KONGU ENGINEERING COLLEGE

(Autonomous Institution Affiliated to Anna University, Chennai)

PERUNDURAI ERODE – 638 060

TAMILNADU INDIA

Estd : 1984

REGULATIONS, CURRICULUM & SYLLABI - 2020

(CHOICE BASED CREDIT SYSTEM AND OUTCOME BASED EDUCATION)

(For the students admitted during 2020 - 2021)

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 development and dissemination of knowledge in Electrical and Electronics Engineering to benefit the society in the National and global level.

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, analyse and design products in core domains namely power, control and energy to meet the ever-changing demands of industry and society.
PSO2	Develop expertise to apply and control the conventional and non-conventional electrical systems for specific requirements.

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 2020

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 2020 – 2021 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" means authorized person who is responsible for all examination related activities of the College.

xi. "Head of the Department" means Head of the Department concerned of the College.

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 in relevant branches of study.

(OR)

The candidates who hold a BSc degree (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 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, 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

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, Comprehensive Test & Viva, Entrepreneurships/Start ups and Internship 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 169.

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 8.0 CGPA and no history of arrears during the entire programme to opt for the honours degree.

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

S. No.	Specializations for Honours degree in emerging areas	To be offered as Honours, Only for the following branches mentioned against the specialization
1.	Construction Technology	Civil Engineering
2.	Robotics	Mechanical Engineering
3.	Electric Vehicles	Mechanical Engineering
4.	Artificial Intelligence and Machine Learning	Mechatronics Engineering
5.	Electric Vehicles	Automobile Engineering
6.	Artificial Intelligence and Machine Learning	Electronics and Communication Engineering
7.	Electric Vehicles	Electrical and Electronics Engineering
8.	Control Systems and Sensors Technology	Electronics and Instrumentation Engineering
9.	Cyber Security	Computer Science and Engineering
10.	Data Science	Computer Science and Engineering
11.	Cyber Security	Information Technology
12.	Data Science	Information Technology
13.	Waste Technology	Chemical Engineering
14.	Food Processing and Management	Food Technology

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

4.3.1 Professional Skills Training/ Entrepreneurships/Start Ups

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 fifth semester and phase II in sixth 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 sixth semester vacation period. Such candidate can earn two credits for this training course in place of Professional Skills Training course II in sixth semester. He/She shall attend Professional Skills Training Phase I in fifth 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 a maximum of 2 credits per semester for two semesters each in place of either Professional Skills Training I or 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 & 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 Internships

The curriculum enables a candidate to go for full time projects 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 I Phase II 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 Value Added 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 Value Added 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.

4.4 Value Added Courses / Online Courses / Self Study Courses

The candidates may optionally undergo Value Added Courses / Online Courses / Self Study Courses as elective courses.

4.4.1 Value Added Courses: Value Added courses each with One / Two credits 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 value added 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 value added 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 eighth 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. Total number of credits of such courses during the entire programme of study cannot exceed eight.

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), 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, Project Work, Professional Skills Training / Industrial Training, Internship 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 / Practical</td><td>50</td><td>50</td></tr>
<tr><td>2.</td><td>Theory cum Practical</td><td colspan="2">The distribution of marks shall be decided based on the credit weightage assigned to theory and practical components.</td></tr>
<tr><td>3.</td><td>Professional Skills Training / / Comprehensive Test & Viva / Entrepreneurships / Start ups / Project Work 1 / Industrial Training / Mandatory Course</td><td>100</td><td>---</td></tr>
<tr><td>4.</td><td>Project Work 2 Phase I / Project Work 2 Phase II / Internships</td><td>50</td><td>50</td></tr>
<tr><td>5.</td><td>Value Added Course</td><td rowspan="2">The distribution of marks shall be decided based on the credit weightage</td><td rowspan="2">---</td></tr>
<tr><td>6.</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 50 marks and the end semester examination shall be for 50 marks. However, the end semester examinations shall be conducted for 100 marks and the marks obtained shall be reduced to 50. The continuous assessment tests shall be conducted as per the schedule laid down in the academic schedule. Three tests shall be conducted for 50 marks each and reduced to 30 marks each. 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	30	Average of best two
	Test - II	30	
	Test - III	30	
2.	Tutorial	15	Should be of Open Book/Objective Type. Average of best 4 (or more, depending on the nature of the course, as may be approved by Principal)
3.	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	50	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 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 50 marks and the end semester examination shall be for 50 marks. Every exercise / experiment shall be evaluated based on the candidate's performance during the practical class and the candidate's 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.

7.6 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 (both Phase I and 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	Guide	Review Committee (excluding guide)	Guide	Review Committee (excluding guide)	Guide	Ext. Exr.	Guide	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 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 guide 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 Phase 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:

Continuous Assessment (Max. 100 Marks)								
Zeroth Review		Review I (Max.. 20 Marks)		Review II (Max.. 30 Marks)		Review III (Max. 50 Marks)		
						Report Evaluation (Max. 20 Marks)	Viva - Voce (Max. 30 Marks)	
Review Committee	Guide	Review Committee (excluding guide)	Guide	Review Committee (excluding guide)	Guide	Review Committee	Guide	Review Committee
0	0	10	10	15	15	20	10	20

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

7.8 Professional Skills Training

Phase I training shall be conducted for minimum of 80 hours in 4th semester vacation and during 5th semester. Phase II training shall be conducted for minimum of 80 hours in 5th semester vacation and during 6th semester. The evaluation procedure shall be approved by the Principal.

7.9 Comprehensive Test/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 two credits in sixth semester respectively 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 Projects through Internships

Each candidate shall submit a brief report about the internship undergone and a certificate issued from the organization concerned at the time of Viva-voce examination to the review committee. The evaluation method shall be same as that of the Project Work II as per clause 7.6.

7.12 Value Added Course

Minimum of two assessments shall be conducted during the value added course duration by the offering department concerned.

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 SF (Satisfactory). 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 Course

A candidate shall attend and complete the induction training program of duration three weeks at the beginning of the first semester. It is mandatory for all candidates who have joined in various branches of all BE/BTech programmes. The induction training program includes the courses recommended by AICTE. Apart from this induction program, a candidate shall undergo the courses listed by AICTE as mandatory courses during their programme. No credits shall be given for such courses and shall be evaluated through continuous assessment tests only vide clause 7.1 for a maximum of 100 marks each. Since these courses have no grade points assigned, these courses will not be counted for the purpose of GPA and CGPA calculations.

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

Courses such as YVHD and UHV shall be offered to all candidates of all BE/BTech programmes. 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, but the grade awarded shall be only the lowest passing grade irrespective of the marks secured.

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.

The candidates who have failed in the courses Professional Skill Training I/II and Comprehensive Test/Viva shall be permitted to take up supplementary examinations.

15. AWARD OF LETTER GRADES

Range of % of Total Marks	Letter Grade	Grade Point
91 to 100	O (Outstanding)	10
81 to 90	A+ (Excellent)	9
71 to 80	A (Very Good)	8
61 to 70	B+ (Good)	7
50 to 60	B (Average)	6
Less than 50	RA (Reappear)	0
Satisfactory	SF	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-2020 (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 and 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 7.00

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 Honours 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 8.00

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 Kongu Engineering 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 (for 2020-21 / 2021-22 batches of students)

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	3	4	3				3		13	7.69
BS	11	11	4	4					30	17.75
ES	4	4*/8#	4	8*/4#					20	11.83
PC	4	4*	12*/13#	9*/12#	12	12	3		56	33.13
PE					3	3	12	3	21	12.42
OE				4	4			3	11	6.5
EC					2	6	3	7	18	10.65
MC				✓						
Semesterwise Total	22	23	23*/24#	25*/24#	21	21	21	13	169	100.00

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

*2020-21 batch, #2021-22 batch

CATEGORISATION OF COURSES

HUMANITIES AND SOCIAL SCIENCE INCLUDING MANAGEMENT (HS)

S. No.	Course Code	Course Name	L	T	P	C	Sem
1.	20EGT11	English Language Skills	3	0	0	3	I
2.	20EGT21	Advanced Communication Skills	3	0	0	3	II
3.	20VEC11	Yoga and Values for Holistic Development	1	0	1	1	II
4.	20EGL31	English for Workplace Communication Laboratory	0	0	2	1	III
5.	20GET31	Universal Human Values	2	0	0	2	III
6.	20GET71	Engineering Economics and Management	3	0	0	3	VII
Total Credits to be earned						**13**	

BASIC SCIENCE (BS)							
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Sem**
1.	20MAC11	Matrices and Differential Equations	3	1*	2*	4	I
2.	20PHT11	Applied Physics	3	0	0	3	I
3.	20CYT11	Applied Chemistry	3	0	0	3	I
4.	20PHL11	Physical Sciences Laboratory I	0	0	2	1	I
5.	20MAC21	Multivariable Calculus and Complex Analysis	3	1*	2*	3	II
6.	20PHT24	Materials Science and Solid State Devices	3	0	0	3	II
7.	20CYT23	Chemistry of Electronic Materials	3	0	0	3	II
8.	20PHL25	Physical Sciences Laboratory II	0	0	2	1	II
9.	20MAT32	Probability, Transforms and Partial Differential Equations	3	1	0	4	III
10.	20MAT41	Statistics and Numerical Methods	3	1	0	4	IV
Total Credits to be earned						**30**	

ENGINEERING SCIENCE (ES)							
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Sem**
1.	20EET12	Electrical Measurements and Instrumentation	3	0	0	3	I
2.	20EEL11	Electric circuits and Measurements Laboratory	0	0	2	1	I
3.	20MEC11	Engineering drawing	2	0	2	3	II
4.	20MEL11	Engineering Practices Laboratory	0	0	2	1	II
5.	20CSC31	Programming in C	3	0	2	4	II*/III#
6.	20CSC41	Python Programming	3	0	2	4	III*/ IV#
7.	20EET43	Generation, Transmission and Distribution	3	1	0	4	IV
Total Credits to be earned						**20**	

PROFESSIONAL CORE (PC)								
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Sem**	**Domain/ Stream**
1.	20EET11	Electric Circuits and Electron Devices	3	1	0	4	I	EL
2.	20EET21	Network Analysis	3	1	0	4	II*/III#	EL
3.	20EET31	DC Machines and Transformers	3	1	0	4	III	EM

4.	20EET32	Analog Electronics	3	0	0	3	III	EL
5.	20EET33	Digital Electronics	3	0	0	3	III*/IV#	EL
6.	20EEL31	DC Machines and Transformers Laboratory	0	0	2	1	III	EM
7.	20EEL32	Analog and Digital Electronics Laboratory	0	0	2	1	III*/IV#	EL
8.	20EEL33	Electronic Design Laboratory	0	0	2	1	III*/ IV#	EL
9.	20EET41	Synchronous and Induction Machines	3	1	0	4	IV	EM
10.	20EET42	Electromagnetic Theory	3	0	0	3	IV	PS
11.	20EEL41	Synchronous and Induction Machines Laboratory	0	0	2	1	IV	EL
12.	20EET51	Power Electronics	3	0	0	3	V	PE
13.	20EET52	Power System Analysis	3	0	0	3	V	PS
14.	20EET53	Control systems	3	0	0	3	V	CA
15.	20EEL51	Power Electronics Laboratory	0	0	2	1	V	PE
16.	20EEL52	Power System Analysis Laboratory	0	0	2	1	V	PS
17.	20EEL53	Control System Laboratory	0	0	2	1	V	CA
18.	20EET61	Microprocessor and Microcontroller	3	0	0	3	VI	EL
19.	20EET62	Electric Drives and Control	3	0	0	3	VI	PE
20.	20EET63	Signals and Systems	3	0	0	3	VI	EL
21.	20EEL61	Microprocessor and Microcontroller Laboratory	0	0	2	1	VI	EL
22.	20EEL62	Electric Drives Laboratory	0	0	2	1	VI	PE
23.	20EEL63	Power and Energy Laboratory	0	0	2	1	VI	PS
24.	20EET71	Power System Protection and Switchgear	3	0	0	3	VII	PS
Total Credits to be earned						56		

*2020-21 batch, #2021-22 batch

PROFESSIONAL ELECTIVE (PE)								
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Sem**	**Domain/ Stream**
		Elective – I						
1.	20EEE01	Power Semiconductor Devices	3	0	0	3	V	PE
2.	20EEE02	Electrical Distribution System Analysis	3	0	0	3	V	PS
3.	20EEE03	Renewable Energy System	3	0	0	3	V	ES

4.	20EEE04	Generalized Machine Theory	3	0	0	3	V	EM
5.	20EEE05	Digital System Design	3	0	0	3	V	EL
		Elective – II						
6.	20EEE06	Advanced Power Electronic Circuits	3	0	0	3	VI	PE
7.	20EEE07	Substation Engineering and Automation	3	0	0	3	VI	PS
8.	20EEE08	Biomass Energy System	3	0	0	3	VI	ES
9.	20EEE09	Special Electrical Machines	3	0	0	3	VI	EM
10.	20EEE10	VLSI Design	3	0	0	3	VI	EL
11.	20EEE11	Advanced Control Theory	3	0	0	3	VI	CA
		Elective – III						
12.	20EEE12	Design of Power Converters	3	0	0	3	VII	PE
13.	20EEE13	Restructured Power System	3	0	0	3	VII	PS
14.	20EEE14	Design, Installation and Commissioning of Solar & wind Energy Systems	3	0	0	3	VII	ES
15.	20EEE15	Advanced Electric Drives and Control	3	0	0	3	VII	EM
16.	20EEE16	Advanced Microprocessors and Microcontrollers	3	0	0	3	VII	EL
17.	20EEE17	PLC and SCADA System	3	0	0	3	VII	CA
		Elective – IV						
18.	20EEE18	Pulse Generating Circuits for Power Converters	3	0	0	3	VII	PE
19.	20EEE19	High Voltage Engineering	3	0	0	3	VII	PS
20.	20EEE20	Energy Storage Systems	3	0	0	3	VII	ES
21.	20EEE21	CAD of Electrical Machines	3	0	0	3	VII	EM
22.	20EEE22	Embedded System and IOT	3	0	0	3	VII	EL
23.	20EEE23	Computational Intelligence Techniques	3	0	0	3	VII	CA
		Elective – V						
24.	20EEE24	Power Electronic Interfaces to Renewable Energy	3	0	0	3	VII	PE
25.	20EEE25	Power System Operation and Control	3	0	0	3	VII	PS
26.	20EEE26	Microgrid	3	0	0	3	VII	ES
27.	20EEE27	Electrical Machine Design	3	0	0	3	VII	EM
28.	20EEE28	Digital Image Processing and Multi Resolution Analysis	3	0	0	3	VII	EL
29.	20EEE29	Industrial Automation	3	0	0	3	VII	CA
		Elective – VI						

30.	20EEE30	Power Quality	3	0	0	3	VIII	PE
31.	20EEE31	Smart Grid	3	0	0	3	VIII	PS
32.	20EEE32	Hybrid Electric Vehicles	3	0	0	3	VIII	ES
33.	20EEE33	Electrical Machine Control and Maintenance	3	0	0	3	VIII	EM
34.	20EEE34	Digital Signal Processors and its Applications	3	0	0	3	VIII	EL
35.	20EEE35	Electric Power Utilization	3	0	0	3	VIII	CA
Total Credits to be earned						**18**		

* Domain stream Power Electronics stream- PE, 2. Power system stream-PS, 3. Energy storage Stream- ES, 4. Electrical Machines stream-EM, 5. Electronics stream-EL,6. Controller & Automation –CA

EMPLOYABILITY ENHANCEMENT COURSES (EC)							
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Sem**
1.	20GEL51/ 20GEI51	Professional Skills Training I / Industrial Training I	-	-	-	2	V
2.	20EEP61	Project Work I	0	0	4	2	VI
3.	20GEP61	Comprehensive Test / Viva	-	-	-	2	VI
4.	20GEL61/ 20GEI61	Professional Skills Training II / Industrial Training II				2	VI
5.	20EEP71	Project Work II Phase I	0	0	6	3	VII
6.	20EEP81	Project Work II Phase II	---	---	14	7	VIII
Total Credits to be earned						**18**	

MANDATORY COURSES (MC)							
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Sem**
1.	20MNT11	Student Induction Program	-	-	-	0	I
2.	20MNT31	Environmental Science	2	0	0	0	IV
Total Credits to be earned						**0**	

***** Domain/Stream Abbreviations: AE – AUTOMATION ENGINEERING, AS – AUTONOMOUS SYSTEMS, PD – PRODUCT DESIGN, PS – PRODUCTION SYSTEMS, GE – GENERAL ENGINEERING

OPEN ELECTIVE COURSES OFFERED TO OTHER DEPARTMENTS (OE)							
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Sem**
1.	20EEO01	Solar & Wind Energy Systems	3	1	0	4	IV
2.	20EEO02	Electrical Wiring and Lighting	3	1	0	4	IV
3.	20EEO03	Electrical Safety	3	1	0	4	IV
4.	20EEO04	Energy Conservation and Management	3	1	0	4	V
5.	20EEO05	AI with MATLAB	3	1	0	4	V
6.	20EEO06	Micro Grid and Smart Grid	3	0	0	3	VI
7.	20EEO07	E-Waste Management	3	0	0	3	VI
8.	20EEO08	Electric Vehicle	3	0	0	3	VIII
9.	20GEO13	NCC Studies(Army Wing) – I	3	0	2	4	VI/VIII

KEC R2020: SCHEDULING OF COURSES – BE (Electrical and Electronics Engineering) Total Credits :169

Sem	Course1	Course2	Course3	Course4	Course5	Course6	Course7	Course8	Course9	Course10	Credits
I	20EGT11 English Language Skills (3-0-0-3)	20MAC11 Matrices and Differential Equations (3-1*- 2*-4)	20PHT11 Applied Physics (3-0-0-3)	20CYT11 Applied Chemistry (3-0-0-3)	20EET11 Electric Circuits and Electron Devices (3-1-0-4)	20EET12 Electrical Measurements and Instrumentation (3-0-0-3)	20EEL11 Electric circuits and Measurements Laboratory (0-0-2-1)	20PHL11 Physical Sciences Laboratory I (0-0-2-1)	20MNT11 Student Induction Program		**22**
II	20EGT21 Advanced Communication Skills (3-0-0-3)	20MAC21 Multivariable Calculus and Complex Analysis (3-1*- 2*-4)	20PHT24 Materials Science and Solid State Devices (3-0-0-3)	20CYT23 Chemistry of Electronic Materials (3-0-0-3)	20VEC11 Yoga and Values for Holistic Development (0-0-0-1)	20MEC11 Engineering drawing (2-0-2-3)	20EET21 Network Analysis* (3-1-0-4)/ 20CSC31- Programming in C# (3-0-2-4)	20PHL25 Physical Sciences Laboratory II (0-0-2-1)	20MEL11 Engineering Practices Laboratory (0-0-2-1)		**23**
III	20MAT32 Probability, Transforms and Partial Differential Equations (3-1-0-4)	20CSC31 Programming in C* (3-0-2-4)/ 20CSC41 Python Programming# (3-0-2-4)	20EET31 DC Machines and Transformers (3-1-0-4)	20EET32 Analog Electronics (3-0-0-3)	20EET33 Digital Electronics* (3-0-0-3)/ 20EET21 Network Analysis# (3-1-0-4)	20EEL31 DC Machines and Transformers Laboratory (0-0-2-1)	20EEL32 Analog and Digital Electronics Laboratory* (0-0-2-1)/ 20EEL33 Electronic Design Laboratory (0-0-2-1)#	20EGL31 English for Workplace Communication Laboratory (0-0-2-1	20GET31 Universal Human Values (2-0-0-2)		**23*/24#**
IV	20MAT41 Statistics and Numerical Methods (3-1-0-4)	20CSC41 Python Programming * (3-0-2-4)/ 20EET33 Digital Electronics# (3-0-0-3)	20EET41 Synchronous and Induction Machines (3-0-0-3)	20EET42 Electromagnetic Theory (3-0-0-3)	20EET43 Generation, Transmission and Distribution (3-1-0-4)	Open Elective 1 (3-1-0-4)	20EEL41 Synchronous and Induction Machines Laboratory (0-0-2-1)	20EEL33 Electronic Design Laboratory* (0-0-2-1) / 20EEL32 Analog and Digital Electronics Laboratory# (0-0-2-1)	20MNT31 Environmental Science (2-0-0-0)		**25*/24#**
V	20EET51 Power Electronics (3-0-0-3)	20EET52 Power System Analysis (3-0-0-3)	20EET53 Control systems (3-0-0-3)	Professional Elective I (3-0-0-3)	Open Elective 2 (3-1/0-0/2-4)	20EEL51 Power Electronics Laboratory (0-0-2-1)	20EEL52 Power System Analysis Laboratory (0-0-2-1)	20EEL53 Control System Laboratory (0-0-2-1)	20GEL51 Professional Skills Training I /20GEI51 Industrial Training I (0-0-0-2)		**21**
VI	20EET61 Microprocessor and Microcontroller (3-0-0-3)	20EET62 Electric Drives and Control (3-0-0-3)	20EET63 Signals and Systems (3-0-0-3)	Open Elective II (3-0-0-3)	20EEL61 Microprocessor and Microcontroller Laboratory (0-0-2-1)	20EEL62 Electric Drives Laboratory (0-0-2-1)	20EEL63 Power and Energy Laboratory (0-0-2-1)	20GEL61 Professional Skills Training II / Industrial Training II (0-0-0-2)	20GEP61 Comprehensive Test / Viva (0-0-0-2)	20EEP61 Project Work I (0-0-4-2)	**21**

VII	20GET71 Engineering Economics and Management (3-0-0-3)	20EET71 Power System and Protection and Switchgear (3-0-0-3)	Professional Elective II (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)	20EEP71 Project Work II Phase I (0-0-6-3)				**21**
VIII	Professional Elective VI (3-0-0-3)	Open Elective IV (3-0-0-3)	20EEP81 Project Work II Phase II (0-0-14-7)								**13**

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	20EGT11	English Language Skills						✓			✓	✓	✓	✓		
1	20MAC11	Matrices and Differential Equations	✓	✓	✓	✓	✓									
1	20PHT11	Applied Physics	✓	✓	✓											
1	20CYT11	Applied Chemistry	✓	✓	✓	✓										
1	20EET11	Electric Circuits and Electron Devices	✓	✓	✓	✓	✓								✓	✓
1	20EET12	Electrical Measurements and Instrumentation	✓	✓	✓	✓									✓	✓
1	20EEL11	Electric circuits and Measurements Laboratory	✓	✓	✓	✓									✓	✓
1	20PHL11	Physical Sciences Laboratory I				✓										
1	20MNT11	Student Induction Program														
2	20EGT21	Advanced Communication Skills						✓			✓	✓	✓	✓		
2	20MAC21	Multivariable Calculus and Complex Analysis	✓	✓	✓		✓									
2	20PHT24	Materials Science and Solid State Devices	✓	✓	✓											
2	20CYT23	Chemistry of Electronic Materials	✓	✓	✓	✓										
2	20VEC11	Yoga and Values for Holistic Development						✓		✓	✓			✓		
2	20MEC11	Engineering drawing	✓	✓	✓	✓						✓	✓	✓	✓	✓
2	20EET21	Network Analysis	✓	✓	✓	✓	✓								✓	✓
2	20PHL25	Physical Sciences Laboratory II			✓											
2	20MEL11	Engineering Practices Laboratory	✓		✓	✓	✓	✓			✓	✓		✓		
2	20MAT32	Probability, Transforms and Partial Differential Equations	✓	✓	✓											
3	20CSC31	Programming in C	✓	✓	✓	✓	✓				✓	✓		✓		
3	20EET31	DC Machines and Transformers	✓	✓	✓	✓	✓								✓	✓
3	20EET32	Analog Electronics	✓	✓	✓	✓									✓	✓
3	20EET33	Digital Electronics	✓	✓	✓	✓	✓								✓	✓

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
3	20EEL31	DC machines and Transformers Laboratory	✓	✓	✓	✓	✓								✓	✓
3	20EEL32	Analog and Digital Electronics Laboratory	✓	✓	✓	✓	✓	✓							✓	✓
3	20EGL31	English for Workplace Communication Laboratory									✓	✓		✓		
3	20GET31	Universal Human Values						✓	✓	✓	✓	✓				
3	20EEL33	Electronic Design Laboratory	✓	✓	✓	✓	✓	✓				✓			✓	✓
4	20MAT41	Statistics and Numerical Methods	✓	✓	✓	✓										
4	20CSC41	Python Programming	✓	✓	✓	✓										
4	20EET41	Synchronous and Induction Machines	✓	✓	✓	✓	✓								✓	✓
4	20EET42	Electromagnetic Theory	✓	✓	✓										✓	✓
4	20EET43	Generation, Transmission and Distribution	✓	✓	✓										✓	✓
4	20EEL41	Synchronous and Induction Machines Laboratory	✓	✓	✓	✓	✓								✓	✓
4	20MNT31	Environmental Science	✓	✓	✓				✓							
5	20EET51	Power Electronics	✓	✓	✓	✓									✓	✓
5	20EET52	Power System Analysis	✓	✓	✓	✓	✓								✓	✓
5	20EET53	Control systems	✓	✓	✓	✓	✓								✓	✓
5	20EEL51	Power Electronics Laboratory	✓	✓	✓	✓	✓								✓	✓
5	20EEL52	Power System Analysis Laboratory	✓	✓	✓	✓	✓								✓	✓
5	20EEL53	Control System Laboratory	✓	✓	✓	✓	✓								✓	✓
5	20GEL51/ 20GEI51	Professional Skills Training I / Industrial Training I	✓	✓				✓	✓		✓	✓	✓	✓		
6	20EET61	Microprocessor and Microcontroller	✓	✓	✓	✓	✓								✓	✓

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
6	20EET62	Electric Drives and Control	✓	✓	✓	✓									✓	✓
6	20EET63	Signals and Systems	✓	✓	✓	✓	✓								✓	✓
6	20EEL61	Microprocessor and Microcontroller Laboratory	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓	✓
6	20EEL62	Electric Drives Laboratory	✓	✓	✓	✓	✓								✓	✓
6	20EEL63	Power and Energy Laboratory	✓	✓	✓	✓									✓	✓
6	20EEP61	Project Work I	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
6	20GEL61/ 20GEI61	Professional Skills Training 2 / Industrial Training 2	✓	✓				✓	✓		✓	✓	✓	✓		
6	20GEP61	Comprehensive Test / Viva	✓	✓	✓	✓					✓	✓	✓	✓	✓	✓
7	20GET71	Engineering Economics & Management											✓			
7	20EET71	Power System Protection and Switchgear	✓	✓	✓	✓	✓								✓	✓
7	20EEP71	Project Work II Phase I	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
8	20EEP81	Project Work II Phase II	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Professional Elective Courses														
5	20EEE01	Power Semiconductor Devices	✓	✓	✓										✓	✓
5	20EEE02	Electrical Distribution System Analysis	✓	✓	✓										✓	
5	20EEE03	Renewable Energy System	✓	✓	✓				✓						✓	✓
5	20EEE04	Generalized Machine Theory	✓	✓	✓										✓	✓
5	20EEE05	Digital System Design	✓	✓	✓	✓	✓								✓	✓
6	20EEE06	Advanced Power Electronic Circuits	✓	✓	✓										✓	✓
6	20EEE07	Substation Engineering and Automation	✓	✓	✓	✓	✓								✓	✓
6	20EEE08	Biomass Energy System	✓	✓	✓				✓						✓	✓
6	20EEE09	Special Electrical Machines	✓	✓	✓	✓									✓	✓
6	20EEE10	VLSI Design	✓	✓	✓	✓									✓	✓

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
6	20EEE11	Advanced Control Theory	✓	✓	✓	✓									✓	✓
7	20EEE12	Design of Power Converters	✓	✓	✓	✓									✓	✓
7	20EEE13	Restructured Power System	✓	✓	✓	✓									✓	
7	20EEE14	Design, Installation and Commissioning of Solar & wind Energy Systems	✓	✓	✓				✓						✓	✓
7	20EEE15	Advanced Electric Drives and Control	✓	✓	✓	✓									✓	✓
7	20EEE16	Advanced Microprocessors and Microcontrollers	✓	✓	✓	✓									✓	✓
7	20EEE17	PLC and SCADA System	✓	✓	✓	✓									✓	✓
7	20EEE18	Pulse Generating Circuits for Power Converters	✓	✓	✓	✓							✓		✓	✓
7	20EEE19	High Voltage Engineering	✓	✓	✓										✓	✓
7	20EEE20	Energy Storage Systems	✓	✓	✓										✓	✓
7	20EEE21	CAD of Electrical Machines	✓	✓	✓										✓	✓
7	20EEE22	Embedded System and IOT	✓	✓	✓	✓									✓	✓
7	20EEE23	Computational Intelligence Techniques	✓	✓	✓	✓	✓								✓	✓
7	20EEE24	Power Electronic Interfaces to Renewable Energy	✓	✓	✓										✓	✓
7	20EEE25	Power System Operation and Control	✓	✓	✓	✓									✓	✓
7	20EEE26	Microgrid	✓	✓	✓				✓						✓	✓
7	20EEE27	Electrical Machine Design	✓	✓	✓	✓									✓	✓

7	20EEE28	Digital Image Processing and Multi Resolution Analysis	✓	✓	✓	✓	✓								✓	✓
7	20EEE29	Industrial Automation	✓	✓	✓	✓									✓	✓
8	20EEE30	Power Quality	✓	✓	✓	✓									✓	✓
8	20EEE31	Smart Grid	✓	✓	✓										✓	
8	20EEE32	Hybrid Electric Vehicles	✓	✓	✓	✓									✓	✓
8	20EEE33	Electrical Machine Control and Maintenance	✓	✓	✓										✓	
8	20EEE34	Digital Signal Processors and its Applications	✓	✓	✓	✓	✓								✓	✓
8	20EEE35	Electric Power Utilization	✓	✓	✓	✓									✓	✓

		Open Elective Courses														
4	20EEO01	Solar & wind energy systems	✓	✓	✓				✓							
4	20EEO02	Electrical wiring and lighting	✓	✓	✓	✓	✓									
4	20EEO03	Electrical Safety	✓	✓	✓											
5	20EEO04	Energy Conservation and Management	✓	✓	✓		✓									
6	20EEO05	AI with MATLAB	✓	✓	✓											
7	20EEO06	Micro Grid and Smart Grid	✓	✓	✓	✓										
7	20EEO07	E-Waste Management	✓	✓	✓	✓										
8	20EEO08	Electric Vehicle	✓	✓	✓	✓										
6,8	20GEO13	NCC Studies(Army Wing) – I	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				

B.E. DEGREE IN ELECTRICAL AND ELECTRONICS ENGINEERING
CURRICULUM UNDER REGULATIONS 2020

SEMESTER – I

Course Code	Course Title	Hours/ Week			Credit	Maximum Marks			Category
		L	T	P		CA	ESE	Total	
	Theory/Theory with Practical								
20EGT11	English Language Skills	3	0	0	3	50	50	100	HS
20MAC11	Matrices and Differential Equations	3	1*	2*	4	50	50	100	BS
20PHT11	Applied Physics	3	0	0	3	50	50	100	BS
20CYT11	Applied Chemistry	3	0	0	3	50	50	100	BS
20EET11	Electric Circuits and Electron Devices	3	1	0	4	50	50	100	PC
20EET12	Electrical Measurements and Instrumentation	3	0	0	3	50	50	100	ES
	Practical								
20EEL11	Electric Circuits and Measurements Laboratory	0	0	2	1	50	50	100	ES
20PHL11	Physical Sciences Laboratory I	0	0	2	1	50	50	100	BS
20MNT11	Student Induction Program #	-	-	-	0	100	0	100	MC
	Total				**22**				

Induction Training Program (including, Indian Constitution and Essence of Indian Knowledge Tradition, etc.) to be conducted at the beginning of the semester for 3 weeks

SEMESTER – II

Course Code	Course Title	Hours/ Week			Credit	Maximum Marks			Category
		L	T	P		CA	ESE	Total	
Theory/Theory with Practical									
20EGT21	Advanced communication Skills	3	0	0	3	50	50	100	HS
20MAC21	Multivariable Calculus and Complex Analysis	3	1*	2*	4	50	50	100	BS
20PHT24	Materials Science and Solid State Devices	3	0	0	3	50	50	100	BS
20CYT23	Chemistry of Electronic Materials	3	0	0	3	50	50	100	BS
20MEC11	Engineering Drawing	2	0	2	3	50	50	100	ES
20EET21/20CSC31	Network Analysis */ Programming in C #	3	1*/ 0#	0*/ 2#	4	50	50	100	PC/ES
Practical									
20MEL11	Engineering Practices Laboratory	0	0	2	1	50	50	100	ES
20PHL25	Physical Sciences Laboratory II	0	0	2	1	50	50	100	BS
20VEC11	Yoga and Values for Holistic Development	1	0	1	1	100	0	100	HS
	Total				**23**				

L – Lecture, T – Tutorial, P – Practical, C – Credits, CA – Continuous Assessment, ESE – End Semester Examination CBS – Curriculum Breakdown Structure

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B.E. DEGREE IN ELECTRICAL AND ELECTRONICS ENGINEERING

SEMESTER – III									
Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
		L	T	P		CA	ESE	Total	
Theory/Theory with Practical									
20MAT32	Probability, Transforms and Partial Differential Equations	3	1	0	4	50	50	100	BS
20CSC31/ 20CSC41	Programming in C * / Python Programming #	3	0	2	4	50	50	100	ES
20EET33/ 20EET21	Digital Electronics * / Network Analysis #	3	0/1	0	3/4	50	50	100	PC
20EET31	DC Machines and Transformers	3	1	0	4	50	50	100	PC
20EET32	Analog Electronics	3	0	0	3	50	50	100	PC
Practical / Employability Enhancement									
20EGL31	English for Workplace Communication Laboratory	0	0	2	1	50	50	100	HS
20EEL31	DC Machines and Transformers Laboratory	0	0	2	1	50	50	100	PC
20EEL32/ 20EEL33	Analog and Digital Electronics Laboratory*/ Electronic Design Laboratory#	0	0	2	1	50	50	100	PC
20GET31	Universal Human Values	2	0	0	2	100	0	100	HS
Total Credits to be earned					**23/24**				

SEMESTER – IV									
Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
		L	T	P		CA	ESE	Total	
Theory/Theory with Practical									
20MAT41	Statistics and Numerical Methods	3	1	0	4	50	50	100	BS
20CSC41/ 20EET33	Python Programming* / Digital Electronics #	3	0	2/0	4/3	50	50	100	ES/PC
20EET41	Synchronous and Induction Machines	3	1	0	4	50	50	100	PC
20EET42	Electromagnetic Theory	3	0	0	3	50	50	100	PC
20EET43	Generation, Transmission and Distribution	3	1	0	4	50	50	100	ES
	Open Elective 1	3	1	0	4	50	50	100	OE
Practical / Employability Enhancement									
20EEL41	Synchronous and Induction Machines Laboratory	0	0	2	1	50	50	100	PC
20EEL33/ 20EEL32	Electronic Design Laboratory * / Analog and Digital Electronics Laboratory #	0	0	2	1	50	50	100	PC
20MNT31	Environmental Science	2	0	0	0	100	0	100	MC
Total Credits to be earned					**25/24**				

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B.E. DEGREE IN ELECTRICAL AND ELECTRONICS ENGINEERING

SEMESTER – V									
Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
		L	T	P		CA	ESE	Total	
Theory/Theory with Practical									
20EET51	Power Electronics	3	0	0	3	50	50	100	PC
20EET52	Power System Analysis	3	0	0	3	50	50	100	PC
20EET53	Control systems	3	0	0	3	50	50	100	PC
	PE 1	3	0	0	3	50	50	100	PE
	OE2 (JAVA Programming/ Web Engineering)	3	1/0	0/2	4	50	50	100	OE
Practical / Employability Enhancement									
20EEL51	Power Electronics Laboratory	0	0	2	1	50	50	100	PC
20EEL52	Power System Analysis Laboratory	0	0	2	1	50	50	100	PC
20EEL53	Control System Laboratory	0	0	2	1	50	50	100	PC
20GEL51/ 20GEI51	Professional Skills Training I / Industrial Training I	--	--	--	2	100	0	100	EC
Total Credits to be earned					**21**				

SEMESTER – VI									
Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
		L	T	P		CA	ESE	Total	
Theory/Theory with Practical									
20EET61	Microprocessor and Microcontroller	3	0	0	3	50	50	100	PC
20EET62	Electric Drives and Control	3	0	0	3	50	50	100	PC
20EET63	Signals and Systems	3	0	0	3	50	50	100	PC
	Open Elective III	3	0	0	3	50	50	100	OE
Practical / Employability Enhancement									
20EEL61	Microprocessor and Microcontroller Laboratory	0	0	2	1	50	50	100	PC
20EEL62	Electric Drives Laboratory	0	0	2	1	50	50	100	PC
20EEL63	Power and Energy Laboratory	0	0	2	1	50	50	100	PC
20GEL61/ 20GEI61	Professional Skills Training II / Industrial Training II	--	--	--	2	100	0	100	EC
20GEP61	Comprehensive Test / Viva	--	---	---	2	100	0	100	EC
20EEP61	Project Work I	0	0	4	2	100	0	100	EC
Total Credits to be earned					**21**				

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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									
20GET71	Engineering Economics and Management	3	0	0	3	50	50	100	HS
20EET71	Power System Protection and Switchgear	3	0	0	3	50	50	100	PC
	Professional Elective II	3	0	0	3	50	50	100	PE
	Professional Elective III	3	0	0	3	50	50	100	PE
	Professional Elective IV	3	0	0	3	50	50	100	PE
	Professional Elective V	3	0	0	3	50	50	100	PE
Practical / Employability Enhancement									
20EEP71	Project Work II Phase I	0	0	6	3	100	0	100	EC
Total Credits to be earned					**21**				

SEMESTER – VIII									
Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
		L	T	P		CA	ESE	Total	
Theory/Theory with Practical									
	Open Elective IV	3	0	0	3	50	50	100	OE
	Professional Elective VI	3	0	0	3	50	50	100	PE
Practical / Employability Enhancement									
20EEP81	Project Work II Phase II	---	---	14	7	50	50	100	EC
Total Credits to be earned					**13**				

* 2020-2021, #2021-2022

Total Credits: 169

LIST OF PROFESSIONAL ELECTIVES							
Course code	Course Title	Hours/Week			Credit	Sem	Domain/ Stream
		L	T	P			
Elective I-5 SEM							
20EEE01	Power Semiconductor Devices	3	0	0	3	V	PE
20EEE02	Electrical Distribution System Analysis	3	0	0	3	V	PS
20EEE03	Renewable Energy System	3	0	0	3	V	ES
20EEE04	Generalized Machine Theory	3	0	0	3	V	EM
20EEE05	Digital System Design	3	0	0	3	V	EL
Elective II- 7SEM							
20EEE06	Advanced Power Electronic Circuits	3	0	0	3	VII	PE
20EEE07	Substation Engineering and Automation	3	0	0	3	VII	PS
20EEE08	Biomass Energy System	3	0	0	3	VII	ES
20EEE09	Special Electrical Machines	3	0	0	3	VII	EM
20EEE10	VLSI Design	3	0	0	3	VII	EL
20EEE11	Advanced Control Theory	3	0	0	3	VII	CA
Elective III-7 SEM							
20EEE12	Design of Power Converters	3	0	0	3	VII	PE
20EEE13	Restructured Power System	3	0	0	3	VII	PS
20EEE14	Design, Installation and Commissioning of Solar and Wind Energy Systems	3	0	0	3	VII	ES
20EEE15	Advanced Electric Drives and Control	3	0	0	3	VII	EM
20EEE16	Advanced Microprocessors and Controllers	3	0	0	3	VII	EL
20EEE17	PLC and SCADA System	3	0	0	3	VII	CA
Elective IV-7 SEM							
20EEE18	Pulse Generating Circuits for Power Converters	3	0	0	3	VII	PE
20EEE19	High Voltage Engineering	3	0	0	3	VII	PS
20EEE20	Energy Storage Systems	3	0	0	3	VII	ES
20EEE21	CAD of Electrical Machines	3	0	0	3	VII	EM
20EEE22	Embedded System and IOT	3	0	0	3	VII	EL
20EEE23	Computational Intelligence Techniques	3	0	0	3	VII	CA
Elective V-7 SEM							
20EEE24	Power Electronic Interfaces to Renewable Energy	3	0	0	3	VII	PE
20EEE25	Power System Operation and Control	3	0	0	3	VII	PS
20EEE26	Microgrid	3	0	0	3	VII	ES
20EEE27	Electrical Machine Design	3	0	0	3	VII	EM
20EEE28	Digital Image Processing and Multi Resolution Analysis	3	0	0	3	VII	EL
20EEE29	Industrial Automation	3	0	0	3	VII	CA

Elective VI-8 SEM							
20EEE30	Power Quality	3	0	0	3	VIII	PE
20EEE31	Smart Grid	3	0	0	3	VIII	PS
20EEE32	Hybrid Electric Vehicles	3	0	0	3	VIII	ES
20EEE33	Electrical Machine Control and Maintenance	3	0	0	3	VIII	EM
20EEE34	Digital Signal Processors and its Applications	3	0	0	3	VIII	EL
20EEE35	Electric Power Utilization	3	0	0	3	VIII	CA

LIST OF OPEN ELECTIVES OFFERED TO OTHER DEPARTMENTS

(Common to all BE/BTech branches except EEE branch)

Course Code	Course Title	Hours/Week			Credit	Sem
		L	T	P		
20EEO01	Solar & Wind Energy Systems	3	1	0	4	IV
20EEO02	Electrical Wiring and Lighting	3	1	0	4	IV
20EEO03	Electrical Safety	3	1	0	4	IV
20EEO04	Energy Conservation and Management	3	1	0	4	V
20EEO05	AI with MATLAB	3	1	0	4	V
20EEO06	Micro Grid and Smart Grid	3	0	0	3	VI
20EEO07	E-Waste Management	3	0	0	3	VI
20EEO08	Electric Vehicle	3	0	0	3	VIII
20GEO13	NCC Studies(Army Wing) – I	3	0	2	4	VI/VIII

20EGT11 ENGLISH LANGUAGE SKILLS

(Common to all Engineering and Technology Branches)

Programme & Branch	All BE/BTech branches	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	1	HS	3	0	0	3

Preamble	This course is designed to impart required levels of fluency in using the English Language at A2/B1 Level in the Common European Framework (CEFR).	
Unit - I	**Listening, Speaking, Reading, Writing and Grammar & Vocabulary. Activity Based Learning – Phase – I**	**9**
Listening - Talking about past experiences - listening to descriptions - Speaking - Exchanging personal information - Talking about cities and transportation - Reading - Life and achievements of a famous personality - Global transport systems - Writing - Childhood experiences - Process Description – Grammar & Vocabulary – Past tense – Expressions of quantity – Indirect questions.		
Unit - II	**Listening, Speaking, Reading, Writing and Grammar & Vocabulary. Activity Based Learning – Phase – II**	**9**
Listening - Information about hotels and accommodation - Recipes and food items - Speaking - Life style changes and making comparisons - Talking about food - Reading - Habit formation and changing habits - International cuisine - Writing - Personal email - emails about food and recipes – Grammar & Vocabulary – Evaluations and Comparisons with adjectives – Simple past and present perfect tenses.		
Unit - III	**Listening, Speaking, Reading, Writing and Grammar & Vocabulary. Activity Based Learning – Phase – III**	**9**
Listening - Information about travel - descriptions / conversations about family life - Speaking - Vacations and Holidays - Requests, complaints and offering explanations - Reading - Tourist places and travel experiences - Group behaviour and politeness - Writing - Personal letter about travelling - Writing guidelines and checklists – Grammar & Vocabulary – Future tense – Modals – Two-part verbs.		
Unit - IV	**Listening, Speaking, Reading, Writing and Grammar & Vocabulary. Activity Based Learning – Phase – IV**	**9**
Listening - Descriptions about festivals - Presentations on technology - Speaking - About technology - festivals, special events and traditions - Reading - Sports, hobbies and past time - About different cultures - Writing - Product Description - Writing web content – Grammar & Vocabulary – Infinitives and Gerunds for uses and purposes – Imperatives for giving suggestions – Relative clauses of time.		
Unit - V	**Listening, Speaking, Reading, Writing and Grammar & Vocabulary. Activity Based Learning – Phase – V**	**9**
Listening - Talking about changes - Job preferences - Speaking - Comparing different periods or phases in life – Changes that happen - Skills and abilities, Personality Development - Employability Skills – Reading - Reading about life experiences - Emotions and feelings – Job preferences – Jobs and Personality – Writing - Writing about one's past, present and future – Researching job options – Choosing the right job – Grammar & Vocabulary – Time contrasts – Conditional sentences with "if clauses" – Gerunds – short responses.		

Total: 45

TEXT BOOK:

1. Jack C. Richards, Jonathan Hull, and Susan Proctor, "Interchange - Student's Book 2", 4th Edition, Cambridge University Press, New York, 2017.

REFERENCES:

1. Sanjay Kumar and Pushp Lata, "Communication Skills", 2nd Edition, Oxford University Press, New Delhi, 2015.
2. Pamela Hartmann and Brenda Wegmann, "New Interactions English Language Learning and Assessment Platform (Level Intro - Level IV)", McGraw Hill India, 2020.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	use language effectively and accurately acquiring vocabulary from real-life context	Applying (K3)
CO2	listen/view and comprehend different spoken discourses / excerpts in different accents	Applying (K3)
CO3	read different genres of texts adopting various reading strategies	Analyzing (K4)
CO4	write cohesively, coherently and flawlessly avoiding grammatical errors, using a wide range of vocabulary, organizing their ideas logically on a topic	Creating (K6)
CO5	speak clearly, confidently, comprehensibly and communicate with others using appropriate communicative strategies	Creating (K6)

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	2	2		
CO2									2	3		1		
CO3						1				3	1	1		
CO4										3		1		
CO5									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		16	30	37		17	100
CAT2		17	30	37		16	100
CAT3		13	33	37		17	100
ESE		7	21	37		35	100

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

20MAC11 - MATRICES AND 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 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.		
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.		
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^nsinax and x^ncosax – 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** & **Inverse 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) – Solution of linear ODE of second order with constant coefficients.		

List of Exercises / Experiments:

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

***Alternate week**

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

TEXT BOOK:

1. Ravish R. Singh, Mukul Bhatt "Engineering Mathematics", 1st Edition, McGraw Hill Education, New Delhi, 2016.

REFERENCES:

1. Kreyszig E., "Advanced Engineering Mathematics", 10th Edition, John Wiley Sons, 2011.
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. MATLAB 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	know the basics of MATLAB and computing eigen values and eigen vectors of real matrix by MATLAB.	Understanding (K2), Manipulation (S2)
CO7	solve ordinary differential equations with constant and variable coefficients and simultaneous first order ordinary differential equations using MATLAB.	Applying (K3), Manipulation (S2)
CO8	compute Laplace and inverse Laplace Transform of basic functions and solve Second Order ODE by using Laplace Transform with 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	1										
CO2	3	3	2	1										
CO3	3	3	2	1										
CO4	3	3	2											
CO5	3	3	2	1										
CO6					3									
CO7					3									
CO8					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)**

20PHT11 - APPLIED PHYSICS

(Common to All Engineering and Technology Branches)

Programme & Branch	All BE/BTech Branches	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	1	BS	3	0	0	3

Preamble	This course aims to impart the essential concepts of propagation of elastic waves, acoustics, ultrasonics, laser and fiber optics, quantum physics, crystal structure and crystal defects. It also describes the physical phenomena related to the aforementioned concepts and their applications in engineering and provides motivation towards innovations	
Unit - I	**Propagation of Elastic Waves:**	**9**
Oscillatory Motion: Introduction to simple harmonic motion - Damping velocity - Damping coefficient - Differential equation of simple harmonic motion - Velocity and acceleration - Restoring force - Vibration of a spring and mass system - Frequency response - Phase response - Resonance - Wave motion: Definition of a plane progressive wave - Attenuation of waves - Differential equation of a plane progressive wave - Phase velocity - Phase and phase difference - Solution of the differential equation of a plane progressive wave.		
Unit - II	**Acoustics and Ultrasonics:**	**9**
Acoustics: Introduction - Reverberation and reverberation time - Growth and decay of sound - Sabine's formula for reverberation time – Determination of sound absorption coefficient – Design of an auditorium: Factors affecting acoustics of buildings and the remedies. Ultrasonics: Introduction – Properties of ultrasonic waves – Generation of ultrasonic waves: Magnetostrictive generator and Piezoelectric generator - Determination of velocity of ultrasonics in a liquid: Acoustic grating – Industrial application: Non-destructive testing - Other applications of ultrasonic waves (qualitative).		
Unit - III	**Laser and Fiber Optics:**	**9**
Laser and Applications: Introduction – Interaction of light with matter - Three quantum process: Stimulated absorption, spontaneous emission and stimulated emission - Population inversion - Einstein's coefficients and their relations - Pumping methods - Nd:YAG laser - CO_2 laser - Holography. Fiber Optics and Applications: Introduction - Numerical aperture and acceptance angle - Classification of optical fibers based on refractive index, modes and materials - Fiber optics communication system (qualitative) - Fiber optic sensors: Temperature and displacement sensors.		
Unit - IV	**Quantum Physics:**	**9**
Introduction - Blackbody radiation - Planck's quantum hypothesis - Compton scattering (qualitative) - de Broglie's hypothesis - Properties of matter waves - Application of Heisenberg uncertainty principle - Schrodinger's time independent and time dependent wave equations - Physical significance of wave function - The free particle - Potential energy step - Infinite potential well (one - dimensional).		
Unit - V	**Crystal Physics:**	**9**
Introduction - Classification of solids - Space lattice - Crystal structure - Unit cell - Bravais lattice - Single and polycrystalline materials - Lattice planes - Miller indices - Indices of crystal direction - Interplanar spacing in cubic system - Hexagonal close packed crystal structure and c/a ratio - Symmetry -Symmetry elements in cubic crystal - Crystal imperfections: line, surface and volume imperfections - Features of crystal imperfections (qualitative).		

Total: 45

TEXT BOOK:

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

REFERENCES:

1. Purnima Khare and Swarup A.,"Engineering Physics: Fundamentals and Modern Applications", 1st Edition, Jones and Bartlett Publishers, Sudbury, Massachusetts, 2009.
2. Gaur R.K. and Gupta S.L., "Engineering Physics", 8th Edition, Dhanpat Rai and Sons, New Delhi, 2009.
3. Tamilarasan K. and Prabu K., "Engineering Physics – I", 3rd Edition, McGraw Hill Education Pvt. Ltd., New Delhi, 2014.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	make use of the concepts of oscillatory and wave motion to comprehend the phenomena related to the propagation of elastic waves.	Applying (K3)
CO2	apply the concepts of growth and decay of sound energy in a hall to compute Sabine's formula to recognize the requirements of acoustically good buildings, and to describe the production of ultrasonic wave, working of acoustic grating & non-destructive testing using ultrasonic waves.	Applying (K3)
CO3	apply the concepts of stimulated emission to explain the working and the applications of laser in engineering and technology, and to apply the principle of propagation of light through optical fiber to compute acceptance angle and numerical aperture to comprehend the loss in optical fiber, fiber optic communication system and working of fiber optic sensors.	Applying (K3)
CO4	use the concepts of quantum mechanics to describe the behavior of electrons in a metal by solving Schrodinger's wave equation for particle motion in infinite potential well.	Applying (K3)
CO5	utilize the concepts of the seven crystal systems to obtain interplanar spacing in cubic lattice and c/a ratio of HCP crystal structure, and to comprehend symmetry elements, reciprocal lattice and the types of crystal imperfections and their impacts.	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											
CO2	3	2	1											
CO3	3	2	1											
CO4	3	2	1											
CO5	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	40	40				100
CAT2	20	35	45				100
CAT3	25	35	40				100
ESE	20	40	40				100

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

20CYT11 - APPLIED CHEMISTRY

(Common to All Engineering and Technology Branches)

Programme & Branch	All BE/BTech Branches	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	1	BS	3	0	0	3

Preamble	Applied Chemistry course explores the basic principles and advancements of chemistry in the field of engineering and technology. It aims to impart the fundamentals of chemistry towards innovations in science and technology and also for societal applications.	
Unit - I	**Water Technology:**	**9**
Introduction - sources of water - impurities in water - types of water - hardness of water- expression of hardness (simple problems) - units of hardness –estimation of hardness of water by EDTA method – determination of alkalinity - disadvantages of using hard water in Industries - boiler troubles - scale and sludge, boiler corrosion, caustic embrittlement, priming and foaming - softening of water: i) Internal treatment process - carbonate and calgon conditioning ii) External treatment method -demineralization process iii) Treatment of water for municipal water supply (Removal of suspended particles and disinfection methods, Break-point of chlorination).		
Unit - II	**Electrochemistry:**	**9**
Introduction – electrochemical cells - applications of electrochemical series - reference electrode - standard calomel electrode - ion selective electrode - glass electrode - concentration cells - electrode and electrolyte concentration cells (simple problems) - applications- potentiometric titrations - acid-base, redox, precipitation titrations - advantages- conductometric titrations - strong acid vs strong base, weak acid vs strong base, mixture of weak and strong acid vs strong base- advantages of conductometric titrations.		
Unit - III	**Corrosion and its Control:**	**9**
Introduction – causes and effects of corrosion - types of corrosion - chemical corrosion – Pilling Bed-worth rule - electrochemical corrosion –types **-** galvanic corrosion, concentration cell corrosion – other types of corrosion -stress, intergranular and microbiological corrosion- galvanic series - factors influencing rate of corrosion – corrosion control methods - design and material selection, anodic protection, corrosion inhibitors, protective coatings - i) metallic coatings : hot dipping (tinning and galvanizing) ii) non-metallic coating : anodizing iii) organic coating : paints – constituents and their functions.		
Unit - IV	**Fuels and Combustion:**	**9**
Introduction – classification of fuels - characteristics of a good fuel - combustion - calorific values – gross and net calorific values - Dulong's formula (simple problems) - Flue gas analysis by Orsat's method - ignition temperature - spontaneous ignition temperature - explosive range - solid fuels - coal and its varieties – proximate and ultimate analysis – significance – metallurgical coke - Otto-Hoffman byproduct method - liquid fuel - refining of petroleum – manufacture of synthetic petrol - hydrogenation of coal - Bergius process - knocking - octane number – cetane number - gaseous fuel - water gas.		
Unit - V	**Polymers:**	**9**
Introduction – terminology - classification - polymerization - types of polymerization (definition only)- polymerisation techniques- bulk, solution, suspension and emulsion polymerisation - plastics- difference between thermoplastics and thermosetting plastics - compounding of plastics- plastic moulding methods - compression, injection, extrusion and blow moulding methods - industrial polymers: preparation, properties and applications of PVC, PAN, polyurethane, polyesters –biodegradable polymers-classification and applications.		

Total: 45

TEXT BOOK:

1. Wiley Editorial Board, "Wiley Engineering Chemistry", 2nd Edition, Wiley India Pvt. Ltd, New Delhi, Reprint 2019.

REFERENCES:

1. Palanisamy P.N., Manikandan P., Geetha A.& Manjula Rani K., "Applied Chemistry", 6th Edition, Tata McGraw Hill Education Private Limited, New Delhi, 2019.
2. Payal B. Joshi, Shashank Deep, "Engineering Chemistry", Oxford University Press, New Delhi, 2019.
3. Palanna O., "Engineering Chemistry", McGraw Hill Education, New Delhi, 2017.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	apply the suitable water softening methods to avoid boiler troubles.	Applying (K3)
CO2	apply the principle of electrochemistry for various applications.	Applying (K3)
CO3	make use of corrosion control methods to solve corrosion related problems.	Applying (K3)
CO4	illustrate the quality of fuels from its characteristics.	Understanding (K2)
CO5	explain the types of polymers, plastics and fabrication methods.	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										
CO2	3	2	1	1										
CO3	3	2	1	1										
CO4	3	1												
CO5	3	1												

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

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	25	35	40				100
CAT2	25	35	40				100
CAT3	25	35	40				100
ESE	25	35	40				100

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

20EET11 ELECTRIC CIRCUITS AND ELECTRON DEVICES

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

Preamble	This course aims to impart knowledge on analysis of electric AC and DC circuits. And also impart knowledge on construction, characteristics and applications of electron devices like Diode, BJT and its biasing.	
Unit - I	**DC Circuits:**	**9+3**
Ohm's law - Kirchhoff's law-Series and Parallel connection of resistance - Current and Voltage division rule - Dependent and Independent sources - Source transformation - Star-Delta transformation - Mesh and Nodal analysis - Analysis of simple electric circuits using dependent and independent sources.		
Unit - II	**AC Circuits and Resonance:**	**9+3**
Power and power factor of simple series RL, RC and RLC circuits – Mesh and nodal analysis - **Resonance circuits:** Resonant Frequency, Current and Voltage Variations, Bandwidth, Q factor for Series and Parallel Resonance Circuits.		
Unit - III	**Three Phase Circuits:**	**9+3**
Star and Delta systems – Line and Phase Quantities - Three Phase Power - Balanced and Unbalanced Circuit – Three wire and Four wire systems.		
Unit - IV	**Diodes:**	**9+3**
VI characteristics of PN junction diode –Diode current equation - Transition and Diffusion capacitance – clipper, clamper and voltage multiplier - Construction and Characteristics: Zener diode, Varactor diode, Tunnel diode, PIN diode, LASER and CCD, Opto-coupler.		
Unit - V	**Bipolar Junction Transistor:**	**9+3**
Construction and operation of a BJT – Input and Output characteristics of a transistor in CE and CB configurations–Transistor as an amplifier - Transistor Biasing and Stability: Operating point – DC and AC load line - Stability and stability factor- Fixed bias and Voltage-divider bias.		

Lecture:45, Tutorial:15, Total:60

TEXT BOOK:

1. Sudhakar A. and Shyammohan S. Palli, "Circuits and networks- Analysis and Synthesis", 5th Edition, Tata McGraw Hill Publishing Company, New Delhi, 2015.
2. Sedha R.S., "A Textbook of Applied Electronics", 4th Edition, S.Chand & Co., Ltd., New Delhi, 2014. (reprint)

REFERENCES:

1. David A. Bell, "Electric Circuits and Electronic Devices", 5th Edition, Oxford University Press, New Delhi, 2010.
2. Salivahanan S., Suresh Kumar N., "Electronic Devices and Circuits", 4th Edition, Tata Mcgraw Hill, New Delhi, 2017.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	discuss various parameters of electric circuits using dependent and independent sources.	Applying (K3)
CO2	analyze AC circuits and resonance	Analyzing (K4)
CO3	differentiate balanced and unbalanced load condition in three phase AC circuits	Applying (K3)
CO4	explain the construction and characteristics of diode and its applications.	Understanding (K2)
CO5	illustrate the working and biasing methods of BJT.	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	2
CO2	2	3	2	2	1								1	3
CO3	3	2	1	1									2	2
CO4	2	1											3	1
CO5	2	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	15	15	60	10			100
CAT2	15	15	70	-			100
CAT3	10	60	20	10			100
ESE	10	40	40	10			100

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

20EET12 - ELECTRICAL MEASUREMENTS AND INSTRUMENTATION

Programme & Branch	BE - Electrical and Electronics Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	1	ES	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, Resitance, 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 – 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 – 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**
Block diagram of Digital voltmeter – Block diagram of Digital Multimeters – Working of CRO –Time, Frequency and phase angle measurements using CRO –Function generators, Signal generators, Weston Type Frequency Meter – Digital Frequency Meter..		

Total: 45

TEXT BOOK:

1. Sawhney A.K., “Electrical and Electronic Measurements and Instrumentation”, 19th Revised Edition, Dhanpath Rai & Co., New Delhi, 2013 Reprint.

REFERENCES:

1. Gupta J.B., “A Course in Electronic and Electrical Measurements and Instrumentation”,13th Edition, S.K.Kataria & Sons, New Delhi, 2007.
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 its working principle	Understanding (K2)
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 instrument for measurement of various electrical parameters and explain various digital measuring instruments.	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	1
CO2	2	1											3	1
CO3	2	1											3	1
CO4	3	2	1	1									2	2
CO5	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	50	50					100
CAT2	30	70					100
CAT3	30	50	20				100
ESE	20	60	20				100

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

20EEL11 – ELECTRIC CIRCUITS AND MEASUREMENTS LABORATORY

Programme & Branch	BE – Electrical and Electronics Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	1	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 Exercises / Experiments:

Electric Circuits	
1.	Verification of kirchhoffs current and voltage law.
2.	Determination of loop currents in mesh analysis.
3.	Three phase power measurement by two wattmeter method.
4.	Design and simulation of series and parallel resonance for a given frequency.
5.	VI characteristics of PN junction diode and Zener diode.
6.	Simulation of input and output characteristics of CE bipolar junction transistor.
Electrical Measurements	
7.	Calibration of Energy Meter
8.	Extension of DC voltmeter and DC ammeter ranges
9.	Calibration of current transformer and potential transformer
10.	Measurement of DC resistance by Wheatstone and Kelvin double bridge
11.	Measurement of inductance and capacitance using Maxwell's bridge

Total: 30

REFERENCES /MANUALS/SOFTWARES:

1.	Laboratory Manual
2.	Orcad software

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	determine various parameters of a given electrical circuit and Analyze three phase power measurement	Applying(K3), Precision (S3)
CO2	model and analyze electric circuits and semiconductor devices using Simulation tools.	Applying (K3), Manipulation (S2)
CO3	measure unknown resistance, capacitance, inductance and calibrate CT,PT and energy meter	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	2
CO2	3	2	1	1									2	2
CO3	3	2	1	1									2	2

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

20PHL11 – PHYSICAL SCIENCES LABORATORY I

(Common to All Engineering and Technology Branches)

Programme & Branch	All BE/BTech Branches	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 the physical parameters such as Young's modulus, rigidity modulus, frequency of vibration, velocity of ultrasonic waves, compressibility of water, wavelength of laser, acceptance angle and the numerical aperture of an optical fiber, and to develop the skills in handling different basic instruments and also aims to impart the basic concepts of volumetric, conductometric and pH meter experiments and thereby, to improve the analytical capability.

List of Exercises / Experiments:

1.	Determination of the Young's modulus of the material of a given beam using uniform bending method.
2.	Determination of the rigidity modulus of the material of a given wire using torsional pendulum.
3.	Determination of frequency of electrically vibrating rod by forming standing waves using Melde's apparatus.
4.	Determination of the velocity of ultrasonic waves in a liquid and the compressibility of a liquid using ultrasonic interferometer.
5.	Determination of (i) the wavelength of a semiconductor laser and (ii) the acceptance angle and the numerical aperture of a given optical fiber.
6.	Estimation of total, temporary and permanent hardness of water by EDTA method.
7.	Estimation of $Ca^{2+}$and Mg^{2+}hardness separately by EDTA method.
8.	Estimation of alkalinity of the given water sample.
9.	Conductometric titration -Mixture of acids.
10.	Estimation of hydrochloric acid using pH meter.

Total: 30

REFERENCES:

1.	Tamilarasan K. and Prabu K.,"Physics Laboratory Manual', 1st Edition, SCM Publishers, Erode, 2020.
2.	Palanisamy P.N., Manikandan P., Geetha A. and Manjula Rani K., "Chemistry Laboratory Manual", 1st Edition, Rajaganapathy Publishers, Erode, 2020.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	determine the Young's modulus of a material using the concepts of elasticity and bending moment of a beam and to determine the rigidity modulus of a wire using the concepts of twisting couple and to compute the frequency of electrically vibrating rod using the concept of standing waves formed in fixed vibrating string.	Applying (K3), Precision (S3)
CO2	determine the wavelength of a semiconductor laser beam using the concept of diffraction of light, and to compute the acceptance angle and the numerical aperture of an optical fiber using the concepts of total internal reflection and divergence of light in air and estimate the amount of hardness for the given water sample by EDTA method, and the amount of alkalinity for the given water sample.	Applying (K3), Precision (S3)
CO3	demonstrate the conductivity meter and pH meter to estimate the amount of the given solution.	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										
CO2				3										
CO3				3										

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

20EGT21 ADVANCED COMMUNICATION SKILLS

(Common to all Engineering and Technology Branches)

Programme & Branch	All BE/BTech branches	Sem.	Category	L	T	P	Credit
Prerequisites	20EGT11 – English Language Skills	2	HS	3	0	0	3

Preamble	This course is designed to impart required levels of fluency in using the English Language at B1Level in the Common European Framework (CEFR).	
Unit - I	**Listening, Speaking, Reading, Writing and Grammar & Vocabulary. Activity Based Learning – Phase –VI**	**9**
Listening – Job and career related descriptions and conversations – requests of different kinds and the responses – Speaking - Career choices and professional skills – making requests and responding to requests – Reading – Using texts about jobs and careers – about different societies and cultural differences – Writing – Resumes, CVs and job oriented advertisements – business and career related emails – Grammar &Vocabulary – Gerunds and elements of comparison – requests and indirect requests.		
Unit - II	**Listening, Speaking, Reading, Writing and Grammar & Vocabulary. Activity Based Learning – Phase – VII**	**9**
Listening – Expository and narrative descriptions – information about different cultures, nations and societies. Speaking – Narrating and describing – talking about other countries and other cultures – Reading – Using texts about media and information technology – living abroad and experiencing different cultures – Writing – Blog writing – brochures and tourist pamphlets – Grammar & Vocabulary – The past tense forms - noun phrases and relative clauses.		
Unit - III	**Listening, Speaking, Reading, Writing and Grammar & Vocabulary. Activity Based Learning – Phase – VIII**	**9**
Listening – Consumerism – product description – complaints and redressal – environmental issues – ecology – saving the planet – Speaking – Talking about problems, issues, complaints – solutions and redressal – talking about environmental issues – Reading – Using texts on segregating wastes – recycling and reusing – texts on environmental issues – Writing – Online reviews, articles and writing web content – Grammar & Vocabulary – Phrases and sentences used for describing problems – passives – prepositions and infinitives.		
Unit - IV	**Listening, Speaking, Reading, Writing and Grammar & Vocabulary. Activity Based Learning – Phase – IX**	**9**
Listening – Education, learning and the choice of courses – various services needed in daily life – self-improvement for success in life – Speaking - Discussions about educational and career oriented issues – talking about everyday services – giving advice and self improvement – Reading – Reading about learning strategies and learning styles – using texts about personality development – Writing – Writing about hobbies – pastime and individual skills – writing short articles on everyday life and personality development – Grammar & Vocabulary – Using of "would" and certain gerund forms – use of modals, verbs, gerunds, negative questions and infinitives.		
Unit - V	**Listening, Speaking, Reading, Writing and Grammar & Vocabulary. Activity Based Learning – Phase – X**	**9**
Listening – Historical narratives – biographies and learning about the future – important life events, milestones and happenings of the past – **Speaking** – Talking about the past, present and the future – talking about important events in life – **Reading** – Texts about new technologies and future science – using texts about social organization, culture and social practices – **Writing** – Biographical sketches – historical events – famous personalities, stages of life and getting along with people – **Grammar & Vocabulary** – Future tense forms – time clauses and certain "if clauses".		

Total: 45

TEXT BOOK:

1. Jack C. Richards, Jonathan Hull, and Susan Proctor, "Interchange - Student's Book 3", 4th Edition, Cambridge University Press, New York, 2017.

REFERENCES:

1. Sanjay Kumar and Pushp Lata, "Communication Skills: A Workbook based on AICTE Syllabus", Oxford University Press, 2018.
2. Board of Editors, "Skills Annexe: Functional English for Success", Orient BlackSwan, Hyderabad, 2013.

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 spoken excerpts critically and infer Unspoken and implied meanings.	Applying (K3)
CO3	read different genres of texts, infer implied meanings and critically analyze and evaluate them for ideas as well as for method of presentation.	Analyzing (K4)
CO4	write effectively and persuasively and produce different types of writing such as narration, description, exposition and argument as well as creative, critical, analytical and evaluative writing.	Creating (K6)
CO5	speak effectively, to express opinions clearly, initiate and sustain a discussion and also negotiate using appropriate communicative strategies.	Creating (K6)

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	1	1		
CO2									2	3		1		
CO3						1				3	1	1		
CO4										3		2		
CO5									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		13	30	33	-	17	100
CAT2		13	33	37	-	17	100
CAT3		20	30	33	-	17	100
ESE		6	40	36	-	18	100

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

20MAC21 - MULTIVARIABLE CALCULUS AND COMPLEX ANALYSIS

(Common to All Engineering and Technology Branches)

Programme & Branch	All BE/BTech 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 – 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 – 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 – 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 Exercises / Experiments:

1.	Finding ordinary and partial derivatives
2.	Computing extremes of a single variable function
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

***Alternate week**

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

TEXT BOOK:

1. Ravish R. Singh, Mukul Bhatt "Engineering Mathematics", 1st Edition, McGraw Hill Education, New Delhi, 2016.

REFERENCES:

1. Kreyszig E., "Advanced Engineering Mathematics", 10th Edition, John Wiley Sons, 2011.
2. Dass H K, "Higher Engineering Mathematics", 3rd Revised Edition, S.Chand and Co., New Delhi, 2014.
3. Duraisamy C., Vengataasalam S., Arun Prakash K. and Suresh M., "Engineering Mathematics – I", 2nd Edition, Pearson India Education, New Delhi, 2018.
4. MATLAB Manual.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	compute extremal values which arise in function of several variables.	Applying (K3)
CO2	solve Problems involving Double and Triple integrals.	Understanding (K2)
CO3	apply the concept of vectors in engineering problems.	Applying (K3)
CO4	identify, construct and apply analytic functions in electrostatics and fluid flow problems.	Applying (K3)
CO5	evaluate complex integrals which are extensively applied in engineering.	Applying (K3)
CO6	compute maxima and minima of a single variable function, gradient, curl and divergence of a vector function using MATLAB.	Understanding (K2), Manipulation (S2)
CO7	evaluate Double, Triple integrals and determine area between two curves using MATLAB	Applying (K3), Manipulation (S2)
CO8	construct analytic function, find bilinear transformation and compute poles and residues 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												
CO2	3	3	2											
CO3	3	3												
CO4	3	3												
CO5	3	3	2											
CO6					3									
CO7					3									
CO8					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)**

20PHT24 - MATERIALS SCIENCE AND SOLID STATE DEVICES

(Common to Electrical and Electronics Engineering and Electronics and Instrumentation Engineering branches)

Programme & Branch	BE-Electrical and Electronics Engineering and BE-Electronics and Instrumentation Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Applied Physics	2	BS	3	0	0	3

Preamble	This course aims to impart the knowledge on the physics of conductors, superconductors, semiconductors, magnetic materials, dielectrics, nanomaterials, biomaterials and smart materials. It also describes the working of the select solid state devices and the applications of aforementioned materials in Electrical, Electronics and Instrumentation Engineering and provides motivation towards innovations.	
Unit - I	**Conducting and Superconducting Materials:**	**9**
Conducting Materials: Introduction – Classical free electron theory – Success and failures of classical free electron theory – Quantum free electron theory of metals – Fermi distribution function – Effect of temperature on Fermi distribution function – Density of energy states for a metal – Carrier concentration in a metal – Superconducting Materials: Properties – Type I and Type II superconductors – Applications: Cryotron, Superconducting quantum interference device (SQUID).		
Unit - II	**Semiconducting Materials:**	**9**
Intrinsic semiconductor: Carrier concentration, variation of Fermi level with temperature, electrical conductivity and band gap - Extrinsic semiconductors: Carrier concentration in n-type and p-type semiconductors, variation of Fermi level with temperature and impurity concentration - Homojunction semiconductor laser: Construction, working and applications – Heterojunction semiconductor laser (qualitative) - Hall effect: Theory and experimental determination of Hall coefficient - Applications.		
Unit - III	**Solid State Devices:**	**9**
Introduction **-** Uni-junction transistor: Construction and characteristics – Junction field effect transistor: Construction and characteristics – Metal oxide semiconductor field effect transistor: Construction and characteristics – Silicon controlled rectifier: Construction and characteristics - Diac and triac: Construction and characteristics – Photodiode and phototransistor: Construction and characteristics.		
Unit - IV	**Magnetic and Dielectric Materials:**	**9**
Magnetic Materials: Introduction – Domain theory of ferromagnetism – Hysteresis loss – Soft and hard magnetic materials – Ferrites: Properties, Structures and applications – Transformer core: Materials and types – Dielectric Materials: Introduction – Electronic, Ionic, Orientational and Space charge polarization – Frequency and temperature dependence of polarization – Dielectric loss – Dielectric breakdown – Applications of dielectric materials		
Unit - V	**Nanomaterials and Biomaterials:**	**9**
Nanomaterials: Introduction **-** Low dimensional structures: Quantum well, quantum wire and quantum dot – Synthesis techniques: Ball milling, Lithography and Physical vapour deposition – Applications of nanomaterials – Carbon nanotubes: Structures, properties, synthesis by laser ablation method and applications - Bio materials: Introduction – Basic requirements of biomaterials – Biocompatibility – Classification of biomaterials – Metallic and alloy biomaterials (qualitative): Cobalt–chromium alloys and Titanium and titanium alloys.		

Total:45

TEXT BOOK:

1. Avadhanulu M.N., Kshirsagar P.G. and Arun Murthy T.V.S., "A Textbook of Engineering Physics",11th Edition, S. Chand & Company Pvt. Ltd., New Delhi, 2019, for Unit I, II, IV, V.
2. Albert Malvino and David J. Bates, "Electronic Principles", 8th Edition, McGraw-Hill Publications, New Delhi, 2016, for Unit III.

REFERENCES:

1. Mehta V. K. and Rohit Mehta, "Principles of Electronics", 23rd Edition, S.Chand and Company Limited, New Delhi, 2005.
2. Thomas L. Floyd, "Electronic Devices", 10th Edition, Pearson Education, New York, 2018.
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	apply the concepts of classical and quantum free electron theory of metals to comprehend the effect of temperature on Fermi function and to compute the density of states in metals, and to explain the types, properties and applications of superconductors (Cryotron and Superconducting quantum interference device).	Applying (K3)
CO2	use the concepts of density of states to compute the carrier concentration, electrical conductivity and band gap of intrinsic semiconductor and to compute the carrier concentration of extrinsic semiconductors, working of semiconductor laser, Hall effect and its applications.	Applying (K3)
CO3	describe the construction, working and characteristics of select electronic devices using the concept of carrier transport in semiconductors.	Applying (K3)
CO4	apply the domain theory of ferromagnetism to explain hysteresis and to explain structure, properties and applications of ferrites, and to apply the concept of electric dipole moment and electric polarization to compute the polarisability of select polarization mechanisms in dielectrics and to describe the related phenomenon.	Applying (K3)
CO5	utilize appropriate methods to prepare nano-materials and carbon nano-tubes, and to comprehend their properties, types and applications. To discuss the properties, select types and applications of biomaterials.	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											
CO2	3	2	1											
CO3	3	2	1											
CO4	3	2	1											
CO5	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	40	40				100
CAT2	20	40	40				100
CAT3	25	35	40				100
ESE	20	40	40				100

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

20CYT23 - CHEMISTRY OF ELECTRONIC MATERIALS

Programme & Branch	B.E – ECE, CSE, EEE, EIE & B.TECH- IT branches	Sem.	Category	L	T	P	Credit
Prerequisites	Applied Chemistry	2	BS	3	0	0	3

Preamble	Chemistry of electronic materials aims to equip the engineering students to realize the importance of chemistry in polymeric materials, metal finishing, organic electronic materials, fuel cells, renewable energy and e-waste management.	
Unit - I	**Chemistry of Polymeric and Composite Materials :**	**9**
Introduction - structure and property relationship of polymers - plastics - properties and uses of plastics as engineering materials - rubbers (elastomers) - natural rubber- processing of latex- vulcanization of rubber - synthetic rubbers- preparation, properties and uses of thiokol and butyl rubber- polymer blends and alloys - fibres-physical properties-types-spinning processes- composites - classification of composites - fibre reinforced plastics- processing , properties and uses of fiber reinforced plastics		
Unit - II	**Industrial Metal Finishing :**	**9**
Introduction – technological importance of metal finishing- methods of metal finishing - manufacturing of electronic component-PCB fabrication- essential 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 - electroless copper plating on printed circuit board - electroless nickel plating process -Distinction between electroplating and electroless plating- advantages of electroless plating.		
Unit - III	**Chemistry of Organic Electronic Materials and Fuel Cells:**	**9**
Introduction-Organic semiconducting materials – principle and applications - advantages over inorganic semiconducting materials - P-type and N-type organic semiconducting materials (definition and examples) - conducting polymers and its applications - organic dielectrics (principle and example) - organic light emitting diodes - working and applications. Fuel Cells: Importance and classification of fuel cells - description, principle, components, applications and environmental aspects of fuel cells: alkaline fuel cells, phosphoric acid, molten carbonate and direct methanol fuel cells.		
Unit - IV	**Renewable Energy Resources:**	**9**
Introduction – global energy consumption scenario- types of energy resources - nuclear energy - nuclear power reactor - breeder reactors - applications and disadvantages of nuclear energy - design, working, advantages and disadvantages of solar energy, hydropower, wind energy, geothermal energy, tidal and wave power, ocean thermal energy - biomass and biofuels - hydrogen as an alternate fuel - hydrogen production - advantages ,disadvantages and applications - nanotechnology for energy sector.		
Unit - V	**E-Waste and its Management:**	**9**
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 – 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 Units I,II,IV.
2. Palanisamy P.N., Manikandan P., Geetha A., Manjula Rani K.& Kowshalya V.N., “Environmental Science”, Revised Edition, Pearson Education, New Delhi, 2019 for Units I, III, IV, V.

REFERENCES:

1. Palanna O., "Engineering Chemistry" , McGraw Hill Education, New Delhi, 2017 for Units II,III.
2. B.Joshi & Shashank Deep, “Engineering Chemistry”, Oxford University Press, New Delhi, 2019.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	utilize the polymeric and composite materials for various applications	Applying (K3)
CO2	employ the concept of coating techniques in industrial metal finishing	Applying (K3)
CO3	apply the concepts of fuel cells, organic electronic materials and its applications	Applying (K3)
CO4	explain the role of renewable energy resources to attain sustainability	Understanding (K2)
CO5	utilize the knowledge to handle the e-waste and reduce its impacts on environment	Applying (K3)

Mapping of COs with POs and PSOs

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

20VEC11 – YOGA AND VALUES FOR HOLISTIC DEVELOPMENT

Programme & Branch	All BE/BTech Branches	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	1	HS	1	0	1	1

Preamble	Providing Value Education to improve the Students' character - understanding yogic life and physical health - maintaining youthfulness - Measure and method in five aspects of life	
Unit - I	**Physical Health:**	**2**
Manavalakalai (SKY) Yoga: Introduction - Education as a means for youth empowerment - Greatness of Education - Yoga for youth Empowerment. **Simplified Physical Exercises:** Need and Objectives of Simplified Physical Exercise - Hand, Leg, Breathing, Eye exercises - Kapalabathi, Makarasana Part I, Makarasana Part II, Body Massage, Acu pressure, Relaxation exercises - Benefits. **Yogasanas:** Pranamasana - Hastha Uttanasana - Pada Hasthasana - Aswa Sanjalana Asana - Thuvipatha asva Sanjalana asana - Astanga Namaskara - Bhujangasana - Atha Muktha Savasana - Aswa Sanjalana Asana - Pada Hasthasana - Hastha Uttanasana - Pranamasana. **Pranayama:** Naddi suddi - Clearance Practice - Benefits.		
Unit - II	**Life Force:**	**2**
Reasons for Diseases: Body Function - Reason for Diseases and Prevention - Natural reasons (Genetic / imprints, Planetary Position, Natural calamities and climatic changes) - Unnatural reasons (Food habits, Thoughts, Deeds). **Philosophy of Kaya kalpa:** Enriching Bio-Magnetism - Physical body - Sexual vital fluid - Life force - Bio-Magnetism - Mind. **Maintaining youthfulness:** Postponing old age - Transformation of food into seven components - Importance of sexual vital fluid - Measure and method in five aspects of life - Controlling undue Passion. **Kayakalpa practice:** Aswini Mudra - Ojas breath - Benefits of Kaya Kalpa.		
Unit - III	**Mental Health:**	**2**
Mental Frequencies: Beta, Apha, Theta and Delta wave - Agna Meditation explanation - benefits. **Shanti meditation:** Shanthi Meditation explanation – benefits. **Thuriya Meditation:** Thuriya Meditation explanation – benefits. **Benefits of Blessing:** Self blessing (Auto suggestion) - Family blessing - Blessing the others - World blessing - Divine protection.		
Unit - IV	**Values:**	**2**
Human Values: Self control - Self confidence - Honesty Contentment - Humility – Modesty - Tolerance - Adjustment - Sacrifice – Forgiveness - Purity (Body, Dress, Environment) - Physical purity - Mental purity - Spiritual purity. **Social Values:** Non violence – Service. Patriotism – Equality. Respect for parents and elders - care and protection - Respect for teacher. Punctuality - Time Management.		
Unit - V	**Morality (Virtues):**	**2**
Importance of Introspection: I - Mine (Ego, Possessiveness). Six Evil Temperaments - Greed - Anger - Miserliness - Immoral sexual passion - Inferiority and superiority Complex – Vengeance. Maneuvering of Six Temperaments: Contentment - Tolerance - Charity - Chastity - Equality - Pardon (Forgiveness). Five essential Qualities acquired through Meditation: Perspicacity - Magnanimity - Receptivity - Adaptability - Creativity (Improved Memory Power).		

Lecture:10, Practical:10, Total:20

TEXT BOOK:

1. Thathuvagnani Vethathiri Maharishi, "Yoga for Youth Empowerment", Vethathiri Publications, 2019.

REFERENCES:

1. Thathuvagnani Vethathiri Maharishi, "Yoga for Modern Age", Vethathiri Publications, 2019.
2. Thathuvagnani Vethathiri Maharishi, "Simplified Physical Exercises", Vethathiri Publications, 2019.
3. Neelam Sharma, "Holistic Education and Yoga", Shipra Publications, 2017.
4. Dr. Joseph Murphy, "The Power of Your Subconscious Mind", Pushpak Publication, 2019.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	understand the importance of physical health and practice simplified physical yoga exercise.	Applying (K3)
CO2	understand the importance of Kayakalpa exercise to enrich Bio-Magnetism and practice it.	Applying (K3)
CO3	understand the significance of meditation and do meditation to get sound mind.	Applying (K3)
CO4	understand the human and social values to provide service to society.	Applying (K3)
CO5	understand the evil temperaments and five essential qualities acquired through meditation	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		
CO3						3		3				1		
CO4						3		2	1			1		
CO5						3		3				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	NA						
CAT2	NA						
CAT3			100				100
ESE	NA						

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

20MEC11 – ENGINEERING DRAWING

(Common to Civil, Mechanical, Mechatronics, Automobile Engineering, Chemical & Food Technology Branches)

Programme & Branch	BE(Civil, Mech, MTS, Auto) &BTech(Chem, FT)	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	1	ES	2	0	2	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:**	**9**
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:**	**9**
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:**	**9**
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:**	**9**
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:**	**9**
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, Practical:30, Total:60

TEXT BOOK:

1. Venugopal K. and Prabhu Raja V., “Engineering Graphics”, 15th Edition, New Age International Pvt. Ltd., New Delhi, 2018.

REFERENCES:

1. Basant Agrawal, Agrawal C.M., “Engineering Drawing”, 2nd Edition, McGraw Hill Education, 2019.
2. Gopalakrishnana K.R. “Engineering Drawing”, Volume. I & II, Subhas Publications, Bengaluru, 2014.
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.	Understanding (K2)
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 in to 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								3	2	2	2	3
CO2	3	2	1	1						3	2	3	2	3
CO3	3	2	1	1						3	2	3	2	3
CO4	3	2	1	1						3	2	3	2	3
CO5	3	2	1	1						3	2	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	20	40	40				100
CAT2	20	40	40				100
CAT3	20	40	40				100
ESE	25	35	40				100

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

20EET21 - NETWORK ANALYSIS

Programme & Branch	BE- Electrical and Electronics Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Electric Circuits and Electron Devices	2/3	PC	3	1	0	4

Preamble	This course aims to impart knowledge on analysis of various electric networks, like steady state and transients, two port networks, filters and graph theory.	
Unit - I	**Network theorems (Both AC and DC)**	**9+3**
Super Position Theorem - Thevenin's Theorem - Norton's Theorem - Maximum Power Transfer Theorem – reciprocity theorem – Duals and duality.		
Unit - II	**Transients**	**9+3**
Transient and steady state response - Circuit elements in the S-domain – Application of Laplace transform transient analysis-DC transient response of an RL circuit- DC transient response of an RC circuit - DC transient response of an RLC circuits –sinusoidal transient response of an RL and RC circuits.		
Unit - III	**Graph theory**	**9+3**
Introduction - Tree and Co-tree - Twigs and Links - Incidence Matrix (A) - Properties of Incidence Matrix A- Link Currents - Cut-set and Tree Branch voltages – Tie-set Matrix .		
Unit - IV	**Coupled circuits and Two port network**	**9+3**
Coupled Circuits: Mutual inductance -Dot Convention - Coefficient of Coupling – Analysis of Simple Coupled Circuits. Two port networks**:** Open Circuit Impedance (Z) Parameter - Short Circuit Admittance (Y) Parameter- Transmission (ABCD) Parameters – Hybrid (H) parameters.		
Unit - V	**Passive Filters**	**9+3**
Classification of filters – low pass, High pass, Band pass, and Band elimination filter- Filter network-Equations of filter networks-Classification of pass band and stop band-characteristic impedance in pass band and stop band- Constant k-low pass filter-constant k high pass filter -m-derived T-section – m-derived LPF and HPF.		

Lecture:45, Tutorial:15, Total:60

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.	Abhijit Chakrabarti, "Circuit Theory Analysis and Synthesis", 7th Revised Edition, Dhanapat Rai & Co., New Delhi, 2018.
2.	Smarajit Ghosh, "Network theory Analysis and Synthesis", 9th Reprint, PHI Learning Pvt. Ltd., New Delhi, 2015.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	determine various electrical parameters of AC and DC network using various theorems.	Applying (K3)
CO2	analyze DC and sinusoidal transient response of RL, RC and RLC networks using Laplace transform.	Analyzing (K4)
CO3	elaborate the concept of different network topologies	Applying (K3)
CO4	interpret the concepts of coupled circuits and two port networks	Applying (K3)
CO5	illustrate the working of passive filters.	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	2	3	2	2	1								1	2
CO3	3	2	1	1									1	2
CO4	3	2	1	1									1	2
CO5	3	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	10	70	10			100
CAT2	10	10	70	10			100
CAT3	10	10	80	-			100
ESE	10	10	70	10			100

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

20PHL25 - PHYSICAL SCIENCES LABORATORY II

Prog. & Branch	BE, Electrical and Electronics Engineering	Sem.	Category	L	T	P	Credit
Pre requisite	Nil	2	BS	0	0	2	1

Preamble	This course aims to impart hands on training in the determination of physical parameters such as specific resistance, band gap, hysteresis loss and thickness of a nano-structured material and also the working UJT, and to develop the skills in handling different basic instruments. This course also aims to impart the significance of Cl^-, Cr^{6+}, DO, Fe^{2+} and Cu^{2+} and thereby, to improve the analytical capability.

List of Exercises / Experiments:

1.	Determination of the specific resistance of the material of a wire using Carey-Foster's bridge.
2.	Determination of the band gap of a semiconductor using post office box.
3.	Observation of the I-V characteristics of a uni junction transistor.
4.	Determination of hysteresis loss in a ferromagnetic material.
5.	Determination of the thickness of a nano-structured material using air-wedge arrangement.
6.	Estimation of chloride ion in the given water sample using Argentometric method.
7.	Estimation of chromium (Cr^{6+}) in wastewater sample.
8.	Determination of dissolved oxygen in the given wastewater sample.
9.	Estimation of iron using permanganometry.
10.	Estimation of copper in the given solution by Iodometric method.

Total: 30

REFERENCES:

1.	Tamilarasan K. and Prabu K., "Physics Laboratory Manual", 1st Edition, SCM Publishers, Erode, 2020.
2.	Palanisamy P.N., Manikandan P., Geetha A. and Manjula Rani K., "Chemistry Laboratory Manual", 1st Edition, Kalaikathir Publishers, Coimbatore, 2020.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	determine the specific resistance of conducting materials and the band gap of semiconducting materials using the concept of electrical conductivity and to obtain the V-I characteristics of a UJT using the concept of creation of a region with negative resistance.	Applying (K3), Precision (S3)
CO2	determine the hysteresis loss in ferromagnetic materials using the concept of domain theory of ferromagnetism and to determine the thickness of nano-crystalline thin films using the concept of interference of light. Estimation of Chloride and Chromium (Cr^{6+}) in the given water sample and also to determine the dissolved oxygen in the given wastewater sample.	Applying (K3), Precision (S3)
CO3	estimation of iron and copper in the given solution.	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											
CO2			3											
CO3			3											

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

20MEL11 –ENGINEERING PRACTICES LABORATORY

(Common to ECE, EEE, EIE, CSE & IT Branches)

Programme & Branch	BE (ECE, EEE, EIE, CSE) & BTech (IT)	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	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 Exercises / Experiments:

	PART A – MECHANICAL ENGINEERING
1.	To prepare square or rectangular shaped MS plates using power tools for cutting, polishing and shaping to the required dimensions.
2.	To carryout drilling, tapping and assembly on the given MS plates.
3.	To carryout thread forming on a GI/PVC pipes and prepare water leak proof water line from overhead tank.
4.	To prepare a wood or plywood box/tray/any innovative models using modern power tools like cutting machine, router, jigsaw, power screw driver etc.
5.	Welding practice through arc welding / simulator
	PART B – ELECTRICAL AND ELECTRONICS ENGINEERING
1.	Safety Aspects of Electrical Engineering, Electrical Symbols, Components Identification, Fuse selection and installation, Circuit Breakers selection
2.	Wiring circuit for fluorescent lamp and Stair case wiring
3.	Measurement of Earth resistance
4.	Soldering of Simple Circuits and trouble shooting
5.	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), Precision (S3)
CO2	identify and use appropriate modern power tools and complete the exercises/models accurately	Applying (K3), Precision (S3)
CO3	select fuses and Circuit breakers	Understanding (K2), Manipulation (S2)
CO4	perform house wiring and realize the importance of earthing	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	2		3	3	2	1			3	3		3		
CO2	2		3	3	2				3	3		3		
CO3	3		3	3	1				2	2		3		
CO4	3		3	3	1				2	3		3		
CO5	3		3	3	1				2	2		3		

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

20MAT32 - PROBABILITY, TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS

(Common to Electrical and Electronics Engineering & Electronics and Instrumentation Engineering branches)

Programme & Branch	B.E. - Electrical and Electronics Engineering, Electronics and Instrumentation Engineering branches	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	3	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 probability and partial differential equations and express functions in terms of Fourier series.	
Unit - I	**Random Variables and Probability distributions:**	**9+3**
Random Variables: Introduction – Discrete and Continuous random variables – Probability Mass and Probability density functions – Mathematical expectation and Variance – Moments – Moment generating functions. Standard Probability Distributions: Discrete Distributions: Binomial distribution – Poisson distribution – Continuous Distributions: Exponential distribution – Normal distribution.		
Unit - II	**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 - III	**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 - IV	**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 - V	**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.		

Lecture: 45, Tutorial: 15, Total: 60

TEXT BOOK:

1. Ravish R Singh, Mukul Bhatt "Engineering Mathematics", 1st Edition, McGraw Hill Education, New Delhi, 2016.

REFERENCES:

1. Jay L. Devore., "Probability and Statistics for Engineering and the Sciences", 9th Edition, Cengage Learning, USA, 2016.
2. Veerarajan T., "Transforms and Partial Differential Equations", 3rd Reprint, Tata Mc Graw Hill Education Pvt. Ltd., New Delhi, 2013.
3. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, John Wiley & Sons, Limited, 2019.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	classify random variables and apply suitable distributions in practical problems.	Applying (K3)
CO2	express the given function or data in terms of Fourier series.	Applying (K3)
CO3	formulate and solve higher order partial differential equations.	Applying (K3)
CO4	understand the concept of Fourier transform and its properties which will provide the ability to formulate and solve some of the physical problems in engineering.	Understanding (K2)
CO5	possess knowledge of Z transform to analyze linear time invariant 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	3	2											
CO2	3	3	1											
CO3	3	3	1											
CO4	3	3	2											
CO5	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	10	20	70	-	-	-	100
CAT2	10	20	70	-	-	-	100
CAT3	10	10	80	-	-	-	100
ESE	10	20	70	-	-	-	100

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

20CSC31 - PROGRAMMING IN C
(Common to all BE/BTech Engineering & Technology branches except CSE, IT)

Programme & Branch	All BE/BTech Engineering & Technology branches except CSE, IT	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	2/3	ES	3	0	2	4

Preamble	The course is designed for use by freshmen students taking their first course in programming. It deals with the techniques needed to practice computational thinking, the art of using computers to solve problems and the ways the computers can be used to solve problems. This course also focuses on developing programming skills using C language.	
Unit - I	**Introduction to Computer and Problem Solving:**	**9**
Overview of computers : Types, Generations, Characteristics, Basic computer Organization – Problem solving techniques: Algorithms - Flowcharts – Pseudo codes – Structuring the logic: Sequential, selection and repetitive structure		
Unit - II	**Introduction to C and Control Statements:**	**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 - decision making and looping statements		
Unit - III	**Arrays and Functions:**	**9**
Declaring, initializing and accessing arrays – operations on arrays – Two dimensional arrays and their operations. 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, passing arguments to function using pointers -pointers and 1D arrays –arrays vs pointers , 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 Exercises:

1.	Writing algorithms and drawing flowcharts using Raptor Tool for problems involving sequential, Selection and repetition structures
2.	Programs for demonstrating the use of different types of operators like arithmetic, logical, relational and ternary operators
3.	Programs using decision making and repetitive statements
4.	Programs for demonstrating one-dimensional and two-dimensional numeric array
5.	Programs to demonstrate modular programming concepts using functions and strings (Using built-in and user-defined functions)
6.	Programs to illustrate the use of structures and pointers
7.	Programs to implement file operations

Lecture:45, Practical : 30, Total:75

TEXT BOOK:

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

REFERENCES:

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.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1:	outline the basics of computers and apply problem solving techniques to express the solution for the given problem	Applying (K3)
CO2:	identify the appropriate looping and control statements in C and develop applications using these statements	Applying (K3)
CO3:	develop simple C programs using the concepts of arrays and modular programming	Applying (K3)
CO4:	apply the concepts of pointers and develop C programs using strings and pointers	Applying (K3)
CO5:	make use of user defined data types and file concept to solve given problems	Applying (K3)
CO6:	demonstrate the execution of flowcharts for the given problem using Raptor	Applying (K3), Precision (S3)
CO7:	demonstrate the application of sequential, selective and repetitive control structures	Applying (K3), Precision (S3)
CO8:	develop solutions to the given problem using derived /user defined data types and functions and also using file concepts	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		
CO2	3	2	2						1	1		1		
CO3	3	2	2						1	1		1		
CO4	3	2	2						1	1		1		
CO5	3	2	2						1	1		1		
CO6	3	2	2	2	1				1	1		1		
CO7	3	2	2	2	1				1	1		1		
CO8	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	20	30	50				100
CAT2	10	30	60				100
CAT3	10	30	60				100
ESE	20	30	50				100

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

20EET31 - DC MACHINES AND TRANSFORMERS

Programme & Branch	B.E & Electrical and Electronics Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	3	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.		
Unit - II	**DC Generators:**	**9+3**
Constructional Details – Working Principle – Types of Armature Winding and Connections – 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 – 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.		
Unit - V	**Testing of Transformer:**	**9+3**
Losses and Efficiency in Transformers – Condition for Maximum Efficiency – Testing of Transformers – 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. Instrument Transformers: Current Transformer – Potential Transformer.		

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, 2003.

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	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
CO2	3	2	1										2	3
CO3	3	1											1	2
CO4	3	2	1	2									2	3
CO5	2	3	1	2	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	50	30				100
CAT2	15	40	35	10			100
CAT3	15	40	35	10			100
ESE	15	40	35	10			100

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

20EET32 - ANALOG ELECTRONICS

Programme & Branch	B.E & Electrical and Electronics Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Electric Circuits and Electron Devices	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	**Cascade, Differential and Power Amplifiers:**	**9**
h parameters – Hybrid model of BJT – Cascade amplifiers (two-stage) – applications – Differential Amplifier using BJT – Differential and Common Mode Gain, CMRR – Classification of Power Amplifiers – Transformer Coupled Class A, Class B Push Pull Amplifiers		
Unit - II	**Feedback Amplifiers and Oscillators:**	**9**
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 Wien Bridge Oscillators – Colpitts, Hartley Oscillators – Astable and Monostable Multivibrator		
Unit - III	**Operational Amplifier:**	**9**
Basic Information of Operational Amplifier – Block Diagram and Internal Circuits of Operational Amplifier – Circuit Schematic of IC741 – Ideal Operational Amplifier Characteristics, Transfer Characteristics – DC Characteristics – AC Characteristics – Frequency Response, Stability – Frequency Compensation Techniques – CMRR and Slew Rate		
Unit - IV	**Basic Op-amp Applications:**	**9**
Inverting and Non-Inverting Amplifiers, Voltage Follower – Adder – Subtractor – Instrumentation Amplifier – Differentiator – Integrator – V/I and I/V Converter – Comparator – Regenerative Comparator – Square Wave Generator – Triangular Wave Generator – Schmitt Trigger – VCO- PLL: Basic principle – 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 its 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 ", 4th Edition, S.Chand & Co. Ltd., New Delhi, 2014 for Units I,II.
2. Roy Choudhry D. and Shail Jain, " Linear Integrated Circuit ", 5th Edition, New Age International, New Delhi, 2018 for Units III, IV, V.

REFERENCES:

1. Salivahanan S. and Suresh Kumar N., "Electronic Devices and Circuit ", 4th Edition, Tata McGraw Hill Publishing Company, New Delhi, 2017.
2. 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	explain the working and characteristics of cascade, differential, power amplifiers	Understanding (K2)
CO2	illustrate the operation of feedback amplifiers and oscillators	Understanding (K2)
CO3	describe the construction, characteristics and frequency response of op-amps.	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									2	1
CO2	3	2	1	1									2	1
CO3	3	2	1	1									2	1
CO4	2	3	2	1									3	2
CO5	2	3	2	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	40	60					100
CAT2	30	70					100
CAT3	20	60	20				100
ESE	30	40	30				100

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

20EET33 - DIGITAL ELECTRONICS

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

Preamble	This course aims to impart knowledge on combinational and sequential logic circuits that aids the students to perform analysis and design of various digital logic circuits and also write the verilog HDL code for logic circuit.	
Unit - I	**Review of Number Systems and Logic Families:**	**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, 4 bit.		
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-Design of synchronous up/down counter.		
Unit - IV	**Asynchronous Sequential Circuits:**	**9**
Design procedure of Asynchronous sequential circuits – Fundamental mode sequential circuits – Design Procedure for Fundamental mode Asynchronous sequential circuits – Hazards: Static Hazards - Dynamic Hazards – Hazard free Realization – Essential Hazards – Classification of ROM and RAM – PLA– PAL– SPLDS–CPLDS– FPGA.		
Unit - V	**Verilog HDL:**	**9**
Overview of Verilog HDL – Hierarchical Modelling Concepts – Basic Concepts – Modules and Ports – Gate level modelling – Gate level description using Verilog HDL for Adders, subtractors, Decoders, Encoders, Multiplexers, Demultiplexers – Magnitude comparators		

Total:45

TEXT BOOK:

1. Soumithra Kumar Mandal, "Digital Electronics Principles and Applications", 11th 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", 2nd Edition, Pearson Education, New Delhi, 2017 for Unit V.

REFERENCES:

1. Anand Kumar 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.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	discuss number systems, Boolean rules and 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, PLDs	Applying (K3)
CO5	develop Verilog 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									1	2
CO2	3	2	1	1									1	2
CO3	2	3	2	2	1								1	2
CO4	3	2	1	1									1	2
CO5	3	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	30	60				100
CAT2	10	10	60	20			100
CAT3	10	10	80				100
ESE	10	20	50	20			100

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

20EEL31 - DC MACHINES AND TRANSFORMERS LABORATORY

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

List of Exercises / Experiments:

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.	Load test on DC shunt motor.
6.	OC and SC test of 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									2	3
CO2	2	3	2	2	1								3	2
CO3	2	3	2	2	1								3	2

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

20EEL32 - ANALOG AND DIGITAL ELECTRONICS LABORATORY

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

List of Exercises / Experiments :

1.	Design of astable multivibrator using BJT.
2.	Design of RC phase shift oscillators using BJT.
3.	Design of integrator and differentiator circuit using op-amp.
4.	Design a monostable multivibrator using Op-Amps /IC 555.
5.	Design of active filters for the given specifications and obtain their frequency response characteristics using op-amps.
6.	Verification of logic gates (Discrete components/Verilog HDL).
7.	Design and implementation of adders and subtractors (Discrete components/Verilog HDL).
8.	Simulation of code converters and flip-flops using Verilog HDL.
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 verilog 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									2	3
CO2	3	2	1	1									2	3
CO3	2	3	2	2	1	2							2	3

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

20EGL31 - ENGLISH FOR WORKPLACE COMMUNICATION LABORATORY

(Common to all BE/BTech Engineering and Technology branches)

Programme & Branch	All BE/BTech Engineering & Technology branches	Sem.	Category	L	T	P	Credit
Prerequisite	Nil	3 / 4	HS	0	0	2	1

Preamble:	This course is designed to impart required levels of fluency in using the English Language at B1/B2 level in the CEFR through activities, hands-on training and application.	
Unit -I	**Listening:**	**6**
Techniques for effective listening and note taking; listening to audio scripts, podcasts and TED talks; listening to discourse samples of native speakers and imitating; improving pronunciation; introduction to the basics of phonetics and understanding different accents.		
Unit -II	**Reading:**	**6**
Speed reading skills; reading to gain knowledge; reading newspaper articles to improve writing; academic journals to enrich vocabulary and word power; reading aloud with proper stress and intonation; reading to draw inferences.		
Unit -III	**Soft Skills:**	**6**
Importance of soft skills at workplace - understanding soft skills through case studies - developing positive attitude; goal setting; time management; team work; telephone etiquette; developing professionalism, interpersonal skills and work ethics.		
Unit -IV	**Writing:**	**6**
Introduction to pre-writing, style and mechanics of writing; mind mapping; creating content from an outline; paragraph and resume writing; nuances of academic writing; writing Statement of Purpose (SOP), editing, revising and proof reading for clarity and readability; structural and grammatical accuracy.		
Unit -V	**Speaking:**	**6**
Verbal and non-verbal communication; fluency and spoken English; introducing oneself and others; making presentations on topics using prepared material; mock interviews; dynamics of Group Discussion.		

List of Exercises / Experiments :

1.	Mock Interview
2.	Presentation
3.	Reading Aloud
4.	Group Discussion
5.	Soft Skills through Case Studies
6.	Listening Test

Total: 30

REFERENCES/MANUAL/SOFTWARE:

1.	Jeff Butterfield, “Soft Skills for Everyone”, 1st Edition, Cengage Learning, New Delhi, 2011.
2.	Bob Dignen, Steve Flinders and Simon Sweeney, “Professional English for Work and Life, English 365, Student’s Book 2”, 1st Edition, Cambridge University Press, New Delhi, 2004.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1:	acquire effective listening and reading skills	Understanding (K2), Imitation (S1)
CO2:	acquire and demonstrate appropriate professional skills for the workplace	Applying (K3), Naturalization (S5)
CO3:	speak fluently and write meaningfully in English in the given context	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	PSO1	PSO2
CO1									2	3		2		
CO2									2	3		2		
CO3									3	3		3		

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

20GET31 - UNIVERSAL HUMAN VALUES
(Common to All BE/BTech branches)

Programme & Branch	All BE/BTech Engineeirng & Technology branches	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	3 / 4	HS	2	0	0	2

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

Total: 30

TEXT BOOK:

1. Gaur R.R., Sangal R., Bagaria G.P., "A Foundation Course in Human Values and Professional Ethics", 1st Edition, Excell Books Pvt. Ltd., New Delhi, 2016.

REFERENCES:

1. Ivan Illich, "Energy & Equity", The Trinity Press, USA, 1974.
2. Schumacher E.F., "Small is Beautiful: a study of economics as if people mattered", Britain, 1973.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	restate the meaning of happiness and prosperity and do a correct appraisal of the current scenario in the society	Applying (K3)
CO2	distinguish between the Self and the Body, understand the meaning of Harmony in the Self, the Co–existence of Self and Body	Applying (K3)
CO3	infer the value of harmonious relationship based on trust, respect and other naturally acceptable feelings in human–human relationships and explore their role in ensuring a harmonious society	Applying (K3)
CO4	transform themselves to co-exist with nature by realising interconnectedness and four order of nature	Applying (K3)
CO5	distinguish between ethical and unethical practices, and extend ethical and moral practices for a better living	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						3	3	3	3	3				
CO2						3	3	3	3	3				
CO3						3	3	3	3	3				
CO4						3	3	3	3	3				
CO5						3	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	25	75					100
CAT2	25	75					100
CAT3	NA						
ESE	NA						

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

20MAT41 - STATISTICS AND NUMERICAL METHODS

(Common to all Engineering and Technology Branches except ECE, CSE and IT)

Programme & Branch	All BE/BTech branches except ECE, CSE and IT branches	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	4	BS	3	1	0	4

Preamble	To impart knowledge in testing of samples, ANOVA and interpolation. Also develop skills to apply numerical algorithms to identify roots of algebraic and transcendental equations and solve linear and ordinary differential equations.	
Unit - I	**Testing of Hypothesis:**	**9+3**
Introduction – Critical region and level of significance – Types of Errors – Large sample tests: Z-test for single proportion and difference of two sample proportions – Z-test for single mean and difference of means – Small sample tests: Student's t-test for testing significance of single mean and difference of means – F-test for comparison of variances – Chi-square test: Test of goodness of fit – Test of independence of attributes.		
Unit - II	**Design of Experiments:**	**9+3**
Introduction – Analysis of variance – One way classification: Completely Randomized Design – Two way classification: Randomized Block Design – Three way classification: Latin Square Design.		
Unit - III	**Solution to Algebraic and Transcendental Equations:**	**9+3**
Method of false position – Newton-Raphson method – Solution of linear system of equations – Direct methods: Gauss elimination method and Gauss - Jordan method – Iterative methods: Gauss Jacobi and Gauss-Seidel methods.		
Unit - IV	**Interpolation, Numerical Differentiation and Integration:**	**9+3**
Interpolation: Interpolation with equal intervals: Newton's forward and backward difference formulae – Interpolation with unequal intervals: Lagrange's interpolation formula – Newton's divided difference formula. Numerical Differentiation and Integration: Differentiation using Newton's forward, backward and divided difference formulae – Numerical integration: Trapezoidal rule – Simpsons 1/3rd rule.		
Unit - V	**Numerical Solution of First order Ordinary Differential Equations:**	**9+3**
Single step methods: Taylor series method – Euler method – Modified Euler method – Fourth order Runge-Kutta method – Multi step methods: Milne's predictor corrector method – Adam's Bashforth method.		

Lecture: 45, Tutorial: 15, Total: 60

TEXT BOOK:

1. Veerarajan T., Ramachandran T., "Statistics and Numerical Methods", 1st Edition, Tata McGraw Hill Publishing Company, New Delhi, 2018.

REFERENCES:

1. Walpole R.E., Myers R.H., Myers S.L. and Ye K., "Probability and Statistics for Engineers and Scientists", 9th Edition, Pearson Education, Asia, 2012.
2. Jay L. Devore, "Probability and Statistics for Engineering and the Sciences", 9th Edition, Cengage Learning, USA, 2016.
3. Steven C. Chapra, Raymond P. Canale, "Numerical Methods for Engineers", 7th Edition, McGraw-Hill Education, 2014.
4. Ravish R. Singh, Mukul Bhatt, "Engineering Mathematics", 1st Edition, McGraw Hill Education, New Delhi, 2016.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	apply statistical tests for solving engineering problems involving small and large sample tests.	Applying (K3)
CO2	handle experimental data with the knowledge of ANOVA.	Applying (K3)
CO3	apply various numerical techniques to solve algebraic and transcendental equations	Applying (K3)
CO4	compute intermediate values of given data, numerical derivatives and integral values	Applying (K3)
CO5	obtain the solution of first ordinary differential equations by numerical methods.	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	3										
CO2	3	2	1	3										
CO3	3	3	2											
CO4	3	2												
CO5	3	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	20	70				100
CAT2	10	20	70				100
CAT3	10	20	70				100
ESE	10	30	60				100

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

20CSC41 – PYTHON PROGRAMMING
(Common to all BE/BTech Engineering & Technology branches except CSE, IT)

Programme & Branch	All BE/BTech Engineering & Technology branches except CSE, IT	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	3/4	ES	3	0	2	4

Preamble	This course introduces the core python programming. It emphasizes on developing python programs with all data types, functions, classes, objects and numpy	
Unit - I	**Introduction:**	**9**
Introduction: 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,Tuples and Dictionary: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 and Regular Expressions: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 and Modules: 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, NumPy and Matplotlib:**	**9**
Object Orientation: 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 Exercises / Experiments :

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 Edition, Oxford University Press, 2017.

REFERENCES:

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", 1st Edition, O'Reilly Media, , 2016.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	make use of basic python constructs to write simple programs.	Applying (K3)
CO2	apply list, tuple and dictionary to handle variety of data.	Applying (K3)
CO3	apply strings and regular expression for searching in a string.	Applying (K3)
CO4	solve the problems using functions and modules.	Applying (K3)
CO5	understand the class and object and apply inheritance in programming.	Applying (K3)
CO6	implement the basic data types and control statements.	Applying (K3), Manipulation (S2)
CO7	demonstrate functions, regular expressions and object oriented concepts.	Applying (K3), Manipulation (S2)
CO8	perform numpy operations and analyse results using matplotlib	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										
CO2	3	2	1	1										
CO3	3	2	1	1										
CO4	3	2	1	1										
CO5	3	2	1	1										
CO6	3	2	1	1										
CO7	3	2	1	1										
CO8	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	25	50				100
CAT2	20	20	60				100
CAT3	20	20	60				100
ESE	25	25	50				100

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

20EET41 SYNCHRONOUS AND INDUCTION MACHINES

Programme & Branch	B.E & Electrical and Electronics Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	DC Machines and Transformers	4	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 – 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		
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 – Applications.		
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, 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 basic constructional and working principle of synchronous and induction machines	Understanding (K2)
CO2	compute the performance of AC machines with different parameters	Applying (K3)
CO3	analyze the performance characteristics of induction machines	Analyzing (K4)
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	Applying (K3)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	1											1	2
CO2	3	2	1	1									2	3
CO3	2	3	2	2	1								3	2
CO4	3	2	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	50	40				100
CAT2	10	50	30	10			100
CAT3	10	60	30				100
ESE	15	50	25	10			100

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

20EET42 ELECTROMAGNETIC THEORY

Programme & Branch	B.E & Electrical and Electronics Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Applied Physics	4	PC	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 – Calculus of Scalar and Vector Fields in Cartesian and Curvilinear Coordinates – 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 – Energy Stored. 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		**9**
Steady Magnetic Fields: Biot-Savart's Law – Ampere's Circuital 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 – Comparison of Circuit Theory with Field Theory **Electromagnetic Waves (Elementary Ideas only**): Introduction – Wave Equations and Parameters – Wave Propagation in Lossless Dielectrics and Lossy Dielectric(Qualitative analysis) – Poynting vector, Poynting Theorem, Introduction to FEM analysis.		
Unit - V	**Electromagnetic Interference and Compatibility (Theoretical Aspects only)**	**9**
Introduction to Electromagnetic Interference and Electromagnetic Compatibility (EMI & EMC) – Sources and Characteristics of EMI – Control Techniques of EMI – Grounding – Shielding – Filtering		

Total:45

TEXT BOOK:

1. Sadiku Matthew N.O., "Principles of Electromagnetics", 6th Edition, Oxford University Press, New Delhi, 2015.

REFERENCES:

1. Hayt Jr W.H., Buck J.A., Jaleel Akhtar M.," Engineering Electromagnetics " 9th Edition McGraw Hill Education, India, 2020.
2. Gottapu Sasibhushana Rao., "Electromagnetic Field Theory and Transmission Lines", 1st Edition, John Wiley and sons, India, 2013

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	recognize the various coordinate systems and charge distribution	Understanding (K2)
CO2	apply Gauss's law for the evaluation of EFI for different configurations and its application in capacitor	Applying (K3)
CO3	interpret the MFI and inductance for different configurations	Applying (K3)
CO4	examine the electromagnetic wave propagation in different mediums	Applying (K3)
CO5	summarize 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											2	3
CO2	3	2	1										2	3
CO3	3	2	1										2	3
CO4	3	2	1										2	3
CO5	3	2											2	3

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

ASSESSMENT PATTERN - THEORY

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

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

20EET43 GENERATION, TRANSMISSION AND DISTRIBUTION

Programme& Branch	B.E. & Electrical and Electronics Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Applied Physics	4	ES	3	1	0	4

Preamble	This course is aimed to introduce the fundamental concepts and principles in generation, transmission, and distribution of electric power	
Unit - I	**Generation**	**9+3**
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 power generation - fuel handling – Ash handling – dust collection- auxiliaries - schematic arrangement of hydroelectric power generation – Classification – IE Rules		
Unit - II	**Electrical Design of Transmission Lines**	**9+3**
Parameters of Transmission Line – Resistance – Skin and Proximity Effects – Solid, Stranded and Bundled Conductors – 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+3**
Short Line, Medium Line (PI model) and Long Line; Equivalent Circuits, Attenuation Constant, Phase Constant, Surge Impedance; Transmission Efficiency and Voltage Regulation; Surge Impedance Loading – Ferranti Effect Corona: Phenomena of Corona – Factors Affecting Corona – Disruptive Critical Voltage – Visual Critical Voltage – Corona Loss (Qualitative analysis)		
Unit - IV	**Mechanical Design of Transmission Lines**	**9+3**
Insulators: Types, Voltage Distribution in Insulator String and Grading, Improvement of String Efficiency – Failure of Insulators Sag and Tension Calculations: Classification of towers, Sag and Tension in OH lines – Equation of Sag- Calculation of Sag – Towers at Equal Heights – Unequal Heights		
Unit - V	**Distribution Systems**	**9+3**
Components of Distribution System – Types – DC Distribution: DC Distributor – Concentrated and Uniform Loading. AC Distribution: AC Distributor – Concentrated Load – Three Phase Four Wire Distribution System – Sub-Mains – Stepped and Tapered Mains - Kelvin‘s Law. Underground Cables: Constructional Features of LT and HT Cables, Capacitance, Dielectric Stress and Grading, Thermal Characteristics(Qualitative analysis) – Cable Faults and Testing		

Lecture:45, Tutorial:15, Total:60

TEXT BOOK:

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

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, McGraw Hill Education, 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	apply the transmission network parameters for various configurations	Applying (K3)
CO3	examine the performance characteristics of the given transmission line and explain the effect of corona	Applying (K3)
CO4	solve string efficiency of the insulators and Sag of an overhead line for various conditions	Applying (K3)
CO5	calculate the voltage at a point on the given type of distribution system and compute the insulation resistance, capacitance and grading 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	2	1										3	1
CO2	3	2	1										3	1
CO3	3	2	1										3	1
CO4	3	2	1										3	2
CO5	3	2	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	50	30				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)**

20EEL41 SYNCHRONOUS AND INDUCTION MACHINES LABORATORY

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

List of Exercises / Experiments :

1.	Regulation of three-phase alternator by EMF method.
2.	Regulation of three-phase alternator by MMF method.
3.	Regulation of three-phase alternator by ZPF method.
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								3	2
CO2	3	2	1	1									2	3
CO3	3	2	1	1									2	3

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

20EEL33 ELECTRONIC DESIGN LABORATORY

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

List of Exercises / Experiments :

1.	Design and fabrication of constant voltage power supply
2.	Design and fabrication of variable voltage power supply
3.	Design and fabrication of LED based water level indicator
4.	Design and fabrication of isolation circuit using opto coupler
5.	Design and fabrication of driver circuit to control a motor using electromagnetic relay

Total:30

REFERENCES/MANUAL/SOFTWARE:

1.	Laboratory Manual
2.	YouTube Do It Yourself (DIY) videos

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	Design a constant and variable power supply	Understanding (K2), Imitation(S1)
CO2	Design a simple home based simple applications	Applying(K3), Manipulation (S2)
CO3	Design control circuits for various applications	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	3	1	1				3			2	3
CO2	3	3	2	3	1	1				3			2	3
CO3	3	3	2	3	1	1				3			2	3

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

20MNT31 - ENVIRONMENTAL SCIENCE

Programme & Branch	All BE/BTech Engineering & Technology branches	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	3 / 4	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- Value 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.
2. Lodish. H., Berk A., Zipurursky S.L., Matsudaria P., Baltimore D. and Darnell J., “Molecular Cell Biology”, 4th Edition, Freeman Press, 2000.

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. Satyanarayan U.,& Chakrapani U., “Textbook of Biochemistry”,1999 Ed. June 2017.

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

Mapping of COs with POs and PSOs

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

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

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	25	40	35				100
CAT2	25	40	35				100
CAT3	NA						100
ESE	NA						100

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

20EET51 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	**Power Semi Conductor Devices**	**9**
Introduction – Power Diode – Power BJT – Power MOSFET and IGBT - SCR - TRIAC - GTO - Construction, Principle of operation, Static and Dynamic characteristics - Thyristor Protection – Series and parallel connections of thyristors – Data sheet interpretation		
Unit - II	**Single Phase AC to DC Converters**	**9**
Introduction to uncontrolled rectifier – Single Phase and three phase Controlled Rectifiers with R, RL, RL with freewheeling diode and RLE Load – Estimation of performance parameter: RMS load voltage, RMS load current, Power Factor and Distortion Factor – Effect of source inductance – PWM Rectifier.		
Unit - III	**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 – Introduction to Voltage regulator – Buck, Boost, Buck – Boost – Cuk Regulator – SMPS.		
Unit - IV	**DC to AC Converters**	**9**
Single Phase Bridge Inverters – Three Phase Bridge Inverters: 180o and 120o 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 – Basic series inverter – UPS.		
Unit - V	**AC Voltage Controllers and Cycloconverters**	**9**
Principle of AC voltage controller (phase control) – Control Strategy (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. Bimbra P.S., "Power Electronics", 6th Edition, Khanna Publishers, New Delhi, 2015.

REFERENCES:

1. Singh M.D. and Kanchandani, "Power Electronics", 2nd Edition, Tata McGraw-Hill, New Delhi, 2016.
2. Rashid M.H., "Power Electronics: Circuits Devices and Applications", 4th Edition, Pearson Education, New Delhi, 2014.

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	2
CO2	3	2	1	1									2	3
CO3	3	1	1										2	3
CO4	3	2	1	1									1	3
CO5	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	20	50	30				100
CAT2	20	50	30				100
CAT3	20	50	30				100
ESE	20	50	30				100

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

20EET52 POWER SYSTEM ANALYSIS

Programme & Branch	B.E & Electrical and Electronics Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Electromagnetic Theory, Generation, Transmission and Distribution	5	PC	3	0	0	3

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**
Introduction – per unit quantities – changing the base of per unit quantities-one line diagram – impedance and reactance diagram – per unit impedances of a generator, transformer, synchronous machines, transmission lines – per phase representation.		
Unit - II	**Load Flow studies**	**9**
The bus admittance matrix, network incidence matrix and node elimination, power flow problem, Gauss-Siedel method, Newton-Raphson method, Fast Decoupled Load Flow method, Numerical solution of power flow problem by GS method upto three buses		
Unit - III	**Symmetrical Faults in Electrical systems**	**9**
Types of Fault – Need for short circuit study – bus impedance matrices – symmetrical fault analysis – fault calculation using Thevenin's Theorem – fault calculations using Z-bus – selection of circuit breakers		
Unit - IV	**Unsymmetrical Faults in Electrical systems**	**9**
Synthesis of unsymmetrical phasors from their symmetrical components – sequence impedance and sequence network of power system, synchronous machine, transmission lines and transformers. single line-to -ground fault, line-to- line fault, double line-to- ground fault.		
Unit - V	**Stability Analysis**	**9**
Introduction to power system stability – Rotor dynamics and the Swing equation – power angle equation – equal area criterion of stability – Critical clearing angle and time – transient stability studies – factors affecting transient stability. – Multimachine stability studies: classical representation – step by step solution of the swing curve.		

Total:45

TEXT BOOK:

1. Debapriya Das," Electrical Power Systems", 1st Edition, New Age International Publishers Pvt. Ltd, New Delhi, 2006

REFERENCES:

1. Grainger John J.& Stevenson W.D, "Power System Analysis", 1st Edition, Tata McGraw- Hill, New Delhi, 2017.
2. Nagrath I.J.& Kothari D.P, "Modern Power System Analysis", 4th Edition, Tata McGraw- Hill, New Delhi, 2011.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	model various power system components	Understanding (K2)
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	1											3	1
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	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	20	40	40				100
CAT2	20	30	50				100
CAT3	20	30	50				100
ESE	20	30	50				100

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

20EET53 CONTROL SYSTEMS

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

Preamble	The aim of the subject is to give an adequate exposure to transfer function model, State Space model, Stability analysis, compensator and controller design	
Unit - I	**Systems and Representation**	**9**
Basic Elements in Control Systems: Open and Closed Loop Systems – Transfer Function of Electrical, Mechanical and Thermal Systems – Force – Current and Force – Voltage Analogy of Systems – AC and DC Servomotors – Block Diagram Reduction Techniques – Signal Flow Graphs		
Unit - II	**Time Domain Analysis**	**9**
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 – Routh Hurwitz Stability Criterion		
Unit - III	**Frequency Response**	**9**
Bode Plot – Polar Plot – Nyquist Stability Criterion – Correlation between Frequency Domain and Time Domain Specifications		
Unit - IV	**Controller and Compensator Design**	**9**
Root Locus Plots of Typical Systems – Root Locus Analysis - P, PI, PD and PID – Effects of P, PI, PID modes of Feedback Control – Design of Lag, Lead, lead-lag Compensator using Root Locus Plots		
Unit - V	**State Variable Analysis**	**9**
Concept of State Variables – State Models for Linear and Time Invariant Systems – Solution of State and Output Equation in Controllable Canonical Form – Concepts of Controllability and Observability		

Total:45

TEXT BOOK:

1. Nagarath, I.J. & Gopal, M., "Control Systems Engineering", 6th Edition, New Age International Pvt.Ltd, New Delhi, 2017

REFERENCES:

1. Katsuhiko Ogata, "Modern Control Engineering", 5th Edition ,Pearson, New Delhi, 2015
2. Benjamin C. Kuo, Automatic Control Systems, 10th Edition, Mc Graw Hill Education, New Delhi, 2017

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	develop mathematical model of electrical , mechanical and thermal system	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 the mathematical model of linear continuous control systems using state space 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	1											2	1
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	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	30	30	20			100
CAT2	20	30	30	20			100
CAT3	20	30	30	20			100
ESE	20	30	30	20			100

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

20EEL51 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

List of Exercises / Experiments:

1.	Steady state characteristics of SCR.
2.	Single Phase Half controlled and Fully controlled rectifiers.
3.	Three Phase fully controlled rectifiers.
4.	Step down and step up converter.
5.	Three Phase inverters – 180° and 120° mode of operation.
6.	Three Phase AC voltage controller.
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								3	2
CO2	3	3	2	2	1								3	3
CO3	3	2	1	1									2	3

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

20EEL52 POWER SYSTEMS ANALYSIS LABORATORY

Programme & Branch	B.E & Electrical and Electronics Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Electromagnetic Theory,Generation, Transmission and Distribution	5	PC	0	0	2	1

List of Exercises / Experiments :

1.	Computation of line parameters for single and double circuits.
2.	Modeling of medium transmission lines.
3.	Experimental analysis of transmission line.
4.	Analysis of Ferranti effect.
5.	Analysis of Surge impedance loading.
6.	Formation of bus admittance matrices using Direct inspection method.
7.	Formation of impedance matrices using Z bus building algorithm.
8.	Load flow analysis using Gauss Seidal method.
9.	Symmetrical and Unsymmetrical fault analysis.
10.	Transient and small signal stability analysis: Single-Machine infinite bus system.

Total:30

REFERENCES/MANUAL/SOFTWARE:

1.	Laboratory Manual
2.	MATLAB,AU power, 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	analyze the network matrices to carryout various power system studies	Analyzing (K4), Manipulation (S2)
CO3	compute the stability of the power system and carryout power system studies	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
CO2	3	3	2	2	1								3	2
CO3	3	2	1	1									3	1

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

20EEL53 CONTROL SYSTEM LABORATORY

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

List of Exercises / Experiments :

1.	Determination of Transfer Function Parameters of DC Servomotor.
2.	Determination of Transfer Function Parameters of AC Servomotor.
3.	Analysis of second order time domain specifications of system using MATLAB.
4.	Effect of Addition of Poles and Zeros on System Stability using MATLAB.
5.	Frequency domain analysis with bode plot using MATLAB.
6.	Effect of P,PI,PID controllers on time response of system using MATLAB.
7.	Design and implementation of compensators via root locus using MATLAB.
8.	Stability analysis in time and frequency domain using MATLAB.
9.	State space analysis of second order systems using MATLAB.
10.	Design and implementation of simple controller for real time application.

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	estimate the transfer function of AC and DC servo motor and to analyze the time and frequency response	Analyzing (K4), Manipulation (S2)
CO2	design controller and compensator for the given specifications	Analyzing (K4), Manipulation (S2)
CO3	analyze the stability of the systems and to represent its state space model	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									2	3
CO2	2	3	2	2	1								3	2
CO3	2	3	2	2	1								3	2

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

20GEL51 - PROFESSIONAL SKILLS TRAINING I
(Common to all BE/ BTech / MSc / MCA /BSc Branches)

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

Total: 80

TEXT BOOK:

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

REFERENCES:

1	Bailey Stephen, "Academic Writing: A practical guide for students", Routledge, New York, 2011.
2	Raman, Meenakshi and Sharma, Sangeeta**,** "Technical Communication - Principles and Practice", 3rd Edition, Oxford University Press, New Delhi, 2015.

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 individual and as a team	Applying (K3), Precision (S3)
CO2	solve real time problems using numerical ability and logical reasoning	Applying (K3), Precision (S3)
CO3	apply communication skills effectively to understand and deliver information in various written discourses grammatically with accuracy	Applying (K3), Precision (S3)

Mapping of COs with POs and PSOs

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

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

ASSESSMENT PATTERN - THEORY

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

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

20EET61 MICROPROCESSOR AND MICROCONTROLLER

Programme & Branch	B.E & Electrical and Electronics Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Digital Electronics	6	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 – Architecture – 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 – 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 – 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", 8th Edition, Tata McGraw Hill Education (India) Pvt. Ltd, New Delhi, 2013 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.

REFERENCES:

1. Krishna Kant, "Microprocessors and Microcontrollers: Architecture, programming and system design 8085, 8086, 8051, 8096", 2nd Edition, PHI Learning Pvt. Ltd, New Delhi, 2012.
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											3	2
CO2	3	2											3	2
CO3	3	2	1	1	1								1	3
CO4	3	2	1	1	1								1	3
CO5	3	2											3	3

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

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	15	85					100
CAT2	10	45	45				100
CAT3	10	45	45				100
ESE	5	50	45				100

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

20EET62 ELECTRIC DRIVES AND CONTROL

Programme & Branch	B.E & Electrical and Electronics Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	DC Machines and Transformers, Synchronous and Induction Machines, Control System, Power Electronics	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**
Electrical drives – Advantages of Electrical Drives – Choice of Electrical drives – Fundamental torque equation – speed torque conventions and multiquadrant operation – components of load torque – nature and classification of load torque – Modes of operation – Speed control and drive classification – closed loop control of drives – classes of motor duty – determination of motor rating.		
Unit - II	**Converter/Chopper Fed DC Motor Drives**	**9**
DC motor and their performance – Braking – controlled rectifier fed DC drives – single phase and three phase fully controlled rectifier control of dc separately excited motor – multiquadrant operation of DC separately excited motor fed from fully controlled rectifier – chopper controlled DC drives – chopper control of separately excited DC motors – source current harmonics in chopper.		
Unit - III	**Induction Motor Drives**	**9**
Analysis and performance of three phase induction motor – Stator voltage control – Variable frequency control from voltage sources – Voltage source inverter(VSI) control – cycloconverter control – closed loop speed control and converter rating for VSI and cycloconverter induction motor drives – Rotor resistance control-slip power recovery.		
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 (PM) ac motor drives.		
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 – drive considerations for textile mills – cranes and hoist drives – paper mills – centrifugal pumps.		

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. 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	analyse 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	analyse 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									2	3
CO2	3	2	1	1									2	3
CO3	3	1											1	2
CO4	3	2	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	50	40				100
CAT2	10	60	30				100
CAT3	10	60	30				100
ESE	10	60	30				100

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

20EET63 SIGNALS AND SYSTEMS

Programme & Branch	B.E & Electrical and Electronics Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	6	PC	3	0	0	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	**Standard continuous time signals**	**9**
Standard continuous time signals –Classification -Mathematical operation on continuous time signals–Impulse signal - Classification of continuous time systems- Convolution of continuous time signals-Response of LTI continuous time system using convolution –Unit step response using convolution - Impulse response and transfer function, Response of LTI CT systems using Laplace transform.		
Unit - II	**Discrete time signals and systems**	**9**
Sampling and Aliasing- Standard discrete time signals-Classification of discrete time signal-Mathematical operation on discrete time signal- Classification of discrete time systems - Linear convolution- Representation of discrete time signals as summation of impulses-Response of LTI discrete time systems using discrete convolution-Convolution properties-Computation of linear convolution using matrix method - Circular convolution- Computation of circular convolution using matrix method.		
Unit - III	**Z transform**	**9**
Z-transform of DT signals and systems – Region of convergence – Properties of Z transform and ROC- Inverse Z transform using partial fraction method – Impulse response and transfer function – Convolution and de-convolution using Z transform – Stability in Z-domain – Relation between Laplace transform and Z transform.		
Unit - IV	**Fourier Transform**	**9**
Fourier transform – Properties of FT – FT 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	**Discrete Fourier Transform of discrete time signals**	**9**
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 inverse DFT using FFT.		

Total:45

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

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)
CO2	compare various types of discrete time signals and systems.	Applying(K3)
CO3	interpret the importance of Z-transform in DT signals and systems.	Applying(K3)
CO4	analyze CT and DT signals in frequency domain	Analyzing (K4)
CO5	apply DFT using FFT on various discrete time signals	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									2	3
CO3	3	2	1	1									2	3
CO4	2	3	2	2	1								3	2
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	20	70				100
CAT2	10	20	70				100
CAT3	10	20	50	20			100
ESE	10	20	50	20			100

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

20EEL61 MICROPROCESSOR AND MICROCONTROLLER LABORATORY

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

List of Exercises / Experiments :

1.	Arithmetic operations using 8085 Microprocessor.
2.	Arithmetic operations using 8051 Microcontroller.
3.	Interfacing of switches and relays using Microcontroller 8051.
4.	Interfacing of LED and seven segment LED using Microcontroller 8051.
5.	Interfacing of Keypad and LCD using Microcontroller 8051.
6.	Generating Analog Wave form (Square) Using 8051 Microcontroller.
7.	Interfacing of DC Motor with 8051 Microcontroller system.
8.	Interfacing of Stepper motor with 8051 Microcontroller system.
9.	Case Study 1: Design and develop a simple project using Microcontroller 8051.
10.	Case Study 2: Design and develop a simple closed loop application using Microcontroller 8051.

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	Applying (K3), Precision (S3)
CO2	design interfacing circuits with 8051 microcontroller	Applying (K3), Precision (S3)
CO3	develop microcontroller based systems for real time applications	Analyzing (K4), Precision (S3)

Mapping of COs with POs and PSOs

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

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

20EEL62 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

List of Exercises / Experiments:

1.	Simulation of closed loop control of converter fed DC motor drive.
2.	Simulation of closed loop control of chopper fed DC motor drive.
3.	Simulation of VSI fed Three phase induction motor drive.
4.	Simulation of Three phase synchronous motor drive.
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 SRM 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								3	3
CO2	3	2	1	1									2	3
CO3	3	2	1	1									2	3

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

20EEL63 POWER AND ENERGY LABORATORY

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

List of Exercises / Experiments :

1.	Characteristics of over current/ overvoltage relay.
2.	Characteristics of differential relay/ negative sequence relay.
3.	Measurement of breakdown voltage of liquid dielectric.
4.	VI characteristics of solar PV
5.	Testing of solar PV Modules
6.	Testing of Battery
7.	VI characteristics of fuel cell
8.	Power Quality analysis using Chroma/ WT3000
9.	Simulation of WECS using MATLAB
10.	Simulation of solar-wind hybrid system using MATLAB

Total:30

REFERENCES/MANUAL/SOFTWARE:

1.	Laboratory Manual
2.	MATLAB

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	compute the time current characteristics of analog/digital/numerical relays	Applying (K3), Manipulation (S2)
CO2	understand and analyze the VI characteristics of renewable sources and power quality indices	Applying (K3), Manipulation (S2)
CO3	analyze the testing of solar PV modules, batteries and fuel cell	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
CO2	3	2	3	1									3	1
CO3	3	2	3	1									3	1

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

20EEP61 - PROJECT WORK I

Programme & Branch	B.E. & Electrical and Electronics Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	--	6	EC	0	0	4	2

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

20GEL61 PROFESSIONAL SKILLS TRAINING II
(Common to all BE/ BTech / MSc/ MCA /BSc Branches)

Programme & Branch	B.E. & Computer Science and Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	6	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 & 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: 80

TEXT BOOK:

1	Thorpe, Showick and Edgar 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, 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 individual and 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				3	3		3		3	2		
CO2	3	2				3	3		3		3	2		
CO3		2				3	3		3	3	3	2		

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

ASSESSMENT PATTERN - THEORY

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

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

20GET71 - ENGINEERING ECONOMICS AND MANAGEMENT
(Common to All Engineering And Technology Branches)

Programme & Branch	MBA	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	**Introduction to Economics:**	**9**
Basics Concepts and Principles – Demand and Supply – Law of demand – Determinants - Law of Supply – Determinants - Market Equilibrium.		
Unit - II	**National Income & Management Functions:**	**9**
Circular flow of income - National Income and its measurement techniques. Inflation - Causes of Inflation – Controlling Inflation – Business Cycle. Management Functions: Planning – Organizing – Staffing – Leading and Controlling - Managerial Skills - Levels of Management.		
Unit - III	**Marketing:**	**9**
Core Concepts of Marketing - Four P's of Marketing - New product development - 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 Accounting:**	**9**
Accounting Principles – Financial Statements and its uses – Depreciation: Straight Line and Diminishing Balance Method – Break Even Analysis – Capital Budgeting: Meaning – Methods of capital Budgeting.		

Total:45

TEXT BOOK:

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

REFERENCES:

1.	Geetika, Piyali Ghosh & Purba Roy Choudhury, "Managerial Economics", 3 Edition, McGraw Hill Education, Noida, 2017.
2.	William J. Stevenson, "Operations Management Paperback", 12 Edition, McGraw Hill Education, Noida, 2018.
3.	Jain S.P, Narang K.L, Simmi Agrawal & Monika Sehgal, "Financial Accounting for Management", 1 Edition, Kalyani Publishers, New Delhi, 2018.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	understand demand and supply functions and estimate market equilibrium between demand and supply	Analyzing (K4)
CO2	analyse the impact of macro economic variables in business organisations	Analyzing (K4)
CO3	interpret marketing decisions taken by organisations	Understanding (K2)
CO4	assess suitable operation management concepts in business situations	Evaluating (K5)
CO5	apply accounting and financial concepts in decision making	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			
CO2											3			
CO3											3			
CO4											3			
CO5											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	20	20			100
CAT2	20	20	40	20			100
CAT3	20	20	20	20	20		100
ESE	20	20	30	10	20		100

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

20EET71 POWER SYSTEM PROTECTION AND SWITCHGEAR

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

Preamble	The objective of the course is to impact knowledge about the need for protective relays in power systems, protective relays used for the protection of Generators, Transmission line, and Transformers. The course will also describe the various types of circuit breakers and advanced relays used in power system.	
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 – 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		
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 – Digital signal processing in numerical relay – Digital Filtering – Numerical Over current protection – Numerical Transformer Differential Protection – Numerical distance protection of transmission line – Arc flash relays – Shielded solid insulation switchgear – Green switchgear.		

Total:45

TEXT BOOK:

1.	Gupta J.B, "A Course in Power Systems", 11th Edition, S.K.Kataria & Sons, New Delhi, 2017 for Units I, II, III, IV.
2.	Paithankar Y.G & Bhide S.R, “Fundamentals of Power System Protection”, 2nd Edition, Prentice–PHI Learning Private Limited, 2010 for Unit V.

REFERENCES:

1.	Badri Ram & Vishwakarma D.N, "Power System Protection and Switchgear", 2nd Edition, Tata McGraw Hill, New Delhi, 2011.
2.	Madhava Rao T.S, “Digital/Numerical Relays”, 1st Edition, Tata McGraw Hill, 2005.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	outline the basic concepts of protection	Understanding (K2)
CO2	select the protection schemes for power system components	Applying (K3)
CO3	analyze the various problems in circuit interruption	Applying (K3)
CO4	compare the different type of circuit breakers performances	Understanding (K2)
CO5	understand the advanced relays	Understanding (K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1											3	1
CO2	3	2	1	1	1								3	2
CO3	3	2	1	1	1								3	2
CO4	3	1											3	1
CO5	3	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	20	60	20				100
CAT2	20	60	20				100
CAT3	30	70					100
ESE	20	60	20				100

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

20EEP71 - PROJECT WORK II PHASE I

Programme & Branch	B.E. & Electrical and Electronics Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	--	7	EC	0	0	6	3

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

20EEP81 - PROJECT WORK II PHASE II

Programme & Branch	B.E. & Electrical and Electronics Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	---	8	EC	0	0	14	7

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

20EEE01 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 – data sheet interpretation of power 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 – data sheet interpretation of power transistors.		
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 – data sheet interpretation of power thyristor.		
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 ", 4th Edition, Pearson Education., New Delhi, 2014.

REFERENCES:

1. Ned Mohan, Undeland and Robbin, “Power Electronics: converters, Application and design”, 3rd Edition, John Wiley and sons, 2007
2. 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	explain the basic principle and operation of Diode.	Understanding (K2)
CO2	explicate the basic principle and operation of transistor	Understanding (K2)
CO3	describe the principle and operation of power thyristors	Understanding (K2)
CO4	demonstrate the principle and operation of thyristor firing and commutation techniques	Applying (K3)
CO5	design and analyze firing and protection circuits.	Applying (K3)

Mapping of COs with POs and PSOs

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

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

ASSESSMENT PATTERN - THEORY

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

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

20EEE02 ELECTRICAL DISTRIBUTION SYSTEM ANALYSIS

Programme & Branch	B.E & Electrical and Electronics Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Generation,Transmission and Distribution	5	PE	3	0	0	3

Preamble	This course is designed to provide knowledge about modeling of distribution system components and the analysis of the power flow in balanced and unbalanced distribution system	
Unit - I	**Introduction**	**9**
Distribution System – Distribution Feeder Electrical Characteristics – Nature of Loads: Individual Customer Load, Distribution Transformer Loading and Feeder Load – Approximate Method of Analysis: Voltage Drop, Line Impedance, “K” Factors, Uniformly Distributed Loads and Lumping Loads in Geometric Configurations.		
Unit - II	**Distribution System Line and Transformer Model**	**9**
Exact Line Segment Model – Modified Line Model – Approximate Line Segment Model – Three phase transformer model: Generalized matrices – Delta grounded Wye step down connection – Ungrounded Wye – Delta step down connection.		
Unit - III	**Load Model**	**9**
Wye-Connected and Delta-Connected Loads: Constant real and reactive power loads, constant impedance loads, constant current loads, combination loads – Two Phase and Single Phase Loads – Shunt Capacitors – Three phase induction motor		
Unit - IV	**Voltage Regulation**	**9**
Standard Voltage Ratings – Two-Winding Transformer Theory – Two-Winding Autotransformer – Step-Voltage Regulators: Single Phase Step-Voltage Regulators – Three Phase Step-Voltage Regulators.		
Unit - V	**Distribution Feeder Analysis**	**9**
Power Flow Analysis – Ladder Iterative Technique – Unbalanced Three-Phase Distribution Feeder – Modified Ladder Iterative Technique – Load Allocation – Short-Circuit Studies.		

Total:45

TEXT BOOK:

1. William H. Kersting," Distribution System Modeling and Analysis", 3rd Edition, CRC press, New York ,2012.

REFERENCES:

1. Turan Gonen, “Electric Power Distribution Engineering”, 3rd Edition, CRC Press, New York ,2014.
2. Pabla A S, “Electrical Power Distribution”, 7th Edition, McGraw-Hill, New Delhi, 2019

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	explain the concepts of electrical distribution system.	Understanding (K2)
CO2	model the distribution lines and transformers	Understanding (K2)
CO3	model the various types of distribution loads.	Understanding (K2)
CO4	apply the concepts of voltage control in distribution system.	Applying (K3)
CO5	discuss the power flow techniques in balanced and unbalanced system	Applying (K3)

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

20EEE03 RENEWABLE ENERGY SYSTEM

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 confers the new methodologies and recent technologies for effective utilization of renewable energy sources and various nuances behind renewable energy conversion process.	
Unit - I	**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 - II	**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 - III	**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 – wind energy conversion devices.		
Unit - IV	**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.		
Unit - V	**Energy Conservation**	**9**
Principles of energy conservation – Energy conservation approach/ technologies – Co-generation – Waste heat utilization – Combined cycle power generation – Heat regenerators – Heat pipes – Heat pumps.		

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.

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

20EEE04 GENERALIZED MACHINE THEORY

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

Preamble	The objective of the course is to derive, model and analysis of various DC, AC and permanent magnet machines. Apply various transformation techniques and reference frame theories to simplify the machine dynamic models.	
Unit - I	**Generalized Machine Theory**	**9**
Essential of Rotating Electrical Machines – Conventions – The Basic Two Pole Machine – Invariance of Power – MMF Distribution of DC and AC Machines – Transformations from Three Phase to Two Phase – Kron's Primitive Machine – Restriction of the Generalized Theory of Electrical Machines – Applications.		
Unit - II	**Modeling of DC Machines**	**9**
Theory of Operation – Induced EMF – Equivalent Circuit – Electromagnetic Torque – Field Excitation- Steady State and Transient Analysis of DC Machine – Separately Excited Motor – Shunt Motor – Series Motor – Compound Motor.		
Unit - III	**Modeling of Reluctance and Permanent Magnet Machines**	**9**
Synchronous Reluctance Motor – Voltage Equation of Single Phase and Three Phase Synchronous Reluctance Motor – Permanent Magnet Synchronous Motor (PMSM) – PMSM Voltage Equation in Machine Variables – Permanent Magnet DC Motor – Modeling of Permanent Magnet DC Motor.		
Unit - IV	**Modeling of Induction Machines**	**9**
Three Phase Induction Motor – Voltage and Torque Equation in Machine Variables – Reference Frame Theory – Voltage and Torque Equation in Arbitrary Reference Frame – Voltage and Torque Equation in Synchronous Reference Frame – Model Parameter Identification – Steady State and Transient Analysis of Three Phase Induction Motor.		
Unit - V	**Modeling of Synchronous Machines**	**9**
Three Phase Synchronous Motor – Voltage and Torque Equations in Machine Variables – Voltage Equation in Rotor Reference Frame – Model Parameter Identification – Steady State and Transient Analysis of Three Phase Synchronous Motor.		

Total:45

TEXT BOOK:

1. Bimbhra P.S, "Generalized Theory of Electrical Machines", 6th Edition,Khanna Publishers, 2018 for Unit I,II.
2. Paul C Krause, Oleg Wasynczuk, Scott D. Sudhoff, Steven D. Pekarek, "Analysis of Electric Machinery and Drive Systems", 3rd Edition, IEEE Press Series on Power and Energy Systems, 2013 for Unit III,IV,V.

REFERENCES:

1. Charles Kingsley Jr., A.E. Fitzgerald & Stephen D.Umans, "Electric Machinery", New York, McGraw-Hill Higher Education, 2017.
2. Slobodan N. Vukosavic, "Electrical Machines", 1st Edition, Springer-Verlag New York, 2012.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	understand the fundamentals of mathematical modeling and transformation techniques	Understanding (K2)
CO2	derive the non-linear mathematical equation and analysis the dc shunt, series and compound motors	Applying (K3)
CO3	derive the mathematical equation for reluctance and permanent magnet motor	Applying (K3)
CO4	apply various reference frame theories and transformation techniques to three phase induction motor	Applying (K3)
CO5	derive the non-linear mathematical equations for three phase 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	2											3	1
CO2	3	2	1										2	3
CO3	3	2	1										2	3
CO4	3	2	1										1	3
CO5	3	2	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	40	30				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)**

20EEE05 DIGITAL SYSTEM 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	This course imparts knowledge on different PLD's, analyzing different State Machine charts and Designing FPGAs with its implementation using Verilog code for different combinational and sequential circuits.	
Unit - I	**Programmable Devices**	**9**
Simple Programmable Logic Devices – Complex Programmable logic devices – Field Programmable gate arrays – Implementing functions in FPGA.		
Unit - II	**State Machine Charts**	**9**
State Machine Chart – Derivation of State Machine chart – Realization of State Machine chart – implementation of the dice game.		
Unit - III	**Designing with FPGA's**	**9**
Implementing Functions in FPGAs – Implementing Functions Using Shannon's Decomposition – Carry and Cascade Chains in FPGAs – Examples of Logic Blocks in Commercial FPGAs – Dedicated Memory in FPGAs – Dedicated Multipliers in FPGAs – Design Translation (Synthesis) – Mapping, placement, and Routing		
Unit - IV	**Additional Topics in Verilog**	**9**
Verilog Functions – Verilog Tasks – Multivalued Logic and Signal Resolution – Built-in Primitives – User-Defined Primitives – SRAM Model – Rise and Fall Delays of Gates – Named Association – System Functions – Compiler Directives – File I/O Functions – Timing Checks		
Unit - V	**Design Examples using Verilog**	**9**
BCD to 7-Segment Display Decoder – A BCD Adder – 32-Bit Adders –Traffic Light Controller – State Graphs for Control Circuits – Scoreboard and controller – A Shift-and-Add Multiplier – Array Multiplier – A Signed Integer/Fraction Multiplier		

Total:45

TEXT BOOK:

1. Charles H. Roth Jr, Lizy Kurian Johnb & Byeong Kil Lee, "Digital Systems Design Using Verilog ", 1st Edition, Cengage learning publication, New Delhi, 2016.

REFERENCES:

1. Taraate Vaibbhav, "Digital Logic Design Using Verilog Coding and RTL Synthesis", 1st Edition, Springer India, 2016.
2. Zainalabedin Navabi, "Verilog Digital System Design ", 2nd Edition, McGraw Hill Education, 2017.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	compare programmable logic devices and implement various logic functions using PLDs.	Understanding (K2)
CO2	design and analyze algorithmic state machine for logic circuit.	Analyzing (K4)
CO3	designing and implementing various functions using FPGA's	Applying (K3)
CO4	develop Verilog code for any combinational and sequential logic circuits.	Applying (K3)
CO5	analyze, design and develop Verilog Code for some specific examples	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	2	3	2	2	1								2	3
CO2	3	2	1	1									2	3
CO3	3	2	1	1									1	2
CO4	3	1											1	2
CO5	3	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	30	40	20			100
CAT2	10	10	60	10			100
CAT3	10	30	40	20			100
ESE	10	30	30	30			100

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

20EEE06 ADVANCED POWER ELECTRONIC CIRCUITS

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 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 – Switched Mode DC-to-DC Converter – Design constraints of reactive elements: Design of inductor, transformer and capacitors, Input filter requirement – boundary between continuous and discontinuous conduction – critical values of inductance/load resistance.		

Total: 45

TEXT BOOK:

1.	Euzeli dos Santos, Edison R. da Silva, “Advanced Power Electronics Converters”, New Edition, John Wiley and sons, 2014 for units I,II,III,IV

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

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	appraise different configuration of power electronics circuit	Understanding (K2)
CO2	analyze the various PWM topologies for power converters	Understanding (K2)
CO3	examine the Control strategies of power converters	Understanding (K2)
CO4	design and analyze of single phase to single phase back to back converter	Applying (K3)
CO5	design and analyze 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	2	1											3	1
CO2	2	1											1	2
CO3	3	2	1										2	1
CO4	3	2	1										2	2
CO5	3	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	30	70					100
CAT2	20	60	20				100
CAT3	20	60	20				100
ESE	20	60	20				100

20EEE07 SUBSTATION ENGINEERING AND AUTOMATION

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

Preamble	The course aims in imparting knowledge of substation and its components	
Unit - I	**Introduction**	**9**
General background – Functions of a Substation – Substation Layouts, Busbar Schemes – Voltage levels in AC and HVDC substations – Types of Substations – Features of a substation – Substation equipment – Grounding system – Insulation co-ordination and Surge Arresters – Protective Systems		
Unit - II	**Equipments and Earthing**	**9**
Busbars – Circuit Breakers – Isolators and Earthing switches – Power transformers – CT & VT's – Surge Arresters – Classification of substations – Functional requirements and Description of Earthing system – Equipment Earthing – Neutral point Earthing – Dimension of Earth Conductors – Earth mat – Measurement of Earth Resistance		
Unit - III	**Gas Insulated Substations and Cables**	**9**
Introduction – Applications – Application and range of ratings – Demerits of GIS –Configuration of GIS – Circuit arrangements and Single Line Diagram of GIS – Design aspects – Earthing Switches in GIS – CGIC & CGIT for EHV and UHV Power Transmission – Hybrid Substations		
Unit - IV	**Protection, Control and Automation in Substations**	**9**
Control room and panels – Protective relaying in Substations – Power transformer protection – Bus Zone protection – Protection of Transmission Lines – Carrier assisted distance protection – Substation Control – Applications of digital computers in Substation control – Microprocessor based Relays – Power theft control and Smart metering		
Unit - V	**Maintenance of EHV-AC and HVDC Substations**	**9**
Introduction terminologies – Maintenance of Power transformer, Switchgear and Circuit Breakers – Dielectric oil – Insulation Resistance measurement – Drying out of Power transformer – Preventive Maintenance of HVDC Substation – Hot Line Maintenance		

Total:45

TEXT BOOK:

1. Rao S, "Electrical Substation Engineering and Practice EHV-AC, HVDC and SF6 – GIS", Khanna Publishers, 3rd Edition, 2015

REFERENCES:

1. John D. McDonald, "Electric Power Substations Engineering ", CRC Press 3rd edition, 2017
2. James A. Momoh, "Electric Power Distribution, Automation, Protection, and Control", CRC Press,Taylor and Francis Group, 2017.

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 substation equipments and earthing	Understanding (K2)
CO3	infer Gas Insulated Substations and Cables	Understanding (K2)
CO4	develop the different controls and Automation in substations	Applying (K3)
CO5	describe about the maintenance of substations	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										3	1
CO2	3	2	1										3	1
CO3	3	2	1										3	1
CO4	3	2	1	1	1								3	2
CO5	3	2	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	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)**

20EEE08 BIOMASS ENERGY SYSTEM

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

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				2						3	2
CO2	2	3	2										3	2
CO3	2	2	3										2	3
CO4	2	2	3										2	3
CO5	2	2	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	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)**

20EEE09 SPECIAL ELECTRICAL MACHINES

Programme & Branch	B.E & Electrical and Electronics Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	DC Machines and Transformers, Synchronous and Induction Machines	7	PE	3	0	0	3

Preamble	This course imparts knowledge about the construction and working principle of various special electrical machines and provide 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: SyRM 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	**Stepping 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.

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	2
CO2	3	2	1	1									2	3
CO3	3	2	1	1									2	3
CO4	3	2	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	30	50	20				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)**

20EEE10 VLSI DESIGN

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

Preamble	To expose the knowledge of VLSI System Design in terms of modelling 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 & Circuit Design**	**9**
Introduction – CMOS technologies – Layout Design Rules – CMOS Process Enhancement – Combinational Circuit Design: Circuit Families – Sequential Circuit Design: Circuit Design for Latches and Flipflops		
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”, 4th Edition, Pearson Education, New Delhi, 2017 for Unit I,II,III
2.	Samir Palnitkar, “Verilog HDL: Guide to Digital Design and Synthesis”, 2nd Edition, Pearson Education, New Delhi, 2017 for Unit IV,V

REFERENCES:

1	Pucknell, Douglas A & Eshragian, K., “Basic VLSI Design”, 3rd Edition, Prentice Hall India, Pvt Ltd, 2006.
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.	Understanding (K2)
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	2	1											1	2
CO2	2	1											3	1
CO3	3	2	1	1									3	1
CO4	3	2	1	1									3	3
CO5	3	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**	**70**	**10**				**100**
CAT2	**10**	**60**	**30**				**100**
CAT3	**10**	**30**	**60**				**100**
ESE	**20**	**40**	**40**				**100**

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

20EEE11 ADVANCED CONTROL THEORY

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

Preamble	The objective of this course is to provides the concepts of the state space analysis, feedback control and stability analysis in discrete control systems.	
Unit - I	**Introduction to Design**	**9**
The design problem – Preliminary consideration of classical design – realization of basic compensator – cascade compensation in time domain and frequency domain – turning off PID controllers – feedback compensation.		
Unit - II	**Discrete Time Systems**	**9**
Mathematical Representation of the Sampling Process – signal reconstruction, Z-transform analysis of sampled data control system – Inverse Z transform – Z and S domain Relationship – closed loop pulse transfer function – Modified Z Transforms		
Unit - III	**Liapunov's Stability Analysis**	**9**
Introduction – Liapunov's stability criterion – direct method of Liapunov and linear system – methods of constructing liapunov functions for non linear system.		
Unit - IV	**Digital Control System Design**	**9**
z-Domain root locus – z-Domain digital control system design – Digital implementation of analog controller design – Direct z-domain digital controller design – Frequency response design – Direct control design – Finite settling time design.		
Unit - V	**Optimal Control System**	**9**
Parameter optimization: servomechanism – optimal control problems: transfer function approach, state variable approach – the state regulator problem – the infinite time regulator problem – the output regulator under tracking problem.		

Total:45

TEXT BOOK:

1. Nagrath I.J., Gopal M., "Control Systems Engineering", 6th Edition, New Age International Pvt. Ltd., New Delhi, 2017.

REFERENCES:

1. M. Sami Fadali,. Antonio Visioli, "Digital Control Engineering Analysis and Design" 2nd Edition, Academic Press, Singapore, 2012.
2. Norman S. Nise, "Control Systems Engineering", 8th Edition, Wiley-India Publishers, New Delhi, 2019.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	construct the basic control system model	Applying (K3)
CO2	express the behavior of discrete time system	Understanding (K2)
CO3	inspect the stability of discrete system	Applying (K3)
CO4	analyze digital control system	Applying (K3)
CO5	manipulate the optimal control 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											2	2
CO2	2	3	2										3	2
CO3	2	3	2	1									2	3
CO4	3	2	2	2									3	2
CO5	2	3	2	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	40	30	30				100
CAT2	30	40	30				100
CAT3	30	40	30				100
ESE	30	40	30				100

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

20EEE12 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											3	2
CO2	3	2	1	1									2	3
CO3	2	1											2	3
CO4	3	2	1	1									1	2
CO5	2	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		40	60				100
CAT2		40	60				100
CAT3		40	60				100
ESE		40	60				100

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

20EEE13 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 – Locational marginal price (LMP) – Market Power-Stranded Costs – Transmission Pricing – Congestion Pricing – Management of Inter-Zonal/Intrazonal Congestion		
Unit - II	**ELECTRIC UTILITY MARKETS AROUND THE WORLD**	**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	**ELECTRICITY PRICING**	**9**
Introduction – Electricity price Volatility – Electricity Price Indices – Challenges to Electricity Pricing – Construction of forward pricing curves – Short term price forecasting Wheeling cost		
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, 2001.

REFERENCES:

1. Loi Lei Lai ,"Power System Restructuring and Deregulation", 1st Edition, John Wiley and Sons, New York, 2001.
2. Mohammad Shahidehpour, Hatim Yamin & Zuyi Li, "Market Operations in Electric Power Systems", 1st Edition, John Wiley and Sons, New York, 2002.

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 in the united states & outside the united states	Understanding (K2)
CO3	discuss the concept of open access same-time information system	Applying (K3)
CO4	describe the concept of Electricity Pricing	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											3	
CO2	3	2		1									3	
CO3	2	3	2	2									3	
CO4	2	3											3	
CO5	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	70					100
CAT2	30	50	20				100
CAT3	30	70					100
ESE	30	50	20				100

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

20EEE14 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	NIL	7	PE	3	0	0	3

Preamble	Design, installation and commissioning will always be a joyful content for the engineers as it incorporates the essence of real time study in lieu of theoretical concepts. This course aims in imparting the concepts and nuances of solar and wind energy conversion systems (WECS) along with its design, installation and troubleshooting procedures.	
Unit - I	**Components of solar PV systems**	**9**
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 - II	**Solar PV system design**	**9**
Design methodology for solar PV system: Approximate design of solar PV system – Configuration of grid connected solar PV systems – Grid connected PV system design for power plants.		
Unit - III	**Installation and troubleshooting**	**9**
Installation and troubleshooting of standalone solar PV power plants – Safety in installation of PV systems – Installation and troubleshooting of solar PV power plants – Solar PV installation check list.		
Unit - IV	**Components for WECS**	**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	**Design and Installation of WECS**	**9**
Site preparation – Electrical network – Selection of low voltage and distribution voltage equipments – 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	outline the components involved in the solar PV energy conversion system	Understanding (K2)
CO2	apply the design procedures for solar PV systems towards installation	Applying (K3)
CO3	apply the installation and troubleshooting procedures in a solar PV system	Applying (K3)
CO4	identify the components required 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	2	2	3				1						2	3
CO2	2	3	2				1						2	3
CO3	2	3	2				1						3	2
CO4	2	2	3				1						2	3
CO5	2	3	2				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	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)**

20EEE15 ADVANCED ELECTRIC DRIVES AND CONTROL

Programme & Branch	B.E & Electrical and Electronics Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Control systems, Microprocessor and Microcontroller, Electric Drives and Control	7	PE	3	0	0	3

Preamble	Advanced control techniques are applied 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.		
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, 2001.
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										2	3
CO2	3	2	1										2	3
CO3	3	3	1										3	2
CO4	3	2	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	50	40				100
CAT2	10	60	30				100
CAT3	10	60	30				100
ESE	10	60	30				100

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

20EEE16 ADVANCED MICROPROCESSORS AND MICROCONTROLLERS

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

Preamble	This Course explores the knowledge about advanced microprocessor and microcontroller	
Unit - I	**80186, 80286, 80386 and 80486 Microprocessors**	**9**
80186 Architecture – Enhancements of 80186 – 80286 Architecture – Real and Virtual Addressing Modes – 80386 Architecture – Special Registers – Memory Management – Memory Paging Mechanism – 80486 Architecture (718) – Enhancements – Cache Memory Techniques – Exception Handling – Comparison of Microprocessors (8086 – 80186 – 80286 – 80386 – 80486) – Applications and Datasheets		
Unit - II	**Pentium Microprocessors**	**9**
Pentium Microprocessor Architecture – Special Pentium Registers – Pentium Memory Management – New Pentium Instructions – Pentium Pro Microprocessor Architecture – Special features – Pentium II,III and IV Microprocessor Architecture – Comparison of Pentium Processors – Applications & Datasheets		
Unit - III	**ARM Processor and Programming**	**9**
General concepts – ARM7 – Instruction Set Architecture, Levels in architecture, Functional description – processor and memory organization – Introduction to RISC architecture, pipelining, Instruction issue and execution – Instruction formats – Addressing modes – Data alignment and byte ordering – Simple programs using Assembly language Instruction sets.		
Unit - IV	**MSP430 Microcontroller**	**9**
TI – MSP430 microcontroller feature – development environment – architecture – addressing modes – instruction set – clock and resets – functions – ISR – low power mode – sample programs in MSP430G2ET Launchpad		
Unit - V	**MSP430 Microcontroller Peripherals**	**9**
Digital I/O's – Timers – Analog I/O's – Communication: SPI – SPI with USI – SPI with USCI – I2C Master/Slave – UART – sample programs in MSP430G2ET Launchpad		

Total:45

TEXT BOOK:

1. Brey B.B, "The Intel Microprocessor 8086/8088 /80186/80188, 80286, 80386, 80486 PENTIUM, PENTIUM Pro, PII, PIII & IV Architecture, Programming & Interfacing", 8th Edition, Pearson Education, New Delhi, 2009 for Units I,II.
2. John Davies,"MSP430 Microcontroller Basics", 1st Edition, Newnes-Elsevier, 2008 for Units IV,V.

REFERENCES:

1. Larry D. Pyeatt, "Modern Assembly Language Programming with the ARM Processor", 1st Edition, Newnes-Elsevier, 2016
2. Jerry Luecke, "Analog and Digital Circuits for Electronic Control System Applications Using the TI MSP430 Microcontroller", 1st Edition, Newnes-Elsevier, 2005

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	classify the generalized architecture of various advanced microprocessors	Understanding (K2)
CO2	describe the architecture and functions of Pentium Microprocessors	Understanding (K2)
CO3	describe the architecture, Various operations and instruction set of ARM processor.	Analyzing (K3)
CO4	understand the concepts of development environment boards and operations	Understanding (K2)
CO5	apply the programming knowledge on development boards and its peripheral 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										3	1
CO2	3	2	1										3	1
CO3	3	3	2	2									3	3
CO4	3	2	1										2	2
CO5	3	3	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	20	80					100
CAT2	10	70	20				100
CAT3	10	70	20				100
ESE	10	60	30				100

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

20EEE17 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	**Introduction to Programmable Logic Controller**	**9**
Overview of 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: Bottle filling 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, 2009 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, 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	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									2	3
CO3	3	2	1	1									2	3
CO4	3	1											1	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	30	50	20				100
CAT2	30	40	30				100
CAT3	30	50	20				100
ESE	30	40	30				100

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

20EEE18 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										2	
CO2	3	2	2								1		1	
CO3	3	2	2								1		1	
CO4	3	2	2	1							1		1	
CO5	3	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	30	60	10				100
CAT2	30	70					100
CAT3	30	70					100
ESE	30	60	10				100

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

20EEE19 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 as various High voltage 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, Liquids and Solids**	**9**
Ionization processes – Townsend's 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 – Advances in Partial Discharge measurement – Tan delta measurement, Radio interference measurement – International and Indian Standards.		

Total:45

TEXT BOOK:

1. Naidu M.S. & Kamaraju V, “High Voltage Engineering”, 5th Edition, McGraw-Hill, New York, 2013.

REFERENCES:

1. Kuffel E, Zaengl W.S. & Kuffel J, “High Voltage Engineering Fundamentals”, 2nd Edition, Butterworth-Heinemann, Burlington, 2005.
2. Wadhwa C.L, “ High voltage Engineering”, 3rd Edition, New Age Publishers, New Delhi, 2012.

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.	Understanding (K2)
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											3	1
CO2	3	1											3	1
CO3	3	2	1										3	1
CO4	3	2	1										3	1
CO5	3	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	30	70					100
CAT2	20	60	20				100
CAT3	30	70					100
ESE	20	60	20				100

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

20EEE20 ENERGY STORAGE 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 aimed to introduce the fundamental concepts and principles of various energy storage systems that aids in various real time applications.	
Unit - I	**Energy Storage Systems**	**9**
Introduction – Battery – 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 – Mass Transport to the Electrode Surface.		
Unit - II	**Battery Design and Selection**	**9**
Designing to Eliminate Potential Safety Problems – Battery Safeguards when Using Discrete Batteries – Battery Construction – Factors Affecting Battery Performance – Major Considerations in Selecting a Battery – Applications of Batteries.		
Unit - III	**Primary & 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 – Nickel Hydride.		
Unit - IV	**Advanced Batteries for Emerging Applications**	**9**
Advanced Rechargeable Batteries – General Characteristics – Characteristics of lithium rechargeable batteries. Zinc/Air batteries – Zinc/bromine batteries – Lithium/Iron sulfide Batteries – General characteristics – Performance.		
Unit - V	**Fuel Cells & Ultracapacitors**	**9**
Fuel cells: General Characteristics – Operating Principles of Fuel Cells – Fuel processing and storage configurations. Electrochemical capacitors: Chemistry and material properties – Performance characteristics of devices.		

Lecture:45, Tutorial:0, 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	evaluate the various aspects and performance of battery technologies	Understanding (K2)
CO2	understand the performance of primary batteries and their design aspects	Understanding (K2)
CO3	conceptualize the principles of Primary and Secondary batteries	Understanding (K2)
CO4	analyze the requirement of advanced batteries for emerging applications	Applying (K3)
CO5	illustrate the concepts & principles of fuel cells and ultra-capacitors	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										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	30	70					100
CAT2	30	70					100
CAT3	20	60	20				100
ESE	20	60	20				100

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

20EEE21 CAD OF ELECTRICAL MACHINES

Programme & Branch	B.E & Electrical and Electronics Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	DC Machines and Transformers, Synchronous and Induction Machines	7	PE	3	0	0	3

Preamble	The objective of the course is to identify the design parameter for AC and DC electrical machines using various standard design procedures and development constrain. Apply finite element method and CAD package to design and analysis of electrical machines.	
Unit - I	**Fundamental Aspects and Materials**	**9**
Introduction – Design Factor – Limitations in Design – Windings of Electrical Machines: Salient Pole Winding, Lap and Wave Winding, Three Phase Winding - Electric Conductivity and Resistivity Material – Magnetic Material – Insulating Material – Permanent Magnet and Characteristics - Modern Manufacturing Practices		
Unit - II	**Principles of Magnetic and Thermal Design**	**9**
Fundamental of Magnetic Circuit – Magnetizing Curve – Real and Apparent Flux Density – Determination of Iron Loss – Determination of Copper Loss by Considering Skin and Proximity Effects – Modes of Heat Dissipation – Cooling Strategies		
Unit - III	**Design of DC Motor**	**9**
Constructional Details – Choice of Flux Density and Ampere Conductor – Main Dimension – Poles and Slots – Armature Windings – Design of Field and Armature System – Design of Commutator and Brushes		
Unit - IV	**Design of AC Motor**	**9**
Constructional Details: Induction Motor (IM), Synchronous Reluctance Motor (SYNRM) and Permanent Magnet Synchronous Motor (PMSM) – Choice of Flux Density and Ampere Conductor – Main Dimension – Three Phase Distributed Windings – Stator Design and Rotor Design: IM, SYNRM and PMSM – Length of Air Gap – Design of Shaft		
Unit - V	**Finite Element Modeling and Analysis using ANSYS Software**	**9**
Maxwell's Equation – Preprocessing – Meshing – Material Assigning – Boundary Conditions – Setting up Solution – Post processing – Design of DC Motor –Induction Motor – Permanent Magnet Synchronous Motor.		

Total:45

TEXT BOOK:

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

REFERENCES:

1. Hendershot JR, Miller TJE, "Design of Brushless Permanent Magnet Motors", Motor design book LLC, Venice, 2010.
2. Juha Pyrhonen, Tapani Jokinen and Valeria Hrabovcova, "Design of Rotating Electrical Machines", 2nd Edition, John Wiley & 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 AC and DC electrical machines	Understanding (K2)
CO2	illustrate the principles of magnetic and thermal design for various electrical machines	Understanding (K2)
CO3	identify the design parameter of DC motor by considering load requirement	Applying (K3)
CO4	identify the design parameter of AC motor by considering load requirement	Applying (K3)
CO5	design and finite element analysis of various electrical machines using software package	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										3	1
CO2	3	2	2										3	1
CO3	3	2	1										2	3
CO4	3	2	1										2	3
CO5	2	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	50	10				100
CAT2	30	40	30				100
CAT3	20	30	30	20			100
ESE	20	30	30	20			100

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

20EEE22 EMBEDDED SYSTEM AND IOT

Programme & Branch	B.E & Electrical and Electronics Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Microprocessor and Microcontroller	7	PE	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**	**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 (I^2C) – need for device drivers.		
Unit – III	**Fundamentals of IoT**	**9**
Evolution of Internet of Things – 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 Protocols**	**9**
IoT Access Technologies: 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 and Data Acquisition – Application Layer Protocols: CoAP and MQTT.		
Unit – V	**Design and Development**	**9**
Design Methodology – 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. Kamal R, “Embedded systems: architecture, programming and design”, 2nd Edition, Tata McGraw-Hill Education, New Delhi, 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.

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											1	2
CO2	3	2	1	1									2	3
CO3	3	1											1	2
CO4	3	2	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	30	50	20				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)**

20EEE23 COMPUTATIONAL INTELLIGENCE TECHNIQUES

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 - Overview of Fuzzy Expert System.		
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.		
Unit - V	**GENETIC ALGORITHM – II**	**9**
Advanced Operators and Techniques in Genetic Algorithm : Diploidy, Dominance and Abeyance – Multiploid - Inversion and Reordering - 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 Unit I,II,III
2. Sivanandam S.N.,Deepa S.N., “Introduction to Genetic Algorithms”, Urheberrechtlich Geschutztes material, Springer-Verlag, Berlin Heidelberg,2008 for Unit 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 programming 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								2	3
CO2	3	2	1	1	2								3	2
CO3	3	2	1	1	2								3	2
CO4	3	2	1	1	2								2	3
CO5	3	2	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	70	10				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)**

20EEE24 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", 2nd Edition, PHI Learning Pvt. Ltd, New Delhi, 2011.
2. Mukund R Patel, "Wind and Solar Power Systems: Design, analysis and operation ", 2nd Edition, CRC Press, Boca Raton, 2006.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	recall 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	Applying (K3)
CO4	interpret the grid converter structures and requirements for wind turbine systems	Applying (K3)
CO5	explain the grid converter control 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	2	1											3	2
CO2	2	1											1	2
CO3	3	2	1										2	2
CO4	3	2	1										2	2
CO5	3	3	1										2	2

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

ASSESSMENT PATTERN - THEORY

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

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

20EEE25 POWER SYSTEM OPERATION AND CONTROL

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	This course imparts knowledge about the operations of the power systems and various controls methods adapted in power systems. It also imparts the knowledge on computer control of power systems.	
Unit - I	**Introduction**	**9**
System load variation: System load characteristics, load curves:daily, weekly and annual, load-duration curve, load factor, diversity factor, Plant capacity factor, Utilization factor – Reserve requirements: spinning reserve, cold reserve and hot reserve – Need of voltage and frequency regulation – P-f and Q-V control – Load forecasting: purpose, classification and forecasting procedure.		
Unit - II	**Real Power Frequency Control**	**9**
Necessity of maintaining constant frequency – Load frequency control – Speed governing system – turbine model – generator model – concept of control area – Single area system static and dynamic analysis – Integral control – Two area system static and dynamic response – Area control error – Tie line frequency bias control		
Unit - III	**Reactive Power Voltage Control**	**9**
Necessity of voltage control – Generation and absorption of reactive power – Methods of voltage control: shunt capacitor, shunt reactor, series capacitor, tap-changing transformer, synchronous condenser and Static VAR compensators – Excitation control scheme – Types of excitation system: DC, AC and static excitation systems		
Unit - IV	**Power System Security and State Estimation**	**9**
Introduction – Concept of system security: long term planning, operational planning and on-line planning – Security analysis: and enhancement – State estimation – various operating states – Energy control centre and data acquisition.		
Unit - V	**Economic Dispatch**	**9**
Economic Dispatch Problem – Economic Dispatch with Piecewise Linear Cost Functions – LP Method: Piecewise Linear Cost Functions, Economic Dispatch with LP – The Lambda Iteration Method – Economic Dispatch Using Dynamic Programming – Composite Generation Production Cost Function – Base Point and Participation Factors **Unit Commitment:** Introduction – Need of unit commitment – Constraints in unit commitment: Spinning reserve, thermal unit constraint, hydro constraint, must run and fuel constraint – Solution methods: Priority list method, Full load average production cast, dynamic programming approach.		

Total:45

TEXT BOOK:

1. Sivanagaraju. S & Sreenivasan. G, " Power System Operation and Control ", 1st Edition, Pearson Education, New Delhi, 2009.

REFERENCES:

1. Allen J. Wood & Bruce F. Wollenberg, "Power System Operation and Control", 3rd Edition, John Wiley and Sons, New York, 2012.
2. Elgerd O.I, " Electrical Energy System Theory: An Introduction ", 2nd Edition, Tata McGraw-Hill, New York, 2001.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	understand the overview of power system operation and control	Understanding (K2)
CO2	develop the transfer function model for the speed-governing system	Analyzing (K4)
CO3	analyze the static and dynamics performance of AVR loop	Analyzing (K4)
CO4	understand the concept of power system state estimation and security	Understanding (K2)
CO5	apply dynamic approaches for solving unit commitment and economic dispatch 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	3
CO2	2	3	2	2									2	3
CO3	2	3		2									2	3
CO4	3													3
CO5	3	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	10	30	40	20			100
CAT2	20	30	40	10			100
CAT3	20	60	20				100
ESE	10	30	40	20			100

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

20EEE26 MICROGRID

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

Preamble	The objective of this course is to impart knowledge about the renewable energy based microgrid technology, its types and issues associated with their practical realization. The course also elaborates the various protection, control and operational strategies intended for practical microgrid implementation.	
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	**Operation of Multi-microgrids**	**9**
Introduction – Multi-microgrid control and Management Architecture – Coordination voltage/ VAR support – Coordinated Frequency Control – Emergency Functions – Dynamic equivalents.		

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	understand 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 function of multi-microgrid	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	1										3	2
CO2	2	1	3										1	3
CO3	2	1	3										3	2
CO4	2	1	3										1	3
CO5	3	2	2				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	60	20				100
CAT3	20	40	40				100
ESE	20	40	40				100

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

20EEE27 ELECTRICAL MACHINE DESIGN

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 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 Equations – 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 equations – 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											3	2
CO2	3	2	1	1									2	3
CO3	3	2	1	1									2	3
CO4	3	2	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	30	60	10				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)**

20EEE28 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**	**9**
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 & 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 images	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	3
CO2	3	2	1	1									3	3
CO3	3	3	3	1	2								3	1
CO4	3	3	3	1	2								2	3
CO5	3	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	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)**

20EEE29 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. (Unit-4)
2. Frank D. Petruzella, “Programmable Logic Controllers”, 5th edition, McGraw Hill, New Delhi, 2019. (Unit-5)

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.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	understand the integrated industrial automation system	Understand(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	2
CO2	3	2	1	1									2	3
CO3	3	2	1	1									2	3
CO4	3	1											1	2
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	50	40	10				100
CAT2	30	40	30				100
CAT3	30	40	30				100
ESE	30	40	30				100

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

20EET30 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 Sags and Interruptions**	**9**
Sources of Sags and Interruptions, Estimating voltage Sag Performance, Fundamental Principles of Protection, Solution at the End – User Level, Motor – Starting Sags.		
Unit - III	**Transient over Voltages**	**9**
Sources of Transient Over voltages, Principles of Over voltage Protection, Devices for over voltage Protection, Utility Capacitor – Switching transients, Utility System Lightning Protection, Managing Ferro-resonance, Switching Transient Problems with Loads, Computer Tools for Transients Analysis		
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, 2000.

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 in distribution networks	Understanding (K2)
CO3	analyze the effect of transient over voltages	Applying (K3)
CO4	identify the wiring-grounding problems and design circuits to mitigate harmonic issues	Applying (K3)
CO5	understand the importance of PQ monitoring and select equipments 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	1											3	2
CO2	3	1											3	2
CO3	3	2	1	1									2	3
CO4	3	2	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	20	60	20				100
CAT2	20	60	20				100
CAT3	20	60	20				100
ESE	20	60	20				100

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

20EEE31 SMART GRID

Programme & Branch	B.E & Electrical and Electronics Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Generation, Transmission and Distribution, Power Electronics	8	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	**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 – Phasor measurement unit (PMU).		
Unit - III	**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 – Introduction to cloud Computing.		
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. FereidoonP. Sioshansi ,“Smart Grid–Integrating renewable, distributed and efficient energy”, 1st Edition, Academic Press,United States, 2011.

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	apply the sensing, measurement and control techniques for smart grid applications	Applying (K3)
CO3	identify the information and communication technologies in smart grid	Understanding (K2)
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										3	
CO2	3	3	2										1	
CO3	3		2										2	
CO4	3	2	2										2	
CO5	3	3	3										2	

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

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	70	10				100
CAT2	30	50	20				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)**

20EEE32 HYBRID 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 is aimed to introduce the fundamental concepts and principles of various Hybrid Electric Vehicle technologies with an insight into Power electronic converters and topologies.	
Unit - I	**Introduction to Electric and Hybrid Electric Vehicles**	**9**
Environmental impact and history of modern transportation – Electric vehicles: configuration of EVs- performance of EVs – Tractive effort in normal driving- energy consumption – Hybrid electric vehicles: concept of hybrid electric drive trains – Architecture of hybrid electric drive trains.		
Unit - II	**IC propulsion and Electric Propulsion Systems**	**9**
Vehicle power plant and transmission characteristics – IC engine operating principle- operation parameters – DC Motor Drives – Induction Motor Drives – Permanent Magnetic BLDC Motor Drives – SRM Drives.		
Unit - III	**Electrically Coupled Hybrid Electric Drive Train**	**9**
Design principle of series (electrical coupling) hybrid electric drive train: Operation patterns – Control strategies – Design principles of a series (electrical coupling) hybrid drive train – Design example: Design of traction motor size – Design of the gear ratio – Verification of acceleration performance – Design of the power capacity of PPS – Fuel Consumption.		
Unit - IV	**Mechanically Coupled Hybrid Electric Drive Train**	**9**
Parallel (mechanically coupled) hybrid electric drive train design: Drive train configuration and design objectives – Control strategies – parametric design of a drive train – Design and control methodology of series – parallel (torque and speed coupling) hybrid drive train: Drive train configuration – drive train control methodology – design and control principles of plug-in hybrid electric vehicles.		
Unit - V	**Fundamentals of Regenerative Breaking**	**9**
Braking energy consumed in urban driving – braking energy versus vehicle speed – braking energy versus braking power – braking power versus vehicle speed – braking energy versus vehicle deceleration rate – braking energy on front and rear axles – brake system of EV, HEV, and FCV.		

Total: 45

TEXT BOOK:

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

REFERENCES:

1. Iqbal Hussain, "Electric and Hybrid Vehicles: Design Fundamentals", 2nd Edition, CRC Press, USA, 2011.
2. Chris Mi, Abul Masrur M & David Wenzhong Gao, "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 about concept of electric and hybrid electric vehicles	Understanding (K2)
CO2	distinguish the characteristics of internal combustion vehicles and hybrid electric vehicles	Applying (K3)
CO3	demonstrate the concept of electrically coupled hybrid electric drive trains	Understanding (K2)
CO4	illustrate the concept of mechanically coupled hybrid electric drive trains	Applying (K3)
CO5	outline the importance of regenerative breaking	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									2	3
CO3	3	2	1	1									2	3
CO4	3	1											3	2
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	30	50	20				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)**

20EEE33 ELECTRICAL MACHINE CONTROL AND MAINTENANCE

Programme & Branch	B.E & Electrical and Electronics Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	DC Machines and Transformers, Synchronous and Induction Machines	8	PE	3	0	0	3

Preamble	The 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 – 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”, 2nd Edition, New Age International Publishers, New Delhi, 2006 for Unit I,II.
2. Madhvi Guptha, “Installation, Maintenance and Repair of Electrical Machines and Equipments”, 4th Edition, S.K. Kataria & Sons, New Delhi, 2014 for Unit III,IV, V.

REFERENCES:

1. Sunil S. Rao, “Testing Commissioning Operation & Maintenance Of Electrical Equipments”, 6th Edition, Khanna Publishers, New Delhi, 1991.
2. Charles Kingsley Jr., A.E. Fitzgerald and Stephen D.Umans, “Electric Machinery”, New York, McGraw-Hill Higher Education, 2017.

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										2	
CO2	3	1	2										3	
CO3	3	2	1										2	
CO4	3	1	1										3	
CO5	3	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	30	50	20				100
CAT2	30	50	20				100
CAT3	30	60	10				100
ESE	30	50	20				100

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

20EEE34 DIGITAL SIGNAL PROCESSORS 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 filter design, DSP processor and its real time applications	
Unit - I	**FIR Filter**	**9**
FIR Filter Design: Amplitude and phase responses of FIR filters – Linear phase filters – symmetrical linear phase filter, asymmetrical linear phase filter – windowing techniques for design of linear phase FIR filters – Rectangular, Hamming, Hanning		
Unit - II	**IIR Filter**	**9**
IIR Filter Design (low pass and high pass): Review of design of analogue Butterworth and Chebychev Filters, frequency transformation in analog domain – design of IIR digital filters using impulse invariance technique – design of IIR digital filters using bilinear transformation technique – pre warping – Frequency transformation in digital domain.		
Unit - III	**DSP Processors**	**9**
Architecture and Features of TMS320C5416 DSP Processor, Instruction set, Addressing Modes – Architecture and features of TMS320F2812 DSP processors – Addressing modes – Introduction to Commercial DSP processors.		
Unit - IV	**Realization of Filter Structure and Applications**	**9**
Realization of FIR filters – Direct, cascade, linear phase structures. IIR Filter structure realization – Direct, cascade, and parallel forms. DSP Applications: Harmonic Analysis, Motor Control, Power line communication.		
Unit - V	**Multirate Digital signal processing**	**9**
Sampling rate conversion – Decimation – Interpolation – Fractional sampling rate alteration – signal flow graphs – filter structures – digital filter design – multistage decimators and interpolators.		

Total:45

TEXT BOOK:

1. Salivahanan. S, “Digital Signal Processing”, 4th Edition, Tata McGraw Hill Education, New Delhi, 2019

REFERENCES:

1. John.G.Proakis, Dimitris.G.Manolakis, “Digital Signal Processing: Principles, Algorithms and Applications”, 5th Edition, Pearson Education, India, 2021
2. Baris Bagci, "Programming and Use of TMS320F2812 DSP to Control and Regulate Power Electronic converters", 1st Edition, Grin Publishing, Munich, Germany, 2017.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	design and analyze the FIR filters	Analyzing (K4)
CO2	design the analyze IIR filters	Analyzing (K4)
CO3	explain the architecture of advanced DSP processors	Understanding (K2)
CO4	realize FIR and IIR filter structures	Applying (K3)
CO5	explain multirate digital signal processing and digital filter design	Understanding(K2)

Mapping of COs with POs and PSOs

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

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

ASSESSMENT PATTERN - THEORY

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

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

20EEE35 ELECTRIC POWER UTILIZATION

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", 10th Edition, S.K. Kataria& Sons, New Delhi, 2012 for 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 for Units 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", DhanpatRai& 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											2	1
CO2	3	1											2	1
CO3	3	3	2	2									2	3
CO4	3	1											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	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)**

20EEO01 SOLAR AND WIND ENERGY SYSTEMS

Programme & Branch	All Branches of B.E., / B.Tech.,	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	4	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 equipments – 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 & 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	2	2	3				1							
CO2	2	3	2				1							
CO3	2	3	2				1							
CO4	2	2	3				1							
CO5	2	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	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)**

20EEO02 ELECTRICAL WIRING AND LIGHTING

Programme & Branch	All Branches of B.E., / B.Tech.,	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	4	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											
CO2	3	2	1											
CO3	3	2	1	1	1									
CO4	3	2	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	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)**

20EEO03 ELECTRICAL SAFETY

Programme & Branch	All Branches of B.E., / B.Tech.,	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	4	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**
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**
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**
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**
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**
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.		

Total:45

TEXT BOOK:

1. k., Mary Capelli Schellpfeffer & Dennis Neitzell., “Electircal Safety Handbook” , McGraw Hill Publishers, 4th Edition, 2012.

REFERENCES:

1. n R.K & Saluja H.L., “Electrical Safety, Fire Safety Engineering and Safety Management” Khanna Publishers, 2nd Edition, 1997.
2. utherland., “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											
CO2	3	1	2											
CO3	3	1	2											
CO4	2	1	3											
CO5	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	40	30	30	-	-	-	100
CAT2	40	20	40	-	-	-	100
CAT3	50	40	10	-	-	-	100
ESE	30	40	30	-	-	-	100

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

20EEO04 ENERGY CONSERVATION AND MANAGEMENT

Programme & Branch	All Branches of B.E., / B.Tech.,	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	5	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												
CO2	3	1												
CO3	3	2	1											
CO4	3	1												
CO5	3	3	2		1									

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

ASSESSMENT PATTERN - THEORY

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

20EEO05 AI WITH MATLAB

Programme & Branch	All Branches of B.E., / B.Tech.,	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 artificial intelligence and its step by step implementation procedure using MATLAB software.	
Unit - I	**Introduction to MATLAB programming**	**9+3**
Basic operations- Plotting – Programming – Debugging – Simulink.		
Unit - II	**Introduction of ANN**	**9+3**
Fundamental Concept- Basic models – Important Terminologies – Supervised learning: Perceptron, BPN – Unsupervised learning: Kohonen SOM, LVQ.		
Unit - III	**ANN with MATLAB**	**9+3**
ANN using GUI – ANN using Program codes: Perceptron, BPN and Kohonen SOM – ANN using Simulink: motor speed control.		
Unit - IV	**Introduction of Fuzzy Logic**	**9+3**
Fuzzy logic principle – Membership functions – Fuzzy rule base – Defuzzification methods - Application of FLC Systems.		
Unit - V	**Fuzzy logic system with MATLAB**	**9+3**
FIS using FLC using GUI - Fuzzy Logic using Program codes – FLC using Simulink: motor speed control.		

Lecture:45, Tutorial:15, Total:60

TEXT BOOK:

1. Sivanandam S N and Deepa S N, “Principles of Soft Computing”, 1st Edition, Wiley India, 2008 for Units II,III,IV & V
2. Amos Gilat, “MATLAB- An Introduction with Applications”, 4th Edition, Wiley India, 2012 for Uni I

REFERENCES:

1. Shailendra Jain, “Modelling and Simulation using MATLAB- Simulink”, 1st Edition, Wiley India, 2012.
2. MATLAB Software

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	outline the basic programming procedures using MATLAB software	Understanding (K2)
CO2	make use of ANN for solving engineering problems with aid of different learning methods	Applying (K3)
CO3	apply the various ANN design procedures with MATLAB	Applying (K3)
CO4	understand the fundamental components of fuzzy logic	Understanding (K2)
CO5	examine the fuzzy based design procedures for solving real time problems	Applying (K3)

Mapping of COs with POs and PSOs

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

20EEO06 MICRO GRID AND SMART GRID

Programme & Branch	All Branches of B.E., / B.Tech.,	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	6	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 & Toshifumi Ise, “Microgrid Dynamics and Control”, 1st Edition, Wiley, 2017 for Units I & II.
2. Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu, AkihikoYokoyama, “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												
CO2	3	1												
CO3	3	2	1	1										
CO4	3	2												
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	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)**

20EEO07 E Waste Management

Programme & Branch	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. unit
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, 1993.

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												
CO2	3	1												
CO3	3	2	1	1										
CO4	3	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	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)**

20EEO08 ELECTRIC VEHICLE

Programme & Branch	All Branches of B.E., / B.Tech.,	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	8	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 hydrid 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 - Sensorless 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. Mehrded Ehsani, Yimin Gao & Ali Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory and Design", 2nd Edition, CRC Press, USA, 2010.

REFERENCES:

1. Iqbal Hussain, "Electric and Hybrid Vehicles: Design Fundamentals", 2nd Edition, CRC Press, USA, 2011.
2. Chris Mi, Abul Masrur M & David Wenzhong Gao, "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										
CO2	3	2	1	1										
CO3	2	3	1	1										
CO4	3	2		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	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)**

20GEO13 - NCC Studies(Army Wing) – I

Programme & Branch	All Engineering and Technology Branches	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	VI/VIII	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. It will be converted to 100.						