issues in cyber security – Organization structure for Cyber security in power system – Classification of Cyber security on Load Frequency Control.

Total:45

TEXT BOOK:

1.	P.Venkatesh, B.V.Manikandan, S.Charles Raja and A.Srinivasan , "Electrical Power Systems: Analysis, Security and Deregulations, 1st Edition, PHI India Private Limited, 2012.

REFERENCES:

1.	Hassan Haes Alhelou, Nikos Hatziargyriou and Zhao Yang Dong, “Power Systems Cyber security Methods, Concepts, and Best Practices”, 1st Edition, Springer Cham, 2023.
2.	Hassan Haes Alhelou, Almoataz Y. Abdelaziz, and Pierluigi Siano, “Wide Area Power System Stability, Protection and Security, 1st Edition, Springer Cham, 2021.
3.	Anuradha Tomar and Ritu Kandari,”Advances in Smart Grid Power Systems: Network, Control and Security, Academic Press Inc, 2020 (Edited).

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	Understand the various operations in power system security.	Understanding (K2)
CO2	Apply different state estimation techniques used for power system security analysis.	Applying (K3)
CO3	Understand and conduct optimal power flow analysis and provide the suitable solutions.	Understanding (K2)
CO4	Apply dynamic approaches for solving unit commitment and economic dispatch problems.	Applying (K3)
CO5	Explain the key issues in electric utilities restructuring	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	3	1
CO2	3	2	1	1			1	1				1	3	2
CO3	3	2	1	1			1	1				1	3	2
CO4	3	1	1	1				1				1	2	1
CO5	3	1					1	1				1	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	60	30				100
CAT2	20	50	30				100
CAT3	20	60	20				100
ESE	10	60	30				100

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

22EEE33 – ARTIFICIAL INTELLIGENT TECHNIQUES FOR ELECTRIC VEHICLES

Programme & Branch	**B.E & Electrical and Electronics Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**8**	**PE**	**3**	**0**	**0**	**3**

Preamble	This course will provide an introduction to the basic concepts and principles of AI techniques for EVs, and explore their application in different areas of EV development.

Unit – I	**IoT-Based Battery Management System for Hybrid Electric Vehicle**	**9**

Introduction of Electric Vehicle - Advantages of Electric Vehicle - Artificial Intelligence - Basics of Artificial Intelligence - Advantages of Artificial Intelligence in Electric Vehicle. Battery configuration - Types of batteries for HEV and Electric Vehicles (EV) - Functional Blocks of Battery Management Systems - IoT based BMS.

Unit – II	**Brushless Direct Current Motor Drive Using Artificial Intelligence**	**9**

Brushless DC Motor - Mathematical Representation Brushless DC Motor - Closed-Loop Model of BLDC Motor Drive - PID Controller - Fuzzy Control - Auto-Tuning Type Fuzzy PID Controller - Genetic Algorithm - Artificial Neural Network-Based Controller - BLDC Motor Speed Controller with ANN Based PID Controller - Analysis of Different Speed Controllers.

Unit – III	**Small-Signal Modeling and Magnetic Bearing System**	**9**

Overall System Modeling - The Small-Signal Model of the System. Magnetic Bearing System: Introduction - Basic Components of an Active Magnetic Bearing (AMB) - Active Magnetic Bearing in Electric Vehicles System - Control Strategies for AMB in EVs.

Unit – IV	**Energy Management and Intelligent Hybrid Battery Management System**	**9**

Introduction - Problem Description and Formulation - Modeling of HESS and its Analysis. Intelligent Hybrid Battery Management System: Energy Storage System - Battery Management System - Intelligent Battery Management System

Unit – V	**Power Semiconductor Devices and Induction Motor Control Schemes**	**9**

Introduction - Conventional Methods for Prediction of Reliability for Power Converters - Calculation Process of the Electronic Component - Reliability Prediction for MOSFETs - Reliability Prediction for Power Semiconductor Device - Reliability Prediction for Resistor Control. Schemes of IM: Scalar Control - Vector Control - Modeling of Induction Machine - Controller Design

Total:45

TEXT BOOK:

1. Chitra A., Sanjeevikumar Padmanaban, Jens Bo Holm-Nielsen, S. Himavathi, “Artificial Intelligent Techniques for Electric and Hybrid Electric Vehicles”, Wiley, 2020.

REFERENCES:

1. James Larminie and John Lowry, "Electric Vehicle Technology Explained", John Wiley & Sons, 2012.
2. Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 2012.
3. Salah Kamel and Khaled Seddik, "Electric Vehicle Integration into Modern Power Networks", Springer, 2019.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	discuss IoT Based Battery Management System and type of batteries.	Understanding (K2)
CO2	explain the AI Based BLDC drive for optimum operation of EV.	Applying (K3)
CO3	model and analyse three phase converters for EV applications and Explain Active Magnetic Bearing system	Applying (K3)
CO4	model and analyse the Energy storage and management system	Applying (K3)
CO5	explain the reliability prediction of power semiconductor devices and induction motor control schemes	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	3	3	2				1			1	2	3
CO2	3	2	3	3	2				1			1	2	3
CO3	3	2	3	3	2				1			1	2	3
CO4	3	2	3	3	2				1			1	2	3
CO5	3	2	3	3	2				1			1	2	3

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

ASSESSMENT PATTERN - THEORY

Test / Bloom’s Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	80					100
CAT2	20	40	40				100
CAT3	20	60	20				100
ESE	10	60	30				100

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

22EEE34 – CONTROL AND MAINTENANCE OF ELECTRICAL MACHINES

Programme& Branch	**B.E & Electrical and Electronics Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Electrical Machines I and II**	**8**	**PE**	**3**	**0**	**0**	**3**

Preamble	Objective of the course is to understand the construction and operations of control circuit components and industrial controls used in various applications. To provide fundamental knowledge in maintenance, installation, testing and troubleshooting measures for DC and AC machines.	
Unit – I	**Control Circuit Components:**	**9**
Introduction – Fuses – Contactors and its Rating – Control Circuit Relays – Time Delay Relays – Phase Fault Relays – Solenoid Valves – Pressure Switch – Temperature Switch – Float Switch – Push Button and Selector Switch – Symbols of Control Components		
Unit – II	**Industrial Control:**	**9**
Automatic Control for a Water Pump – Lifting Magnet – Electrical Oven – Overhead Crane – Battery Trolley – Air Compressor – Conveyor System – Starter: Two and Three-Point Starter – Star/Delta Starter – Rotor Resistance Starter		
Unit – III	**Maintenance, Installation and Testing:**	**9**
Importance of Electrical Maintenance - Types of Maintenance - Preventive Maintenance for Induction Motor, Alternator, DC Machines, Transformer - Factor Affecting the Preventive Maintenance - Installation and Commissioning of Induction Motor - Vibration - Installation and Commissioning of Transformer - Testing of Motor and Transformer		
Unit – IV	**Troubleshooting of AC Machines:**	**9**
Significance of Trouble shooting - Types of Faults and Precaution - Instruments for Maintenance - Classifications of Fault in Rotating Electrical Machines - Abnormal Conditions - Trouble Shooting of AC Machines - Noise and Vibration - Bearing Maintenance		
Unit – V	**Troubleshooting of DC Machines and Transformer:**	**9**
Trouble Shooting of DC Motors - Commutator and Brushes - Transformer Types - Determination of Transformer Defects - Troubleshooting of Power and Distribution Transformer - Repairing of Transformer - Inspection - Measurement of Insulation Resistance using Megger		
		Total:45

TEXT BOOK:

1.	S. K. Bhattacharya and Brijinder Singh, “Control of Machines”, New Age International Publishers, 2nd Edition, New Delhi, 2006.

REFERENCES:

1.	Madhvi Guptha, Installation, Maintenance and Repair of Electrical Machines and Equipments, 2nd Edition, S.K. Kataria& Sons, New Delhi, 2014.
2.	Sunil S. Rao, Testing Commissioning Operation & Maintenance Of Electrical Equipments, 6th Edition, Khanna Publishers, New Delhi, 1991.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	Understand the construction and operation of various control circuit components	Understanding (K2)
CO2	Analyze the power and control circuit operation involved in the modern industries	Applying (K3)
CO3	Explain the maintenance, Installation and Testing procedure for AC and DC machines	Understanding (K2)
CO4	Confidently troubleshoot the faults concerned in high power AC machines	Understanding (K2)
CO5	Confidently troubleshoot the faults in high power DC machines and Transformer	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	1			1	1	2	2
CO2	3	1	2				1	1			1	1	3	3
CO3	3	2	1				1	1			1	1	2	2
CO4	3	1	1				1	1			1	1	3	1
CO5	3	1	1				1	1			1	1	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	10	80	20				100
CAT2	10	80	20				100
CAT3	20	80					100
ESE	10	70	20				100

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

22EEE35 – DIGITAL SIGNAL PROCESSING AND ITS APPLICATIONS							
Programme & Branch	**B.E & Electrical and Electronics Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Signals and Systems**	**8**	**PE**	**3**	**0**	**0**	**3**

Preamble	This course helps the students to impart the knowledge on design of FIR and IIR Filters, Realize the structure of digital filters, multirate DSP techniques and apply the signal processing techniques to various fields.	
Unit – I	**FIR Filters:**	**9**
Introduction- Difference between analog filters and digital filters -Magnitude and Phase response of Digital filters -Frequency response of Linear Phase FIR filters – FIR filter design using Windowing Techniques: Rectangular Window, Hamming Window, Hanning Window.		
Unit – II	**IIR Filter:**	**9**
Introduction – IIR filter design by approximation of derivatives – Impulse invariant transformation method- Bilinear transformation method – Frequency Transformation –Butterworth filters –Chebyshev filters		
Unit – III	**Realisation of Digital filters:**	**9**
Introduction – Block diagram and signal flow graph realization – Basic structures for IIR systems: Direct form Realisation, Cascade Realisation, Parallel Realisation. Basic structures for FIR systems: Direct form realization, Cascade form realization, Lattice structure, Realisation of linear phase FIR system		
Unit – IV	**Multirate digital signal processing:**	**9**
Introduction – Sampling – Sampling rate conversion: Decimation, Interpolation - Sampling rate conversion by a rational factor – Signal flow graphs, Filter Structure: FIR direct form structure, IIR direct form structure, Structure for FIR decimators and Interpolator		
Unit – V	**Applications of DSP:**	**9**
Introduction – DSP in biomedical engineering: Removal of artifacts, ECG, EEG – Voice processing: Speech signals, Analysis of speech signals , Sub band coding – Radar signal processing – Image processing – Vibration Analysis		
		Total:45

TEXT BOOK:

1.	S.Salivahanan, “ Digital signal Processing”, fourth edition, McGraw hill Publication, 2019. ISBN (13): 978-93-5316-742-4

REFERENCES:

1.	John.G.Proakis, Dimitris.G.Manolakis, “Digital Signal Processing: Principles, Algorithms and Applications”, 5th Edition, Pearson Education, India, 2021
2.	Nagoor Kani. A ,“Signals and Systems”, 2nd Reprint, Tata McGraw-Hill Education, New Delhi, 2010
3.	Dr.Sanjay Sharma , “ Digital signal Processing (with MATLAB programs)”, 7th Edition, S.K. Kataria &Sons, Newdelhi, 2016.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	Design a digital FIR filter using window techniques	Applying (K3)
CO2	Design a digital and analog IIR filters	Applying (K3)
CO3	Realize FIR and IIR filter structures	Applying (K3)
CO4	Understand the concepts of multirate digital signal processing systems	Understanding (K2)
CO5	Understand the various signal processing techniques used in real time 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				1		1	1	3	3
CO2	3	2	2		1				1		1	1	3	3
CO3	3	2	2		1				1		1	1	3	3
CO4	3	2	1		1				1		1	1	2	2
CO5	3	2	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	5	25	70				100
CAT2	5	25	70				100
CAT3	20	80					100
ESE	10	40	50				100

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

22EEE36 – ELECTRIC POWER UTILISATION

Programme & Branch	**B.E & Electrical and Electronics Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**8**	**PE**	**3**	**0**	**0**	**3**

Preamble	The course aims in imparting knowledge on Electric heating, Electric Welding, Electric Traction, Fans, Pumps, and Lighting systems	
Unit - I	**Electric Heating:**	**9**
Electric Heating; Advantages - Methods of Electric heating – Resistance heating - requirement of a heating element - design of heating element - Arc furnaces – Induction heating - Core type Induction Furnace and Coreless Induction furnace – Eddy current Heating		
Unit - II	**Electric Welding:**	**9**
Welding - Welding processes - Electrodes for metal arc welding - Arc Welding machines – VI characteristics - DC welding machine with motor-generator set - AC Welding Machines, Types of Welding – TIG, MIG, MAG, resistance Welding, Spot Welding, Butt Welding, Projection Welding and Electron Beam Welding		
Unit - III	**Electric Traction:**	**9**
Introduction – requirements of an ideal traction system – supply systems –speed time curves for train movement - calculation of average and crest speed of various services - mechanics of train movement – tractive effort – specific energy consumption - calculation of specific energy consumption on a level track		
Unit - IV	**Fans and Pumps**	**9**
Fans – Types, Characteristics and Typical applications, Fan curves - Fan Laws - Flow Control Strategies – Energy Saving Opportunities in fans - Pumps – Types, System Characteristics, Pump curves - Flow control strategies – Energy Conservation opportunities in Pumps		
Unit – V	**Lighting Systems:**	**9**
Basic Parameters and Terms in Lighting systems - Light sources and Lamp Types - Luminous performance Characteristics of commonly used luminaries - Methods of calculating illuminance - Lighting design for Interiors - Energy saving opportunities in lighting systems		
		Total:45

TEXT BOOK:

1.	Gupta J.B, “Utilization of Electric Power and Electric Traction”, S.K. Kataria & Sons, New Delhi,10th Edition, Reprint 2018 Unit I, II, III.
2.	Energy Efficiency in Electrical Utilities, Guide Book for National Certification Examination for energy managers and Auditors, 4th Edition, Bureau of Energy Efficiency,2015 Unit IV, V.

REFERENCES:

1.	Taylor E. Openshaw, “Utilization of Electrical Energy”, Universities Press, Hyderabad, 2012
2.	Chakrabarti A., Soni M.L., Gupta P.V. and Bhatnagar U.S., “A Textbook on Power System Engineering”, Dhanpat Rai& Co., New Delhi, 2013

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	discuss the applications of electrical energy for heating	Understanding (K2)
CO2	outline the applications of electrical energy for welding	Understanding (K2)
CO3	discuss electric traction systems and their performance	Applying(K3)
CO4	discuss fans and blowers and appraise the energy saving opportunities in them	Understanding (K2)
CO5	describe the lighting systems, lighting design and appraise the energy saving opportunities in them	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	1	2	1
CO2	3	1					1				1	1	2	1
CO3	3	3	2	2			1				1	1	2	3
CO4	3	1					1				1	1	2	1
CO5	3	1					1				1	1	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	20	80					100
CAT2	20	40	40				100
CAT3	20	40	40				100
ESE	20	50	30				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 disseminate 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)

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)

22EEO01 – SOLAR AND WIND ENERGY SYSTEMS

(Offered by Department of Electrical and Electronics Engineering)

Programme & Branch	**All BE/BTech Branches Except EEE**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**5**	**OE**	**3**	**1**	**0**	**4**

Preamble	This course aims in imparting the concepts and nuances of solar and wind energy systems along with its detailed design procedures and analysis.	
Unit – I	**Introduction to Solar PV:**	**9+3**
Solar cell – Parameters of solar cell – Solar PV module – Ratings and parameters – Measuring module parameters – Solar PV module arrays – Factor affecting electricity generation by a solar cell and solar PV module.		
Unit – II	**Types of PV Systems:**	**9+3**
Stand alone, grid connected and hybrid systems – Battery parameters – Battery selection – Charge controllers – DC-DC converters – Inverters – MPPT – Components of grid connected PV systems.		
Unit – III	**Solar PV System Design:**	**9+3**
Design methodology for solar PV system: Approximate design of solar PV system – Solar PV system design chart – Look up table for solar PV system design – Installation and troubleshooting of solar PV power plants.		
Unit – IV	**Introduction to WECS:**	**9+3**
Power output from an ideal turbine – Aerodynamics – Power output from practical turbines – Energy production and capacity factor – Methods of generating synchronous power – DC shunt generator with battery load – AC generators.		
Unit – V	**Wind Power Plant Design:**	**9+3**
Site preparation – Electrical network – Selection of low voltage and distribution voltage equipment – Losses – Wind farm costs.		

Lecture:45, Tutorial:15, Total:60

TEXT BOOK:

1.	Chetan Singh Solanki, "Solar Photovoltaic Technology and Systems – A Manual for Technicians, Trainees and Engineers", 1st Edition, PHI learning Private Limited, New Delhi, 2013 for Units I, II and III.
2.	Gary L.Johnson, "Wind Energy Systems", Electronic Edition, Manhatan, KS, 2006 for Units IV,V.

REFERENCES:

1.	Chetan Singh Solanki, "Solar Photovoltaics – Fundamentals, Technologies and Applications", 2nd Edition, PHI learning Private Limited, New Delhi, 2011.
2.	Spera, D.A., "Wind Turbine Technology: Fundamental concepts of Wind Turbine Engineering", 2nd Edition, ASME, New York, 2009.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	outline the parameters and ratings of solar cell and modules	Understanding (K2)
CO2	make use of various components intended for solar PV system design	Applying (K3)
CO3	apply the design procedures for solar PV systems towards installation	Applying (K3)
CO4	identify the required components for wind energy conversion system	Understanding (K2)
CO5	examine the design and installation procedures for WECS	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	3			1	1					1		
CO2	3	3	2			1	1					1		
CO3	3	3	2			1	1					1		
CO4	3	2	3			1	1					1		
CO5	3	3	2			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	40	40	20				100
CAT2	20	40	40				100
CAT3	20	40	40				100
ESE	30	40	30				100

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

22EEO02 – ELECTRICAL WIRING AND LIGHTING

(Offered by Department of Electrical and Electronics Engineering)

Programme & Branch	**All BE/BTech Branches Except EEE**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**5**	**OE**	**3**	**1**	**0**	**4**

Preamble	Lighting becomes one of the essential requirements for the humans on day-to-day activities. Hence it is necessary to educate an engineer in the aspects of Domestic and Industrial Lighting. The idea of the subject is to educate the electrical engineers on the aspect of Introduction to Wiring and its Design considerations, Installations, Light and Luminaires and Light sources.

Unit – I	**Introduction:**	**9+3**
Electric supply system – List of Electrical Symbols and its interpretation – Electrical Diagrams – System of connection of Appliances and accessories – Example circuits – Panel Boards – Earthing – Different types of wires, wiring system, methods and materials – Fuse Calculation and Circuit breakers – Wiring Tools – IE rules for wiring		
Unit – II	**Domestic Wiring:**	**9+3**
Three phase four wire distribution system – Protection – General requirements of electrical installations – Testing of installations – Types of Loads – Service connections – Service mains – Sub-Circuits – Location of main board and Distribution board – Guidelines for installation of fittings – Voltage drop and size of wires – safety		
Unit – III	**Industrial Wiring:**	**9+3**
Electrical installation for residential buildings - Estimating and costing of material – Solved examples for residential buildings with Problems – Electrical installations for commercial buildings –Electrical installations for small industries		
Unit – IV	**Illumination:**	**9+3**
Introduction – Terms & Definitions – Laws of Illumination – Polar curves – Photometry – Basic principles of Light control – Types of Lighting Schemes – Design of Lighting Schemes – Methods of Lighting calculation with Problems – Factory, Street & Flood Lighting		
Unit – V	**Light Sources:**	**9+3**
History of the electric lamp – Arc lamps – Incandescent Lamps – Gaseous discharge lamps: Sodium vapour discharge lamp, High pressure mercury vapour discharge lamp, Mercury iodide lamp, Neon lamp, Fluorescent Tubes, CFL – LED's		

Lecture:45, Tutorial:15, Total:60

TEXT BOOK:

1.	Raina K.B & Bhattacharya S.K, "Electrical Design Estimating and Costing", 2nd Edition, New Age International Publishers, 2017 for Unit I, II, III.
2.	Gupta J.B, "Utilization of Electric Power and Electric Traction", 10th Edition, S.K. Kataria & Sons, 2012 for Unit IV, V.

REFERENCES:

1.	Pritchard D.C, "Lighting", 6th Edition, Routledge, 2016
2.	Ronald N. Helms, "Illumination Engineering for energy efficient luminous environments", 1st Edition, Prentice–Hall, Inc, 1980

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	discuss the various methods in wiring	Understanding (K2)
CO2	infer the different design considerations in Domestic wiring	Understanding (K2)
CO3	demonstrate the various Electrical Installations	Applying (K3)
CO4	describe the various lighting and its controls	Understanding (K2)
CO5	demonstrate the various types of light sources	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	1							1		
CO4	3	2	1									1		
CO5	3	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	40	60					100
CAT2	20	50	30				100
CAT3	20	50	30				100
ESE	20	40	40				100

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

22EEO03 - PROGRAMMABLE LOGIC CONTROLLER AND SCADA							
(Offered by Department of Electrical and Electronics Engineering)							
Programme & Branch	**All BE/BTech Branches except EEE**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**5**	**OE**	**3**	**1**	**0**	**4**

Preamble	This course imparts knowledge about basic concepts of programmable logic controllers, programming languages, advanced PLC programming, process of SCADA system and also apply this knowledge to develop automation system in industrial applications.	
Unit – I	**Introduction to Programmable Logic Controller:**	**9+3**
Overview of Programmable Logic Controller – Parts of PLC – Principle of operation - I/O Modules: Discrete, Analog, Special – I/O Specifications – CPU – Memory design and types – Programming devices – Recording and Retrieving data –PLC programming languages.		
Unit – II	**Basic PLC Programming:**	**9+3**
Fundamentals of Logic – Hardwired logic versus Programmed Logic - Program Scan– Relay-Type Instructions - Instruction addressing – Branch and Internal relay instructions – Entering the Ladder diagram – Electromagnetic Control relays – Contactors – Motor Starters – Manual operated switches and mechanically operated switches.		
Unit – III	**Advanced PLC Programming:**	**9+3**
Programming Timers: On delay timer and off delay timer instruction – retentive and cascade timer functions- Programming Counters – Program Control Instructions - Math Instructions – Sequencer and Shift Register Instructions. PLC Applications: Bottle filling system –Traffic light control system		
Unit – IV	**PLC Installation and Troubleshooting:**	**9+3**
PLC Enclosures – Electrical Noise – Leaky Inputs and Outputs – Grounding – Voltage Variations and Surges – Program Editing – Programming and Monitoring – Preventive Maintenance – Connecting PC and PLC. Application: PLC Based VFD Drive for AC Pump with Level Control Sensor and Tank.		
Unit – V	**SCADA and its application:**	**9+3**
Introduction to SCADA – A brief history of SCADA –Real-time systems – Remote control – Communications: communication system components – protocol-modems- Remote terminal units (RTUs) – Master terminal units (MTUs) Applications: Real time Revisited - Scanning and communications.		
		Lecture:45, Tutorial:15, Total:60

TEXT BOOK:

1.	Frank D. Petruzella, "Programmable Logic Controllers", 5th Edition, Tata McGraw-Hill, New Delhi, 2019.for Units I, II, III and IV.
2.	Stuart A. Boyer, “SCADA: Supervisory Control and Data Acquisition”, 4th Edition, ISA Press, USA, 2016.for Unit V.

REFERENCES:

1.	Webb John W and Reis Ronald A, "Programmable Logic Controllers - Principles and Applications", 5th Edition, PHI Learning Private Limited, New Delhi, 2002.
2.	Bolton W, “Programmable Logic Controllers”, 5th edition, ELSEVIER, New York, 2009

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	identify the PLC hardware and programming languages for various applications	Understanding (K2)
CO2	develop PLC ladder logic programming for industrial problems	Applying (K3)
CO3	design a PLC system, component, or process to meet a set of specifications	Applying (K3)
CO4	install and troubleshoot the PLC in real time	Applying (K3)
CO5	apply SCADA in real time applications to meet industrial automation	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		
CO2	3	2	1	1		1			1			1		
CO3	3	2	1	1		1			1			1		
CO4	3	1				1			1			1		
CO5	3	2	1	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	30	50	20				100
CAT2	30	50	20				100
CAT3	40	40	20				100
ESE	40	40	20				100

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

22EEO04 – ANALOG AND DIGITAL ELECTRONICS								
(Offered by Department of Electrical and Electronics Engineering)								
Programme & Branch	**All B.E/B.Tech Branches Except EEE**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**	
Prerequisites	**Nil**	**5**	**OE**	**3**	**1**	**0**	**4**	
Preamble	This course aims to impart knowledge on the analog and digital electronics that aids the students to perform the design and analysis of various electronic and digital logic circuits							
Unit – I	**Bipolar Junction Transistor:**						**9+3**	
Construction and operation of a Transistor – Currents in transistor – Input and Output characteristics of a transistor in CE, CB and CC configurations– Current gain in CE, CB and CC configurations – Operating point – Stability and stability factor: Fixed bias circuits and Voltage-divider bias - Hybrid model of BJT.								
Unit – II	**FET, MOSFET and UJT:**						**9+3**	
Construction and characteristics of JFET – Parameters of JFET – FET in CS, CD and CG Configurations – Construction, characteristics of MOSFET in Depletion and Enhancement mode – Applications of MOSFET – Construction, theory of operation and characteristics of UJT – UJT as relaxation oscillator.								
Unit – III	**Combinational Circuits:**						**9+3**	
Design Procedure – Binary Addition – Binary Subtraction – Decoders – Encoders – Multiplexers – Demultiplexers – Code Conversion: Gray to Binary, Binary to gray, BCD to Binary, Binary to BCD – Magnitude comparators: 1 bit, 2 bit.								
Unit – IV	**Sequential Circuits:**						**9+3**	
Latches and Flip-flops – SR, JK, D, T Flip-flops – Master slave Flip-flop - Conversion of one type of flip-flop to another type – Operating characteristics of Flip-flops – counters – Shift registers – Universal Shift registers.								
Unit – V	**Logic Families and Memory devices:**						**9+3**	
Transistor Transistor Logic (TTL): Two-input TTL NAND Gate – Emitter Coupled Logic (ECL) - Inverter: Complementary Metal Oxide Semiconductor (CMOS) Logic – Comparison of Logic families for their performance. Memory Types: Memory Devices: Static RAMs (SRAMs) - Dynamic RAMs (DRAMs). Read-Only Memory (ROM) organization – Types of ROMs: PROM, EPROM & EEPROM.								
Lecture:45, Tutorial:15, Total:60								

TEXT BOOK:

1.	Sedha R.S., "A Textbook of Applied Electronics ", 4th Edition, S.Chand & Co. Ltd., New Delhi, 2014 for Units I,II.
2.	Soumithra Kumar Mandal, “Digital Electronics Principles and Applications”, Eleventh Reprint Edition, Tata Mc Graw Hill, New Delhi, 2017 for units III, IV and V.

REFERENCES:

1.	Salivahanan S. and Suresh Kumar N., "Electronic Devices and Circuit ", 4th Edition, Tata McGraw Hill Publishing Company, New Delhi, 2017.
2.	Anand Kumar.A, “Fundamentals of Digital Circuits” 4th Edition, Prentice Hall of India, Chennai, 2016
3.	Salivahanan, S and Arivazhagan, ―Digital Circuits and Design‖, 4th Edition, Vikas Publishing House Pvt. Ltd., New Delhi, 2012.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	Analyse the characteristics and stability of BJT	Applying (K4)
CO2	acquire knowledge about the operation and characteristics of FET and UJT	Understanding (K2)
CO3	Illustrate combinational logic circuits using logic gates.	Applying (K3)
CO4	Design counters and shift registers using flip-flops.	Analyzing (K3)
CO5	identify the 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	1										1		
CO2	3	2	2	1	1							1		
CO3	3	3	2	1	1							1		
CO4	3	2	2	1	1							1		
CO5	3	2	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	50	40				100
CAT2	10	30	60				100
CAT3	10	30	40	20			100
ESE	5	35	40	20			100

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

22EEO05 - POWER ELECTRONICS AND DRIVES							
(Offered by Department of Electrical and Electronics Engineering)							
Programme& Branch	**All B.E/B.Tech Branches Except EEE**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**5**	**OE**	**3**	**1**	**0**	**4**

Preamble	This course is designed to impart knowledge about the characteristics of power semiconductor devices, working principle of rectifier, chopper, DC to AC converter and AC to AC converter	
Unit – I	**Power Semi-Conductor Devices:**	**9+3**
Introduction – Power BJT – Power MOSFET - IGBT – SCR - Construction, Principle of operation, Static and Dynamic characteristics - Thyristor Protection – Series and parallel connections of thyristors.		
Unit – II	**AC Converters:**	**9+3**
Single phase controlled rectifiers with R, RL Loads: Estimation of RMS load voltage and RMS load current - Principle of AC voltage controller - Single Phase AC Voltage Controllers - Principle of cycloconverter - Single Phase to Single Phase Cycloconverter: step down and step up.		
Unit – III	**DC Converters:**	**9+3**
Principle of Step Up and Down Chopper – Chopper Control Strategies – SMPS - Single Phase Bridge Inverters - PWM Inverters: Single, Sinusoidal PWM technique - UPS		
Unit – IV	**DC Drives:**	**9+3**
Elements of Electrical drives - Speed Control of DC Motors – Ward Leonard Scheme – Drawbacks – single phase fully controlled rectifier control of dc separately excited motor – chopper controlled separately excited DC drives.		
Unit – V	**AC and Special Machine Drives:**	**9+3**
Three phase induction motor Drive: V/f control - Synchronous Motor Drives: self-controlled synchronous motor drive employing load commutated thyristor inverter - Brushless DC motor drives - permanent magnet stepper motor Drives – Drives for specific applications: Textile mills – Steel rolling mills.		
		Lecture: 45, Tutorial :15, Total:60

TEXT BOOK:

1.	Bimbhra P.S., "Power Electronics", 6th Edition, Khanna Publishers, New Delhi, 2018 for Units I, II, III
2.	Dubey G.K. "Fundamentals of Electrical Drives", 2nd Edition, Narosa Publishing House, New Delhi, 2019 for Units IV, V

REFERENCES:

1.	Singh M.D. and Khanchandani, "Power Electronics", 2nd Edition, Tata McGraw-Hill, New Delhi, 2017.
2.	Vedam Subrahmanyam "Electric Drives: Concepts and Applications", 2nd Edition, McGraw-Hill, New Delhi, 2010.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	choose various power semiconductor devices based on their construction, operation and characteristics	Understanding (K2)
CO2	explain the working principle of ac converter and compute its performance parameter	Understanding (K2)
CO3	Classify and explain the working principle of dc converters	Understanding (K2)
CO4	Apply power converters for speed control of DC drives	Applying (K3)
CO5	Understand the operation of AC Drive and special machines Drives and its control schemes for various 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	2	3	1					1					
CO2	3	2	3	1	1	1			1					
CO3	3	1	3	1	1	1			1					
CO4	3	2	3	1	1	1			1					
CO5	3	1	3	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	20	80					100
CAT2	20	80					100
CAT3	20	50	30				100
ESE	20	50	30				100

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

22EEO06 – INTRODUCTION TO SENSORS AND ACTUATORS							
(Offered by Department of Electrical and Electronics Engineering)							
Programme & Branch	**All B.E/B.Tech Branches Except EEE**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**5**	**OE**	**3**	**1**	**0**	**4**

Preamble	This course helps the students to impart the knowledge to interface various sensors and actuators in embedded applications.	
Unit – I	**Inductive Transducers:**	**9+3**
Introduction: Difference between sensor, and transducer- Principles- Classification of sensors- Static and Dynamic characteristics of sensors – Environmental parameters – Characterization **Inductive transducers**: - Principle of operation, construction details, characteristics and applications of LVDT, Induction potentiometer, variable reluctance transducer- Inductive proximity sensor		
Unit – II	**Capacitive & Radiation Sensors:**	**9+3**
Capacitive transducers: - The parallel plate Capacitive sensor – Serrated plate Capacitive sensor – Variable Permittivity Sensor – Electro static transducer **Radiation Sensors:** Types of photosensistors/photo detectors**:** The Photo emissive Cell and the Photomultiplier - The Photoconductive Cell- Photovoltaic and Photo junction Cells - Position-sensitive Cell**.** Fibre optic sensors: Liquid level sensing – Fluid flow sensing		
Unit – III	**Thermal and Magnetic Sensors:**	**9+3**
Thermal Sensors: Gas Thermometric Sensors - Acoustic Temperature Sensor - Resistance Change Type Thermometric Sensors- Thermoemf Sensors **Magnetic Sensors:** Sensors and the principles – Magneto Resistive sensors – Hall effect Sensors – Inductance and Eddy current sensors – Angular/Rotary movement sensors – Switching magnetic sensors		
Unit – IV	**Smart sensors and Applications of sensors:**	**9+3**
Smart Sensors: Introduction, Primary Sensors, Excitation, Amplification, Filters, Converters, Standards for Smart Sensor Interface, MEMS **Sensors Applications**: On-Board Automobile Sensors – Home Appliance sensors-Aerospace sensors-Medical Diagnostic sensors-Sensors for environmental monitoring.		
Unit – V	**Actuators:**	**9+3**
Thermo Mechnaical Actuators -Optical Actuators - Capacitive Actuators -Magneto strictive Actuators -Motors as actuators: Operation principles-BLDC Motors-AC motors-Stepper Motors-Linear Motors-Piezo electric actuators		
		Lecture: 45, Tutorial :15, Total:60

TEXT BOOK:

1.	Patranabis, Sensors and Transducers, 2nd Edition, PHI, 2022. For Units I, II, III, IV.
2.	Nadhan Ida, Sensors, Actuators, and Their Interfaces: A Multidisciplinary Introduction, Sci Tech Publishing, 2013 for Unit V.

REFERENCES:

1.	De Silva and Clarence W, Sensors and Actuators Engineering System Instrumentation, 2nd Edition, CRC Press, 2015.
2.	Jacob Fraden, Handbook of Modern sensors: Physics, Design and Applications, 5th Edition, Springer, 2015.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	explain the theory and working behind the inductive transducers	Understanding (K2)
CO2	Describe the construction and working of Capacitive and Radiation sensors	Understanding (K2)
CO3	Elaborate the various types of thermal and magnetic sensors and its principle of operation	Understanding (K2)
CO4	demonstrate the working of various types of sensors used in real world applications	Applying (K3)
CO5	Illustrate the working principle of Actuators and electrical actuating 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	2	1			1						1		
CO2	3	2	1			1						1		
CO3	3	2	1			1						1		
CO4	3	2	1			1						1		
CO5	3	2	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	15	85					100
CAT2	15	85					100
CAT3	10	60	30				100
ESE	10	70	20				100

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

22EEO07 – ENERGY CONSERVATION AND MANAGEMENT							
(Offered by Department of Electrical and Electronics Engineering)							
Programme & Branch	**All B.E/B.Tech Branches Except EEE**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**6**	**OE**	**3**	**1**	**0**	**4**

Preamble	This course aims in imparting the procedures of energy audit, energy management and financial management. Also it aims to impart knowledge on energy conservation opportunities in thermal utilities, electrical system, lighting Systems and in buildings	
Unit – I	**Introduction:**	**9+3**
Classification of Energy - Energy Scenario - Energy Needs of Growing Economy - Energy Pricing in India – Energy and Environment - Energy Conservation Act. Energy Audit: Types and Methodology - Energy Audit Instruments - Role of energy managers and auditors		
Unit – II	**Thermal Utilities:**	**9+3**
Steam – Introduction, Properties of steam, Steam distribution systems, Boilers- Types and Classification- Performance Evaluation of Boilers – Losses in Boiler – Energy Conservation opportunities in boilers, Waste heat recovery - Classification and benefits		
Unit – III	**Electrical and Lighting System:**	**9+3**
Introduction to Electric Power Supply Systems - Electrical Load Management and Maximum Demand Control- Power factor improvement and its benefit, Basic Parameters and Terms in Lighting systems - Luminous performance Characteristics of commonly used luminaries and Energy saving opportunities in lighting systems		
Unit – IV	**Energy Conservation in Buildings and ECBC:**	**9+3**
About ECBC – Building Envelope, Fenestrations, Insulation, HVAC, Lighting, Water pumping, Inverter – Elevators and Escalators – Star Labeling for existing buildings		
Unit – V	**Financial Management:**	**9+3**
Investment – need, Appraisal and criteria, financial analysis techniques – Simple payback period – Return on investment – Net present value – Internal rate of return – Cash flows, Risk and sensitivity analysis – Financing options – Energy performance contracting and role of ESCOs.		
		Lecture:45, Tutorial:15, Total:60

TEXT BOOK:

1.	Guide Books for National Certification Examination for energy managers and Auditors, 3rd Edition, Bureau of Energy Efficiency,2010

REFERENCES:

1.	Wayne C. Turner & Steve Doty, “Energy Management Handbook”, 6th Edition, The Fairmont Press, GA,2006
2.	Barny L. Capehart, Wainey C. Turner, William J. Kennedy, “Guide to Energy Management”, 7th Edition, The Fairmont Press, GA, 2012

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	interpret the importance of energy, energy conservation and energy audit	Understanding (K2)
CO2	appraise the energy saving opportunities in thermal systems	Understanding (K2)
CO3	predict the energy saving opportunities in lighting systems	Applying (K3)
CO4	appraise the energy conservation in buildings and ECBC	Understanding (K2)
CO5	analyze the different financial management techniques	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	1					1	1	1			1		
CO2	3	1					1	1	1			1		
CO3	3	2	1				1	1	1			1		
CO4	3	1					1	1	1			1		
CO5	3	3	2		1		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	40	60					100
CAT2	20	40	40				100
CAT3	20	40	30	10			100
ESE	20	40	30	10			100

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

22EEO08- MICROPROCESSORS AND MICROCONTROLLERS INTERFACING

(Offered by Department of Electrical and Electronics Engineering)

Programme & Branch	**All BE/BTech Branches except EEE**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**6**	**OE**	**3**	**1**	**0**	**4**

Preamble	To get acquaintance with the architecture of 8085 processor and 8051 controller, apply the embedded programming concepts for interfacing peripherals with the controller and to understand 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 – Seven segment LED –Sensors–A/D and D/A converters–DC Motor – Stepper motor – Servo motor.		
Unit – V	**Applications of Microcontrollers:**	**9+3**
Smart card reader, Automated meter reading system, Washing machine, Speedometer, 3D printers, Healthcare monitoring systems (only block diagram approaches)		

Lecture:45, Tutorial:15, Total:60

TEXT BOOK:

1.	Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin D. McKinlay, “The 8051 Microcontroller and Embedded Systems Using Assembly and C”, 2nd Edition, Pearson Education, New Delhi, 2013, for Units II,III, IV,V.
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, for Unit I.

REFERENCES:

1.	Senthil Kumar N., Saravanan M., Jeevananthan S, “Microprocessor and Microcontroller”, 12^{th} Impression, Oxford University Press, New Delhi, 2015
2.	Krishna Kant, “Microprocessors and Microcontrollers: Architecture, programming and system design 8085, 8086, 8051, 8096”, 2nd 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 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 microcontrollers	Applying(K3)
CO5	recognize microcontroller-based 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	1				1		1		1	1	1		
CO2	3	1				1	2				2	1		
CO3	3	2	1	1	1	1		1		1	1	1		
CO4	3	2	1	1	1	1	2				2	1		
CO5	3	1				1		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	15	85					100
CAT2	10	45	45				100
CAT3	10	45	45				100
ESE	5	55	40				100

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

22EEO09 – ELECTRICAL SAFETY							
(Offered by Department of Electrical and Electronics Engineering)							
Programme & Branch	**All B.E/B.Tech Branches Except EEE**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**6**	**OE**	**3**	**1**	**0**	**4**

Preamble	This course imparts the knowledge about the electrical hazards and its safety measures in electrical systems.	
Unit – I	**Hazards of Electricity:**	**9+3**
Introduction: Objective of safety - Safety Oath, National safety day – Types of safety – Common safety measures – Types of Hazards – Hazards associated with electrical current and voltage – Electrical safety. Definition of terms: Electric shock, Arc and blast. Shock: Impact of electric shock – Influencing factors. Arc – Initiation of Arc – Impacts of Arc – Arc energy release: Arc energy input – Arcing voltage – incident energy – measurement – copper calorimeter – Stoll curve.		
Unit – II	**Personnel Protection Equipment (PPE):**	**9+3**
Flash and thermal protection: Glossary of terminologies – flame resistant, arc thermal performance value (ATPV), energy breakthrough (EBT) – ASTM standard for clothing materials – choice of clothing – flame and non-flame resistant materials – guidelines for selection – Flash Suit. Head Protection: Hard hats – ANSI Z 89.1 standard – Eye Protection - requirements of safety glasses, goggles – selection - Face shield. Hearing Protection – Requirement –ear plugs and ear muffs – Noise reduction ratio – thumb rule. Arm and Hand Protection: Rubber gloves – ASTM standards – leather protective glove – level of protection. Foot and leg protection and respiratory protection.		
Unit – III	**Electrical Safety Equipment:**	**9+3**
Voltage measuring instruments: Safety voltage measurement – contact and non-contact type testers – selection criteria. Rubber Insulating equipment: Rubber mats, blankets, covers, line hoses and sleeves – Inspection techniques – standards. Insulated tools – hot sticks – cherry picker – standards for tools – safety barriers and signs – safety tags, lock and locking devices. Fire extinguishers – fire safety against electrical fire – types of extinguishers.		
Unit – IV	**Safety Earthing Practices:**	**9+3**
Step potential, touch potential – types of grounding- advantages- Distinction between system grounding and equipment grounding – Functional requirement of earthing systems – earth electrodes – types. – Earth resistance measurements- Residual Current Device -composition of RCD-operation- advantages.		
Unit – V	**First Aid and Rescue:**	**9+3**
First Aid: First aid against electric shock, choking, poisoning, wounds and bleeding, burns and scalds, fractures and dislocations, heat stroke and snake bite. Rescue: Primary rescue methods – American Red Cross method. Types: elevated rescue, confined space rescue and ground level rescue. Regulatory Bodies: Functionality – IEEE, IEC, ASTM, NFPA and OSHA.		
Lecture:45, Tutorial:15, Total:60		

TEXT BOOK:

1.	John Caddick., Mary Capelli Schellpfeffer& Dennis Neit zell., “Electrical Safety Handbook” , 4th Edition, McGraw Hill Publishers, 2012.

REFERENCES:

1.	Rao.S, Jain R.K &Saluja H.L., “Electrical Safety, Fire Safety Engineering and Safety Management”, 2nd Edition, Khanna Publishers, 1997.
2.	Peter E. Sutherland., “Principles of Electrical Safety” IEEE Press Series on Power Engineering, John Wiley and Sons, New Jersy, March 2018.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	understand the various terminologies and hazards related to electrical safety	Understand (K2)
CO2	identify and apply the personnel protection equipment for a typical industry	Applying (K3)
CO3	apply the various measuring and insulating equipment's for electrical safety	Applying (K3)
CO4	apply the safety earthing practices for LV and HV system	Applying (K3)
CO5	understand the functionality of international regulatory bodies, first-aid and rescue procedures	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			1	1		
CO2	3	1	2				1	1			1	1		
CO3	3	1	2				1	1			1	1		
CO4	2	1	3				1	1			1	1		
CO5	1	2	3				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	20	80					100
CAT2	20	80					100
CAT3	20	80					100
ESE	20	80					100

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

22EEEO10 – VLSI SYSTEM DESIGN

(Offered by Department of Electrical and Electronics Engineering)

Programme & Branch	**All BE/BTech Branches except EEE**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**6**	**OE**	**3**	**1**	**0**	**4**

Preamble	To expose the knowledge of VLSI System Design in terms of modeling of MOS transistors, designing CMOS logic circuits with its fabrication techniques and programming various digital logic circuits using Verilog Hardware Description Language in different modeling	
Unit – I	**Introduction:**	**9+3**
CMOS Logic – CMOS Fabrication and Layout – Physical Design – Design Verification – Fabrication, packaging and Testing		
Unit – II	**MOS Transistor Theory:**	**9+3**
Introduction – MOS transistor operating regions – Long Channel VI characteristics – Non ideal I-V effects - DC transfer characteristics		
Unit – III	**CMOS Processing Technology:**	**9+3**
Introduction – CMOS technologies – Stick Diagram – Layout diagram – Layout Design Rules – CMOS Process Enhancement – Technology related CAD Issues – Manufacturing Issues		
Unit – IV	**VERILOG HDL–I:**	**9+3**
VLSI Design Flow – Dataflow modelling – Continuous Assignments – Delays – Expressions, operators, operands – Operator Types – Dataflow modelling Examples – Behavioural modelling – Structured Procedures - Procedural Assignments –Timing controls – Conditional statements - Multiway branching -Loops - Behavioural modelling Examples		
Unit – V	**VERILOG HDL–II:**	**9+3**
Tasks and Functions – Difference between tasks and functions – Tasks – Functions – Useful Modelling Techniques – Switch level modelling Elements - Switch level modelling Examples		
		Lecture:45, Tutorial:15, Total:60

TEXT BOOK:

1.	Neil H. E. Weste & David Money Harris, “CMOS VLSI Design A Circuits and Systems Perspective” Fourth Edition, Pearson education, New Delhi, 2017 Unit I, II, III
2.	Samir Palnitkar, “Verilog HDL: Guide to Digital Design and Synthesis”, Second Edition, Pearson Education, New Delhi, 2017. Unit IV, V

REFERENCES:

1.	Pucknell, Douglas A & Eshragian, K., “Basic VLSI Design”, Third Edition, Prentice Hall India, Pvt Ltd, 2015.
2.	A.Albert Raj & T.Latha, “VLSI Design”, Prentice Hall India Learning Private Limited, 2008.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	Comprehend the principles of CMOS Logic and its physical design process.	Understanding (K2)
CO2	Explain MOS transistor characteristics.	Applying (K3)
CO3	Describe CMOS fabrication techniques, layout design rules and different manufacturing issues	Understanding (K2)
CO4	Apply Verilog HDL modeling for different digital logic circuits in dataflow modelling and behavioural modelling.	Applying (K3)
CO5	Model different digital logic circuits using Verilog HDL in Switch level modeling.	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		
CO2	3	2	1	1	1							1		
CO3	3	2	1	1	1							1		
CO4	3	3	3	1	3				2		2	2		
CO5	3	3	3	1	3				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	10	70	20				100
CAT2	10	60	30				100
CAT3	10	30	60				100
ESE	10	40	50				100

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

22EEO11 – AUTOMATION FOR INDUSTRIAL APPLICATIONS							
(Offered by Department of Electrical and Electronics Engineering)							
Programme & Branch	**All BE/BTech Branches except EEE**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**6**	**OE**	**3**	**1**	**0**	**4**

Preamble	This course is aimed to impart knowledge on the technologies used for the automation in industries.	
Unit – I	**Introduction:**	**9+3**
Architecture of the basic three level Integrated Industrial Automation Systems – Field level for sensors actuators and smart devices, Control level for process and motion control functions, Distributed control system - Supervisory level for Data logging and Acquisition systems – DAS and SCADA for Management functions - Integrated automation through bus structure at the different levels.ISA95 pyramid		
Unit – II	**Field Level Equipment-Sensors:**	**9+3**
Field level equipment – Sensors and measurement systems for Temperature, Pressure, Force, Displacement and speed measurement - Flow measurement techniques – Measurement of level, humidity, pH. Retro reflective sensor applications in conveyors		
Unit – III	**Field Level Equipment- Actuators:**	**9+3**
Introduction to Actuators – solenoids, on/off valves-Proportional Flow Control Valves – Hydraulic Actuator Systems – Principles, Components and Symbols – Pumps, fans and Motors – Pneumatic Control Systems – System Components-Integrated Control Systems using Smart sensors, Hart communication protocol.		
Unit – IV	**Process Controls:**	**9+3**
Introduction to process control – Automatic Process Control – Need for Automatic Process Control in Industry – Mathematical Modeling of Processes – First, Second and Higher Order Process Systems – Feed Forward Control – Cascade Control – Ratio Control – Selective Control Systems – Split-Range Control – Adaptive Controls – Inferential Control – Interacting Control Systems – Multi Variable Control.Stack light control and its sequence operations based on machine status		
Unit – V	**PLC and IIoT**	**9+3**
Introduction to PLC-s, PLC-s and Relay controls – PLC processor modules -input/output modules – Parallel /Local and Serial / Remote I/O modules-power supplies for I/O modules – Selection of PLC based on I/O counts and Scan times, PLC programming Languages – Ladder logic, functional block diagram-On/ Off logic functions, timer / counter Introduction to Profibus, Profinet, Modbus and MQTT		
		Lecture:45, Tutorial:15, Total:60

TEXT BOOK:

1.	Krishnaswamy K, “Process Control”, 2nd Edition, New Age International(P) Ltd, NewDelhi, 2015 for Units I, II, III, IV
2.	Frank D. Petruzella, “Programmable Logic Controllers”, 5th edition, McGraw Hill, New Delhi, 2019 for Unit V.

REFERENCES:

1.	NPTEL web book on Industrial Automation and controls by Mr. S.Mukhopadhyay and Mr.S.Sen of IIT, Kharagpur.
2.	Bill Drury, “The Control Techniques Drives and Controls Handbook”, 2nd Edition, IET Power and Energy Series, 2009.
3.	Lukas, Michael P., — Distributed Control Systems‖, Van NostrandReinfold Company, 2002.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	understand the integrated industrial automation system	Understanding (K2)
CO2	utilize the Field level equipment-sensors for different industrial applications	Applying (K3)
CO3	utilize the Field level equipment-Actuators for different industrial applications	Applying (K3)
CO4	understand the Process controls in Industries	Understanding (K2)
CO5	apply the concepts of PLC in control oriented 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			1		
CO2	3	2	1	1			1		1			1		
CO3	3	2	1	1			1		1			1		
CO4	3	1					1		1			1		
CO5	3	2	1	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	20	50	30				100
CAT2	20	40	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)

22EEO12 – ELECTRIC VEHICLE							
(Offered by Department of Electrical and Electronics Engineering)							
Programme & Branch	**All BE/BTech Branches except EEE**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**7**	**OE**	**3**	**0**	**0**	**3**

Preamble	This course is aimed to introduce the fundamental concepts and principles of various Electric Vehicle technologies with an insight into configuration, propulsion system, energy sources and hybrid electric vehicles	
Unit – I	**Introduction to EVs:**	**9**
Importance of Different Transportation Development Strategies to Future Oil Supply - History of EVs - General Description of Vehicle Movement - Configurations of EVs - Performance of EVs: Traction Motor Characteristics - Tractive Effort and Transmission Requirement - Vehicle Performance - Tractive Effort in Normal Driving - Energy Consumption.		
Unit – II	**Electric Propulsion Systems:**	**9**
Induction Motor Drives: Basic Operation Principles of Induction Motors - Power Electronic Control - Field Orientation Control - Voltage Source Inverter for FOC - Permanent Magnetic BLDC Motor Drives: Basic Principles of BLDC Motor Drives - BLDC Machine Construction and Classification - SRM Drives: Basic Magnetic Structure - Modes of Operation - Sensor less Control.		
Unit – III	**Power Sources and Energy Storages:**	**9**
Electrochemical Batteries: Electrochemical Reactions - Thermodynamic Voltage - Specific Energy - Specific Power - Energy Efficiency - Battery Technologies - Lead–Acid Battery - Nickel-Based Batteries - Lithium-Based Batteries – Ultracapacitors - Ultra-High-Speed Flywheels - Hybridization of Energy Storage.		
Unit – IV	**Hybrid Electric Vehicles:**	**9**
Concept of Hybrid Electric Drive Trains - Architectures of Hybrid Electric Drive Trains: Series Hybrid Electric Drive Trains (Electrical Coupling) - Parallel Hybrid Electric Drive Trains (Mechanical Coupling) - Hybrid Drive Trains with Both Torque and Speed Coupling.		
Unit – V	**Fuel Cell Hybrid Electric Drive Train:**	**9**
Operating Principles of Fuel Cells - Fuel Cell System Characteristics - Fuel Cell Technologies - Fuel Supply - Fuel Cell Hybrid Electric Drive Train Design: Configuration - Control Strategy - Parametric Design.		
		Total:45

TEXT BOOK:

1.	MehrdedEhsani, YiminGao& Ali Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory and Design", 2nd Edition, CRC Press, USA, 2010.

REFERENCES:

1.	IqbalHussain, "Electric and Hybrid Vehicles: Design Fundamentals", 2nd Edition, CRC Press, USA, 2011.
2.	Chris Mi, AbulMasrur M & David WenzhongGao, "Hybrid Electric Vehicles Principles And Applications With Practical Perspectives", 1st Edition, Wiley Publication, UK, 2011.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	explain the importance and different configurations of electric vehicles	Understanding (K2)
CO2	distinguish the characteristics of various motor drives for EVs	Understanding (K2)
CO3	identify the importance of energy storage systems in EVs	Applying (K3)
CO4	illustrate the concept of hybrid electric drive trains	Applying (K3)
CO5	demonstrate the concept of fuel cell drive train in Hybrid EVs	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			1		
CO2	3	2	1	1		1	1		1			1		
CO3	2	3	1	1		1	1		1			1		
CO4	3	2		1		1	1		1			1		
CO5	3	2	1	1		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	40	60					100
CAT2	30	40	30				100
CAT3	20	40	40				100
ESE	30	40	30				100

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

22EEO13 – E-WASTE MANAGEMENT

(Offered by Department of Electrical and Electronics Engineering)

Programme & Branch	**All BE/BTech Branches except EEE**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**7**	**OE**	**3**	**0**	**0**	**3**

Preamble	This course covers various aspects of Waste from Electrical and Electronic Equipment, E-waste disposal along with recycling with an integrated approach. It also gives an insight into the management of special waste and domestic hazardous waste.

Unit – I	**Introduction**	**9**

Waste Electrical and Electronic Equipment (WEEE) - The Scale of the Problem - Electronics Recycling - Treatment Options for WEEE - Material Composition of WEEE - Socio-economic Factors - International Perspective - Barriers to Recycle - Health and Safety Implications – Influence factors - Materials Used in Manufacturing Electrical and Electronic Products - Soldering and the Move to Lead-free Assembly - Printed Circuit Board Materials - Mobile Phones – Televisions - WEEE Engineering Thermoplastics.

Unit – II	**Waste Disposal and Recycling**	**9**

Introduction - Landfill - Pollution from Landfills - Landfill Gas - Landfill-site Construction – Burning - Energy Recovery/Energy from Waste (EFW) - Advanced Thermal Processing - Pollution from Incineration – Recycling and recovery: Separation and Sorting – Treatment - Outputs and Markets - Emerging Technologies – Separation – Treatments – Extraction.

Unit – III	**Integrated Approach to E-waste Recycling**	**9**

Introduction - Recycling and Recovery Technologies - Sorting/Disassembly - Crushing/Diminution - Separation - Emerging Recycling and Recovery Technologies - Automated Disassembly - Comminution – Separation - Thermal Treatments - Hydrometallurgical Extraction - Dry Capture Technologies - Biotechnological Capture - Sensing Technologies - Design for Recycling and Inverse Manufacturing - Printed Circuit Boards - Recycling - Characteristics of PCB Scrap - Emerging Technologies - Sector-based Eco-design

Unit – IV	**Recycling of Display Devices and ERP**	**9**

Introduction - Overview of Liquid Crystals - Classification - Architecture - Liquid Crystal Displays Based on Nematic Mesophase - Manufacturing Process – Environmental Lifecycle Analysis – Toxicity of LCD Constituents – Recycling. European Recycling Platform (ERP): Founding Principles – Structure - Scope of services - Operational Model - Key Performance Indicators.

Unit – V	**Special Waste & Domestic Hazardous Waste Management**	**9**

Introduction - Existing Rules for the management of wastes - Guidance from the Integrated Solid Waste Management (ISWM) Hierarchy - Plastic Waste - Bio-medical Waste - Slaughterhouse Waste – E-Waste Management rules 2016 - Waste Tyres - Lead Battery Waste - Action Points for Awareness Generation.

Total:45

TEXT BOOK:

1.	Hester R.E., Harrison R.M., “Electronic waste management”, 1st Edition, Royal Society of Chemistry (RSC) publishers, Cambridge-UK, 2009
2.	“Municipal Solid waste Management Manual Part II”, 1st Edition, CPHEEO, Ministry of Urban Development, Govt. of. India, New Delhi, 2016

REFERENCES:

1.	Johri R., “E-waste: implications, regulations, and management in India and current global best practices”, 1st Edition, TERI Press, New Delhi, 2008.
2.	Tchobanoglous G., Theisen H., Viquel S.A., “Integrated Solid Waste Management: Engineering, Principles and Management issues”, 1st Edition, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2014.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	understand the challenges and issues of E-wastes and its source of emerging with its barriers for recycling it.	Understanding (K2)
CO2	infer handling and processing the E wastes and its disposal & recovery.	Understanding (K2)
CO3	apply the treatment methods for the E waste recycling technologies.	Applying (K3)
CO4	understand the recycling procedures of LCD devices and infer the European Recycling Platform scheme	Understanding (K2)
CO5	utilize the waste disposal management rules and guidance for handling the special wastes and domestic hazardous waste management.	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					1		
CO3	3	2	1	1		1						1		
CO4	3	1				1	2					1		
CO5	3	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	50	50					100
CAT2	30	50	20				100
CAT3	30	50	20				100
ESE	30	50	20				100

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

22EEO14 - EMBEDDED SYSTEMS AND IOT

(Offered by Department of Electrical and Electronics Engineering)

Programme& Branch	**All BE/BTech Branches except EEE**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**7**	**OE**	**3**	**0**	**0**	**3**

Preamble	This course imparts knowledge about the Building Blocks of Embedded System along with various networking protocols and provides a brief idea of IoT architecture and its related protocols towards building an IoT infrastructure.

Unit – I	**Introduction to Embedded Systems:**	**9**

Introduction to Embedded Systems – Structural units in Embedded processor, selection of processor & memory devices – DMA – Memory management methods – Timer and Counting devices, Watchdog Timer, Real Time Clock, In circuit emulator, Target Hardware Debugging.

Unit – II	**Embedded Networking Protocols:**	**9**

Embedded Networking: Introduction, I/O Device Ports & Buses – Serial Bus communication protocols: RS232 standard – RS422 – RS 485 – CAN Bus – Serial Peripheral Interface (SPI) – Inter Integrated Circuits (I2C) – Need for device drivers.

Unit – III	**Evolution of Internet of Things:**	**9**

Enabling Technologies – IoT Architectures & its Security aspects: oneM2M, IoT World Forum (IoTWF) and Alternative IoT models – Simplified IoT Architecture and Core IoT Functional Stack – Fog, Edge and Cloud in IoT – Functional blocks of an IoT ecosystem – Sensors, Actuators, Smart Objects and Connecting Smart Objects – Case study: Role of IoT in the implementation of Smart cities.

Unit – IV	**IoT Access Technologies:**	**9**

Physical and MAC layers, topology and Security of IEEE 802.15.4, 802.15.4g, 802.15.4e, 1901.2a,802.11ah and LoRaWAN – Network Layer: IP versions, Constrained Nodes and Constrained Networks – Optimizing IP for IoT:From 6LoWPAN to 6Lo, Routing over Low Power and Lossy Networks – Application Transport Methods: Supervisory Control andData Acquisition – Application Layer Protocols: CoAP and MQTT.

Unit – V	**Design Methodology:**	**9**

Embedded computing logic – Microcontroller, System on Chips - IoT system building blocks – Arduino –Board details, IDE programming – Raspberry Pi – Interfaces and Raspberry Pi with Python Programming.

Total:45

TEXT BOOK:

1.	KamalR,“Embeddedsystems:architecture,programminganddesign”,second edition,TataMcGraw-HillEducation,NewDelhi,2011 for Units I, II
2.	Hanes D, Salgueiro G, Grossetete P, Barton R & Henry J, “IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things”, 1st Edition, Cisco Press, United States, 2017 for Units III, IV and V.

REFERENCES:

1.	Hersent O, Boswarthick D &Elloumi O, “The Internet of Things – Key applications and Protocols”, 1st Edition, Wiley & Sons, United States, 2012.
2.	Margolis M, Jepson B & Weldin N.R, “Arduino cookbook: recipes to begin, expand, and enhance your projects”, 3rd Edition, O'Reilly Media, United States, 2020.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	explain the basic building blocks of embedded systems.	Understanding(K2)
CO2	Identify and distinguish the various communication protocols of embedded system.	Applying(K3)
CO3	explain the concept of IoT and role of smart objects in IoT.	Understanding(K2)
CO4	select various protocols for establishing IoT infrastructure.	Applying(K3)
CO5	design and build an IoT system using Rasperry Pi/Arduino.	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	1									
CO2	3	2	2	2	1									
CO3	3	1	3	2	1									
CO4	3	2	3	2	1									
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	10	60	30				100
CAT2	10	50	40				100
CAT3	10	40	50				100
ESE	10	40	50				100

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

22EEO15 - ENERGY STORAGE SYSTEMS AND CONTROLLERS							
(Offered by Department of Electrical and Electronics Engineering)							
Programme& Branch	**All BE/BTech Branches except EEE**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**7**	**OE**	**3**	**0**	**0**	**3**
Preamble	This course aimed to introduce the fundamental concepts and principles of various energy storage systems that aids in various real time applications.						
Unit – I	**Introduction to Energy Storage Systems:**						**9**
Overview of energy storage systems (ESS) - Historical context of ESS - Drivers for ESS deployment - Classification of ESS technologies - Battery: Components of Cells and Batteries – Classification - Operation of a Cell - Theoretical Cell Voltage, Capacity, and Energy							
Unit – II	**Electrochemical and Mechanical Energy Storage Technologies:**						**9**
Electrochemical Energy Storage Systems: Construction, operation and Working Principle of Lithium-ion, Sodium-ion, Solid-state batteries **Mechanical Energy Storage Systems**: Construction, operation and Working Principle of Pumped Hydro Storage (PHS) - Compressed Air Energy Storage (CAES) - Flywheel Energy Storage Systems (FESS)							
Unit – III	**Other Energy Storage Technologies:**						**9**
Ultracapacitors: Features- Basic Principles of Ultracapacitors - Hydrogen Storage Systems: Types of fuel cells -hydrogen oxygen cells, hydrogen air cell, alkaline fuel cell, and phosphoric fuel cell. -Thermal Energy Storage using Phase Change Materials (PCM)							
Unit – IV	**Energy Storage Applications:**						**9**
Grid-scale Energy Storage Applications: Load Shifting, Frequency Regulation, Voltage Support, Peak Shaving, Renewable Integration, Black Start **Distributed Energy Storage Applications**: Residential Energy Storage, Commercial Energy Storage, Electric Vehicles Charging, Micro grids							
Unit – V	**Controllers for Energy Storage Systems:**						**9**
Principles of charge controllers -Types of charge controllers-Charging strategies for energy storage systems, Battery Management Systems (BMS): Principles of BMS-Functions and components of BMS-Battery safety and performance-BMS integration with other controllers							
							Total:45

TEXT BOOK:

1.	David Linden, Thomas B. Reddy, "Handbook of Batteries", 4th Edition, McGraw-Hill, New Delhi, 2011.

REFERENCES:

1.	Mehrdad Ehsani, YiminGao, Ali Emadi, "Modern Electric, Hybrid Electric and Fuel Cell Vehicle", 2nd Edition, CRC Press, New Delhi, 2018.
2.	Nihal Kularatna, Kosala Gunawardane, “Energy Storage Devices for Renewable Energy-Based Systems”, 2nd Edition, Elseivier, 2021
3.	Sandeep Dhundhara, Yajvender Pal Verma, “Energy Storage for Modern Power System Operations”, Wiley, 2021

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	understand the basics of energy storage systems and battery.	Understanding (K2)
CO2	summarize the construction and selection of battery.	Understanding (K2)
CO3	describe the construction and working principle of secondary batteries.	Understanding (K2)
CO4	explain the construction and working principle of Ultra capacitor and Fuel cell	Applying (K3)
CO5	identify the different types of controllers used in energy storage systems and their roles in managing the flow of energy.	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		
CO2	3	2	2			1			1		1	1		
CO3	2	1	3			1			1		1	1		
CO4	3	2	1			1			1		1	1		
CO5	2	1	3			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	30	70	-	-	-	-	100
CAT2	30	70	-	-	-	-	100
CAT3	30	50	20	-	-	-	100
ESE	10	70	20	-	-	-	100

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

22EEO16 – AI TECHNIQUES IN ENGINEERING APPLICATIONS							
(Offered by Department of Electrical and Electronics Engineering)							
Programme & Branch	**All BE/BTech Branches except EEE**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**7**	**OE**	**3**	**0**	**0**	**3**

Preamble	This course enables the students to learn and apply the Artificial Intelligence techniques on real time applications.	
Unit – I	**Robotics in Engineering:**	**9**
Introduction to Robotics and AI integration - Evolution of Robotics in Engineering- Types of Robots and their Applications - AI Algorithms for Robot Control - Collaborative Robotics and Human-Robot Interaction		
Unit – II	**AI in Manufacturing:**	**9**
Introduction to AI in Manufacturing - Enhancing Production Processes with AI - Quality Control and Defect Detection using AI - AI-driven Supply Chain Optimization - Predictive Maintenance and Cost Reduction in Manufacturing		
Unit – III	**Logistics and Supply Chain Management (SCM) With AI:**	**9**
Overview of Logistics and SCM- AI Applications in Transportation and Route Optimization - Demand Forecasting and Inventory Management using AI - AI for Predicting Delays and Improving Efficiency - Case Studies: AI Implementation in Supply Chains		
Unit – IV	**Autonomous Systems and Applications:**	**9**
Understanding Autonomous Systems and AI- AI in Self-Driving Vehicles and Robotics- AI in Autonomous Drones and Spacecraft - Applications of AI in Autonomous Systems - Safety and Ethical Considerations for Autonomous Systems		
Unit – V	**AI in Civil and Aerospace Engineering:**	**9**
AI for Structural Design and Optimization - Predictive Analysis for Civil Engineering Projects - AI in Aerospace Design and Aerodynamics - Autonomous Aircraft and Spacecraft using AI - Case Studies: AI Implementation in Civil and Aerospace Engineering		
		Total:45

TEXT BOOK:

1.	Akhileshwar P. Tiwari and Pankaj K. Agarwal, Artificial Intelligence in Engineering: Systems and Applications, CRC Press, 2019.

REFERENCES:

1.	Akhileshwar P. Tiwari and Pankaj K. Agarwal, Machine Learning for Civil Engineering, CRC Press, 2019.
2.	Nikolaus Correll, Bradley Hayes, Introduction to Autonomous Robots: Mechanisms, Sensors, Actuators, Algorithms" The MIT Press,2022

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	understand the basic concepts of robotics and artificial intelligence	Understanding (K2)
CO2	explain how AI can be used to enhance production processes.	Understanding (K2)
CO3	describe the different ways that AI can be used in logistics and supply chain management.	Understanding (K2)
CO4	Identify the different applications of AI in autonomous systems, such as self-driving vehicles, drones, and spacecraft.	Applying (K3)
CO5	Analyze case studies of AI implementation in civil and aerospace engineering.	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	3	2	2										
CO3	3	2	1	1										
CO4	3	3	2	1										
CO5	3	2	2	2										

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

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	80					100
CAT2	20	80					100
CAT3	20	40	40				100
ESE	10	60	30				100

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

22EEO17 – SMART GRID TECHNOLOGIES

(Offered by Department of Electrical and Electronics Engineering)

Programme & Branch	**All BE/BTech Branches except EEE**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**8**	**OE**	**3**	**0**	**0**	**3**

Preamble	The course content is designed to study about micro grid standalone autonomous system, smart grid technologies, information and communication technologies. It is used to get familiarized with smart metering and control of smart grid systems. The course also aims in imparting knowledge on power electronics and energy storage.	
Unit – I	**Microgrid Concept:**	**9**
Introduction – Renewable Power Generation – Grid Connected Wind Power – Grid Connected PV Power – Microgrid Concept and Structure – Operation Modes.		
Unit – II	**Microgrid Planning and Energy Management:**	**9**
Introduction – Microgrid planning- Forecasting techniques – Energy Management – Emission reduction and Economical Optimization – Robust Energy Consumption Scheduling in Interconnected Microgrids.		
Unit – III	**Smart Grid and Communication Technologies**	**9**
Introduction to Smart grid – Smart grid initiatives – Overview of technologies required for smart grid – Information and communication technologies – Data communication – Communication technologies for smart grid – Information security for smart grid.		
Unit – IV	**Sensing, Measurement, Control and Automation Technologies:**	**9**
Smart metering and demand side integration – Distribution automation equipment – Distribution management systems – Transmission system operation.		
Unit – V	**Power Electronics and Energy Storage:**	**9**
Power electronic converters – Power electronics in smart grid – Power electronics for bulk power flows – Energy storage.		
		Total:45

TEXT BOOK:

1.	Hassan Bevrani, Bruno Francois &ToshifumiIse, “Microgrid Dynamics and Control”, 1st Edition, Wiley, 2017 for Units I, II.
2.	Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama, “Smart Grid: Technology and Applications”, 1st Edition, Wiley & Sons Ltd, 2012 for Units III, IV, V.

REFERENCES:

1.	Chowdhury S, Chowdhury S.P &Crossley P, “Microgrids and Active Distribution Networks”, 1st Edition, The Institution of Engineering and Technology, 2009.
2.	Tony Flick & Justin Morehouse, “Securing the Smart Grid Next Generation Power Grid Security”, 1st Edition, Elsevier, 2011.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	understand the concepts of micro grid.	Understanding (K2)
CO2	assess the micro grid planning and energy management	Understanding (K2)
CO3	analyze the smart grid and its communication technologies.	Applying (K3)
CO4	interpret the sensing, measurement, control and automation technologies.	Applying (K3)
CO5	examine about the power electronics in smart grid and energy storage.	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	2			3				2		
CO4	3	2			2			2				2		
CO5	3	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	40	60					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)

22EEO18 – BIOMASS ENERGY SYSTEMS							
(Offered by Department of Electrical and Electronics Engineering)							
Programme & Branch	**All BE/BTech Branches except EEE**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**8**	**OE**	**3**	**0**	**0**	**3**

Preamble	Biomass energy has evolved through chemical, biological and thermal conversion process. The requirement of learning the nuances of biomass has become significantly important and in fact, this subject addresses the need of biomass, biogas and bio diesel in a comprehensive manner.	
Unit – I	**Introduction:**	**9**
Biomass energy usage – Overall energy needs – Sources of biomass available – Units and conversions – Problems and issues – Advantages and disadvantages in use of biomass as energy source.		
Unit – II	**Biomass Conversion Process**	**9**
Overview – Chemical and biological conversion processes – Thermal conversion process – Hybrid conversion process – Application of biomass conversion products.		
Unit – III	**Biogas Production:**	**9**
Introduction – Biomass parameters in anaerobic digestion – Advantages and disadvantages of anaerobic digestion process – Biogas conversion process and digester designs – Design of biogas digester – Biogas utilization.		
Unit – IV	**Bio-Diesel Production:**	**9**
Introduction – Vegetable oil and animal fat characteristics – Fatty acid composition – Basic oil properties – Oil Extraction processes – Oil refining process – Transesterification - Engine performance and exhaust emissions.		
Unit – V	**Biomass Combustion**	**9**
Introduction – Types of biomass combustion systems – Co-combustion of biomass and co-firing with coal – Slagging and fouling issues with agricultural biomass – Determining melting point of biomass ash pellets – Applications of biomass combustion systems.		
		Total:45

TEXT BOOK:

1.	Sergio Capareda., "Introduction to Biomass Energy Conversions", 1st Edition, CRC press, India, 2013.

REFERENCES:

1.	Kothari D.P., Singal K.C., Rakesh Ranjan., "Renewable Energy Sources and Emerging Technologies", 2nd Edition, PHI Learning Pvt. Ltd., New Delhi, 2011.
2.	John Twidell, Tony Weir., "Renewable Energy Resources", 3rd Edition, Routledge, New York, 2015.
3.	Ibrahim Garbie, “Sustainability in Manufacturing Enterprises, Concepts, analyses and assessments for Industry 4.0”, Springer., Switzerland, 2016

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	explain the nature and principle of biomass energy extraction systems	Understanding (K2)
CO2	illustrate various biomass conversion process	Understanding (K2)
CO3	interpret biogas production and digester design	Applying (K3)
CO4	categorize various techniques for bio-diesel refining process	Applying (K3)
CO5	access different types of biomass combustion process	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			1	2				1	1		
CO2	2	3	2			1	1				1	1		
CO3	2	2	3			1	1				1	1		
CO4	2	2	3			1	1				1	1		
CO5	2	2	3			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	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)

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)

22GEO05 - GERMAN 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	German Language Level 1	**All**	**OE**	**4**	**0**	**0**	**4**

Preamble	This course aims to help the learner to acquire the vocabulary as per the Common European framework of German language A1 level competence. This course will help to assimilate the basic grammar structures and 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	
Unit – I	**Contacts(Kontakte):**	**12**
Understanding Letters, simple instructions, speaking about language learning, finding specific information in text, Acknowledging the theme and understanding conversations, Making appointments. Grammar – Preposition with Dative, Articles in Dative and Accusative possessive articles.		
Unit – II	**Accomodation(Die Wohnung):**	**12**
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		
Unit – III	**Are you Working?(Arbeiten Sie):**	**12**
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*		
Unit – IV	**Clothes and Style(Kleidung und mode):**	**12**
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		
Unit – V	**Health and Vacation(Gesundheit und Urlaub):**	**12**
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*		
		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.
2.	

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 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)

22GEO08 - JAPANESE 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	**Japanese Language Level 1**	**All**	**OE**	**4**	**0**	**0**	**4**

Preamble	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	
Unit – I	**Introduction to groups of verbs:**	**12**
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		
Unit – II	**Introduction to Casual Form:**	**12**
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		
Unit – III	**Express opinions and thoughts:**	**12**
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		
Unit – IV	**Introduction to If clause and remaining Kanjis:**	**12**
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		
Unit – V	**Introduction to giving and receiving with te form and "when, even if" usages:**	**12**
Providing to and getting from differences - Understanding of situations and framing sentences using when and even if..etc.		
		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	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)

22GEO12 -FRENCH 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 French Language**	**All**	**OE**	**4**	**0**	**0**	**4**
Preamble	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.						
Unit – I	**French and You**						**12**
Habits, Strengths & Weakness, Recommendations, Sentiments, Motivations, about favorite films and Types of screens in the movie world, Verbs (Regulars and irregulars), Reflexive Verbs, Prepositions							
Unit – II	**Eat and Repeat**						**12**
Favorite foods, Recopies, Types of meals, Describing House and Kitchen, Presentation of the recipe, Comparatives, Possessive pronouns, Present continuous tense, Simple conditional form							
Unit – III	**Vacation**						**12**
Invitations, presentation, Greetings, Goodbyes, Activities on vacation, past experiences, Describing favorite place, Recommendations on various tours, Past perfect, Past imperfect tense							
Unit – IV	**Likes and Views**						**12**
Favorite persons & things, Giving advice, Experience, Moods, Illness, Discomforts, Symptoms, Roleplay (Doctor & Patient, Guide & Tourist, Pharmacist & Patient), Past perfect, Past indefinite, Imperative							
Unit – V	**Then and Now**						**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.	A2 – 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 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)

22GEO16 - SPANISH 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 Spanish Language**	**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. It almost gives a basic idea on how Natives speak.

Unit – I	**Start Over(Volver a Empezar)**	**9**
Use of periphrases, Discuss a day in life, work, problems in the world, Predictions about future (actions and situations),Hypothetical situations, Imperfect and future tense.		
Unit – II	**Prohibitions and More(Prohibiciones y mas)**	**9**
Prohibitions, Obligations, Habits to change, social customs, Use of subjunctive, Describe synopsis of Movie and its relation to real life, Debate on books vs movies, usage of connectors, Object Direct and Indirect.		
Unit – III	**Let’s be Creative (Seamoscreatives)**	**9**
Write a 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 (Viajar y comunicar)**	**9**
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.		
Unit – V	**Let’s Talk(Hablemos)**	**9**
Expression of Interests, Sentiments, Feelings, Sensations, Manias etc. Certain suggestions to make a better future, use of superlatives, Exclamatory phrases, subjunctive.		
		Total:45

TEXT BOOK:

1.	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.

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	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)

22GEO17 - ENTREPRENEURSHIP DEVELOPMENT

(Offered by Department of Mechatronics Engineering)

Programme & Branch	**All BE/BTech Engineering and Technology Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Engineering Economics & Management**	**7**	**OE**	**3**	**0**	**0**	**3**

Preamble	The purpose of this course to create entrepreneurial awareness among engineering students.	
Unit – I	**Entrepreneurship Concepts:**	**9**
Entrepreneurship & Entrepreneur- Role in Economic Development - Factors affecting Entrepreneurship- Creativity and Innovation - Entrepreneurship vs Intrapreneurship- Entrepreneurial Motivation factors – Types of Entrepreneurship & Entrepreneurs - Characteristics of Entrepreneurs - Entrepreneurship Development in India		
Unit – II	**Entrepreneurial Ventures and opportunity assessment:**	**9**
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.		
Unit – III	**Business Plan:**	**9**
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		
Unit – IV	**Financing and accounting:**	**9**
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		
Unit – V	**Small Business Management:**	**9**
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		
		Total:45

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 ELECTRICAL AND ELECTRONICS ENGINEERING

Programme : B.E & EEE
Honours Degree : Electric Vehicles

The following courses are identified to earn additional 18 credits to get a Honours degree with specialization in Electrical and Electronics Engineering

S.No	Course Code	Course Name	Credits	Prerequisites	Semester
1.	22EEJ01	Fundamentals of Electric Vehicles	4	Nil	5
2.	22EEH01	Energy Storage System	3	Nil	5
3.	22EEJ02	Basics of Automotive Engineering	4	Nil	6
4.	22EEH02	Electric Vehicle Data Acquisition system and Maintenance	3	Nil	6
5.	22EEJ03	Drives and Control of EV	4	Electrical Machines	7
		TOTAL	18		

22EEJ01-FUNDAMENTALS OF ELECTRIC VEHICLES								
Programme & Branch	**BE- Electrical and Electronics Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**5/6/7**	**HN**	**3**	**0**	**2**	**4**

Preamble	The main objective of this course is to develop a basic understanding of the concepts, principles, operation and performance of the electric vehicle. It provides knowledge about the analysis and design of electric vehicles based on the requirement. It enables the development of an electric vehicle model in software for study.	
Unit – I	**Electric Vehicles**	**9**
History, Components of Electric Vehicle, General Layout of EV, EV classification Comparison with Internal combustion Engine: Technology, Advantages &Disadvantages of EV, Overview of Tesla car.		
Unit – II	**Hybrid Electric Vehicles**	**9**
History, Components of Hybrid Electric Vehicle , General Layout of Hybrid EV, Comparison with Electric Vehicles, Advantages &Disadvantages of Hybrid EV, Overview of Toyota prius		
Unit – III	**Vehicle Fundamentals**	**9**
Vehicle resistance, Types: Rolling Resistance, grading resistance, Aerodynamic drag vehicle performance, Calculating The Acceleration Force, maximum speed, Finding The Total Tractive Effort, Torque Required On The Drive Wheel, Transmission: Differential, clutch &gear box, Braking performance		
Unit – IV	**Electric Vehicle Modelling**	**9**
Tractive Effort-Modelling Vehicle Acceleration-Acceleration performance parameters-Modelling the acceleration of an electric scooter-Modelling the acceleration of a small car-Modelling Electric Vehicle Range		
Unit – V	**Design Considerations for Electric Vehicle**	**9**
Aerodynamic Considerations-Consideration of Rolling Resistance-Transmission Efficiency-Consideration of Vehicle Mass-Electric Vehicle Chassis and Body Design-General Issues in Design		

LIST OF EXPERIMENTS / EXERCISES:

1.	Performance Simulation of the GM EV1
2.	Importing and Creating Driving Cycles.
3.	Simulating One Cycle
4.	Range Simulation of the GM EV1 Electric Car.
5.	Electric Scooter Range Modelling

Lecture:45, Practical:30, Total:75

TEXT BOOK:

1.	James Larminie, John Lowry, “Electric Vehicle Technology Explained”, 2nd Edition, Wiley, 2012

REFERENCES:

1.	MehrdadEhsani, YimiGao, Sebastian E. Gay, Ali Emadi, “Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design”, 3rd Edition, CRC Press, 2018
2.	Iqbal Hussain., “Electric and Hybrid Vehicles: Design Fundamentals”, 3rd Edition, CRC press, Taylor & Francis Group, Florida, United States, 2021
3.	Laboratory Manual

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped** **(Highest Level)**
CO1	explain the overview of Electric Vehicle and Examine the performance of an electric vehicle using a software tool	Applying (K3) Precision (S3)
CO2	explain the overview of Hybrid Electric Vehicle and Demonstrate the driving cycles and analyze the performance of an electric car	Applying (K3) Precision (S3)
CO3	illustrate the fundamental terminologies of Electric vehicle	Applying (K3) Precision (S3)
CO4	demonstrate a basic electric vehicle model	Applying (K3) Precision (S3)
CO5	design an electric vehicle based on the requirement and execute the range modeling of an electric scooter	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									2	3
CO2	3	2	1	1									2	3
CO3	3	1											2	3
CO4	3	1											2	3
CO5	3	2	1	1									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	10	80	10				100
CAT2	10	80	10				100
CAT3	10	75	15				100
ESE	10	80	10				100

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

22EEH01 – ENERGY STORAGE SYSTEMS

Programme& Branch	BE & Electrical and Electronics Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	**Nil**	**5/6/7**	**HN**	**3**	**0**	**0**	**3**

Preamble	This course aims in imparting the fundamental concepts and principles of various energy storage systems.

Unit – I	Introduction to Energy Storage Systems:	**9**
Introduction – Need of energy storage systems - Basic Concepts: Components of Cells and Batteries – Classification – Operation of a cell – Theoretical Cell Voltage, Capacity and Energy. Electrochemical Principles and Reactions: Cell Polarization – Electrical Double Layer Capacity and Ionic Adsorption – Parameters of Batteries – Comparison of various Rechargeable Batteries.		
Unit – II	Design and Selection of Battery:	**9**
Designing to Eliminate Potential Safety Problems – Battery Safeguards when using Discrete Batteries – Battery Construction – Factors Affecting Battery Performance – Major Consideration in Selecting a Battery – Applications of Battery.		
Unit – III	Primary and Secondary Batteries:	**9**
General characteristics and Applications of Primary Batteries – Types and Characteristics of Primary and Secondary Batteries – Zinc Chloride Lithium Battery – Nickel Cadmium – Lead Acid – Classifications of reserve batteries.		
Unit – IV	Advanced Batteries for Emerging Applications:	**9**
Advanced Rechargeable Batteries – General Characteristics – Characteristics of lithium rechargeable Batteries – Zinc/Air Batteries: Portable Primary Zinc/Air Battery – Zinc/Bromine Batteries: Advantages and Disadvantages – Electrochemical System of three-cell Zinc/Bromine Battery – Lithium/Ion Sulfide Batteries: General characteristics – Performance.		
Unit – V	Fuel Cells and Ultra Capacitors:	**9**
Fuel Cells: General Characteristics – Operating Principles of Fuel Cells – Fuel Processing and storage configurations. Electrochemical capacitors: Chemistry and materials properties – Performance characteristics of devices.		
		Total:45

TEXT BOOK:

1.	David Linden, Thomas B.Reddy, “Handbook of Batteries”, 4th Edition.\, McGraw-Hill, New Delhi, 2011.

REFERENCES:

1.	Mehrdad Ehsani, YiminGao, Ali Emadi, “Modern Electric, Hybrid Electric and Fuel Cell Vehicle”, 2nd Edition, CRC Press, New Delhi, 2010.
2.	James Larminie, Andrew Dick, “Fuel Cell System Explained”, 2nd Edition, J.Wiley, New Jersy, 2003.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	Explain the various aspects and performance of battery technologies	Understand (K2)
CO2	Understand the performance of batteries and their design aspects	Understand (K2)
CO3	Conceptualize the principles of Primary and Secondary batteries	Understand (K2)
CO4	Apply the requirement of advanced batteries for emerging applications	Applying (K3)
CO5	Illustrate the concepts & principles of fuel cells and ultra-capacitors	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										3	2
CO2	3	2	2										3	2
CO3	2	1	3										3	2
CO4	3	2	1										2	3
CO5	2	1	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	80	--	--	--	--	100
CAT2	20	80	--	--	--	--	100
CAT3	10	60	30	--	--	--	100
ESE	10	70	20	--	--	--	100

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

22EEJ02 - BASICS OF AUTOMOTIVE ENGINEERING

Programme & Branch	B.E & Electrical and Electronics Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	5/6/7	HN	3	0	2	4

Preamble	This course provides the knowledge on working principle of automotive components and various alternative fuel resources recommended for automotive engines.	
Unit – I	**Engines and Exhaust systems**	**9**

Engine components: Cylinder block – Cylinder head – Sump – Manifolds – Gaskets – Cylinder - Piston – Rings – Connecting rod – Piston pins – Crank shaft – Bearings – Valves – Mufflers. Simple Carburetor, Port and Valve Timing diagram, Engine cooling and Lubrication systems, MPFI and CRDI.Exhaust systems – SCR, EGR, Catalytic converter, DeNox Trap, Emission standards in India.

Unit – II	**Transmission Systems**	**9**

Clutch – Types and Construction – Clutch operation: Electromagnetic – Mechanical – Hydraulic – Vacuum. Gear Boxes: Manual and Automatic – Simple Floor Mounted Shift Mechanism, CVT, Dual Clutch transmission. – Over Drives – Transfer Box - Fluid flywheel - Torque converter – Propeller shaft – Slip Joint – Universal Joints – Differential and Rear Axle.

Unit – III	**Steering, Brakes and Suspension**	**9**

Wheels and Tyres – Wheel Alignment Parameters. Steering: Steering Geometry - Types of steering gear box – Davis and Ackermann steering mechanism - Power Steering – Electronic Steering. Types of Front Axle. Suspension systems: Types of suspension springs - Shock absorbers. Braking Systems: Types and Construction – Hydraulic brakes – Air brakes - Antilock Braking System.

Unit – IV	**Chassis Frame, Battery and Lighting System**	**9**

Chassis construction – Truck chassis, Four wheel drive chassis, Body on frame, semi integral and integral type, Loads acting on frame. Types of batteries - Construction, Operation and Maintenance. Electrical systems: Lighting – Wiring circuit.

Unit – V	**Automotive accessories and Alternate Energy Sources**	**9**

Head lights – Switches – Indicating lights. Accessories: Direction indicators – Windscreen wiper – Horn – Speedometer – Heaters – Air conditioner , Use of Natural Gas, LPG, CNG, LPG, Bio diesel, Shale gas, Liquid nitrogen, Ethanol and Hydrogen in Automobiles - Fuel Cells.

LIST OF EXPERIMENTS / EXERCISES:

1.	Dismantling and Assembling of Two stroke Petrol Engine
2.	Dismantling and Assembling of Four Stroke Petrol Engine
3.	Dismantling and Assembling of Four Stroke Diesel Engine
4.	Dismantling and Assembling of Constant Mesh Gear Box
5.	Dismantling and Assembling of Synchromesh Gear Box
6.	Dismantling and Assembling of Differential and Live Axles
7.	Dismantling and Assembling of Hydraulic and Pneumatic Braking Systems
8.	Dismantling and Assembling of Re-circulating Ball and Rack & Pinion Steering Systems
9.	Fault diagnosis in Automotive Electrical Wiring Circuit
10.	Dismantling and Assembling of Horn, Wiper and Starter Motor

Lecture:45, Practical:30, Total:75

TEXT BOOK:

1.	Kirpal Singh, “Automobile Engineering”, 13th Edition, Volume I & II, Standard Publishers, New Delhi, 2017.

REFERENCES/ MANUAL / SOFTWARE:

1.	Ganesan V., “Internal Combustion Engines”, 4th Edition, Tata McGraw-Hill, New Delhi, 2017.

2. Tom Denton, “Automobile Electrical and Electronics Systems”, 4th Edition, Edward Arnold Publishers, 2013.

3. Lab Manual

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	identify the IC engine components and exhaust system along with its function	Understanding (K2) Manipulation (S2)
CO2	categorize the types of transmission system	Applying (K3) Precision (S3)
CO3	select appropriate suspension, brake and steering systems for automobile applications	Applying (K3) Precision (S3)
CO4	illustrate the types of chassis and circuit for automotive electrical systems	Applying (K3) Precision (S3)
CO5	analyze the use of automotive accessories and alternate fuel sources recommended for automobiles	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		2								**2**	**3**
CO2	3	3	2										**2**	**3**
CO3	3	2	1		2								**2**	**3**
CO4	3	2	1										**2**	**3**
CO5	3	3	2		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	20	60	20				100
ESE	20	60	20				100

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

22EEH02 - ELECTRIC VEHICLE DATA ACQUISITION SYSTEM AND MAINTENANCE

Programme & Branch	**BE- Electrical and Electronics Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**5/6/7**	**HN**	**3**	**0**	**0**	**3**

Preamble	This course deals with fundamentals of electronic, electrical systems required for Electric Vehicle along with the details of automotive sensors controlled by On-board Diagnostic with the aid Controller Area Network Bus also covers the power control module interaction with sensors and on-board diagnostic tool.

Unit – I	**Automotive Sensors:**	**9**

Temperature Sensors-Engine Coolant Temperature (ECT)-Intake Air Temperature (IAT)-Throttle Position Sensors-Manifold Absolute Pressure (MAP) Sensors-Barometric (BARO) Sensors-Mass Air Flow (MAF) Sensors-Oxygen Sensors-Heated Oxygen Sensors-Rain Sensor-Electronic Control of Fuel Injection System-Air Fuel Sensors-Fuel Level Sensors-Troubleshooting of Sensors.

Unit – II	**Controller Area Network Bus System:**	**9**

Introduction-Terminating Resistor-Controller Area Network (CAN) Protocols-ISO9131-2-ISO13230-4-ISO15765-3-SAE J2480-J1859 PWM (Class B)-J1859 VPW-Classes of Controller Area Network-Controller Area Network Bus Digital Signals-No Network Communication Diagnosis-Data Link Connector.

Unit – III	**Electrical System Diagnostics:**	**9**

Electronic Components & Circuits-Introduction-Multiplexing Diagnostics-Lighting Diagnostics- Auxiliary System Diagnostics-In Car Entertainment (ICE) Security and Communication Diagnostics-Body Electrical System Diagnostics- Instrumentation Diagnostics-Heating Ventilation and Air Conditioning (HVAC) Diagnostics- Cruise Control Diagnostics-Air Bag and Belt Tensioners Diagnostics

Unit – IV	**On-board Diagnostics:**	**9**

Introduction to On-board Diagnostics(OBD) -Gasoline On-board Diagnostic Monitors-Misfire Detection-Driving Cycles-Future Developments in OBD-OBDI-OBDII- OBDII Monitors-Malfunction Indicator Lamp (MIL)-Diagnostic Trouble Codes (DTC)-DTC Numbering System-Freeze Frame Data-Scan Tool.

Unit – V	**Power Control Module:**	**9**

Power Control Module (PCM) and Sensor Interactions-Body Control Module (BCM)& PCM difference-Antilocking Braking System (ABS) Module-PCM Architecture-Hexacodes for PCM Input-Memories of PCM-Reprogramming PCM-Types of Fuel Trim-PCM Interaction in Air/Fuel Ratio-PCM Controlled Evaporative Emission Controls (EVAP) System-Exhaust Gas Recirculation (EGR) System-Positive Positive Crankcase Ventilation (PCV) System.

Total:45

TEXT BOOK:

1.	Happyson Gavi, “Troubleshooting Automotive Computer Systems: Automotive Computers, Sensors & Network”, Amazon Digital Services LLC, United States, 2018.

REFERENCES:

1.	James Halderman, “Diagnosis and Troubleshooting of Automotive Electrical, Electronic and Computer Systems”,5th Edition, Pearson Prentice Hall, United States,2010.
2.	Tom Denton, “Advance Automotive Fault Diagnosis Automotive Vehicle Maintenance and Repair”, 4th Edition, Routledge Taylor & Francis Group, New York, 2017.
3.	A.K. Sawhney, Puneet Sawhney, “A Course in Electrical and Electronic Measurements and Instrumentation”,Dhanpat Rai & Co,2016.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	Understand the basic operation of sensors used in Electric Vehicle	Understanding (K2)
CO2	Illustrate the Controller Area Network Bus System	Understanding (K2)
CO3	Explain the basics of electrical system diagnostics	Understanding (K2)
CO4	Exemplify on board diagnostics	Understanding (K2)
CO5	Interpret the different power control module components	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	2											2	2
CO4	3	2											2	2
CO5	3	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	10	80	10				100
CAT2	10	80	10				100
CAT3	10	80	10				100
ESE	10	80	10				100

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

22EEJ03-DRIVES AND CONTROL FOR EV							
Programme & Branch	**BE- Electrical and Electronics Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Electrical Machines**	**5/6/7**	**HN**	**3**	**0**	**2**	**4**

Preamble	This course provides a comprehensive discussion on machines and drives for pure electric, hybrid, and fuel-cell vehicles, including both electric propulsion and hybrid propulsion. The corresponding motor drives for electric propulsion range from the existing types, namely the DC, induction, permanent magnet (PM) brushless, and switched reluctance motor drives, to the advanced types which are extensively discussed in this course.	
Unit – I	**DC Motor drives**	**9**
System configurations - DC motor control: speed control and Regenerative braking. Design criteria for DC motor drives for EVs-Design Example – Application examples of DC motor drives in EVs.		
Unit – II	**Induction Motor drives**	**9**
System configurations – Inverters for induction motors – Induction motor control: VVVF control, FOC and DTC. Design criteria for induction motor drives for EVs- Design Example – Application examples of induction motor drives in EVs.		
Unit – III	**Permanent Magnet Brushless Motor drives**	**9**
Permanent magnet materials - System configurations - Inverters for PMBL motors - PMBL motor control: PMSM control and PMBLDC motor control. Design criteria for PMBL motor drives for EVs- Design Example – Application examples of PMBL motor drives in EVs.		
Unit – IV	**Switched Reluctance Motor drives**	**9**
System configurations – SR converters - SR motor control: speed control, Torque ripple minimization control and position sensorless control. Design criteria for SR motor drives for EVs- Design Example – Application examples of SR motor drives in EVs.		
Unit – V	**Advanced motor drives**	**9**
Design criteria and design examples of Stator PM motor drives, Magnetic geared motor drives, vernier permanent magnet motor drives and integrated starter generator systems.		

LIST OF EXPERIMENTS / EXERCISES:

1.	Conversion of AC-DC for plugin hybrid vehicles
2.	Closed loop DC motor control for EV
3.	Control of an induction motor for EV
4.	Control of special electrical drives for EV

Lecture:45, Practical:30, Total:75

TEXT BOOK:

1. Chau K.T., Electric vehicle Machines and drives- Design, analysis and application, Wiley, IEEE Press, 2015

REFERENCES/ MANUAL / SOFTWARE:

1. Dubey G.K., Fundamentals of Electrical Drives, Narosa Publishing House, New Delhi, 2013.
2. L.Ashok Kumar, and S.Albert Alexander, Power Converters for Electric Vehicles. CRC Press, 2020.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	evaluate the performance of DC drives for EV	Applying (K3) Precision (S3)
CO2	understand the operation and control of AC drives for EV and Convert AC-DC for plugin hybrid vehicles	Applying (K3) Precision (S3)
CO3	choose the control techniques employed for PM motor drives for EV and Implement closed loop DC motor control for EV	Applying (K3) Precision (S3)
CO4	Implement the control technique for SR drives for EV	Applying (K3) Precision (S3)
CO5	Apply the advanced drives and control for EV and control of an induction motor and special electrical drives for EV	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**
CO2	3	3	3										**2**	**3**
CO3	3	3	3										**2**	**3**
CO4	3	3	3										**2**	**3**
CO5	3	3	3										**2**	**3**

1 – 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	30	30	40				100

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