REGULATIONS,
COURSE STRUCTURE
AND SYLLABUS

(Aligned with AICTE model Curriculum)

SITE 2021 REGULATIONS

For

B.Tech
in
Electrical & Electronics Engineering

With effective from the Academic Year

2021-2022

Values We Live...
sasi INSTITUTE OF TECHNOLOGY & ENGINEERING
autonomous
Accredited by NAAC with "A" Grade
Recognised by UGC under section 2(f) &12(B)
Approved by AICTE - New Delhi
Permanently Affiliated to JNTUK, SBTET
Ranked as "A" Grade by Govt. of A.P.

B. Tech Regulations

1.1 Short title and Commencement

The regulations listed under this head are common for all degree level under graduate programs (B. Tech.) offered by the college with effect from the academic year 2021-22 and they are called as "SITE21" regulations.

The regulations here under are subject to amendments as may be made by the Academic Council of the college from time to time, keeping the recommendations of the Board of Studies in view. Any or all such amendments will be effective from such date and to such batches of candidates including those already undergoing the program, as may be decided by the Academic Council.

1.2. Definitions

a. "Commission" means University Grants Commission(UGC)
b. "Council" means All India Council for Technical Education(AICTE)
c. "University" Means Jawaharlal Nehru Technological University Kakinada(JNTUK)
d. "College" means Sasi Institute of Technology & Engineering, Tadepalligudem.
e. "Program" Means any combination of courses and /or requirements leading to award of a degree
f. "Course" Means a subject either theory or practical identified by its course title and code number and which is normally studied in a semester.
g. For example, (ELECTRONC DEVICES) is a course offered at third semester of B. Tech (ECT) and its code is (21ETETT3030)
h. "Degree" means an academic degree conferred by the university upon those who complete the undergraduate curriculum
i. "Regular Student" means student enrolled into the four year programme in the first year
j. "Lateral entry Students" Means student enrolled into the four year programme in the second year

1.3. Academic Programs

1.3.1. Nomenclature of Programs

The nomenclature and its abbreviation given below shall continue to be used for the degree programs under the University, as required by the Council and Commission. The name of specialization shall be indicated in brackets after the abbreviation. For e.g. UG engineering degree in Mechanical Engineering program is abbreviated as B. Tech. (ME). Bachelor of Technology (B. Tech.) degree program offered in:

1. Artificial Intelligence & Machine Learning(AI & ML)
2. Civil Engineering(CE)
3. Computer Science and Engineering(Artificial Intelligence and Machine learning)-CSA
4. Computer Science and Engineering (IoT and Cyber Security including Block Chain Technology) (CSB)
5. Computer Science and Engineering(Data Science)-CSD
6. Computer Science and Engineering(CSE)
7. Computer Science and Technology(CST)
8. Electronics and Communication Engineering(ECE)
9. Electronics and Communication Technology(ECT)
10. Electrical and Electronics Engineering(EEE)
11. Information Technology(IT)
12. Mechanical Engineering(ME)

– Curriculum framework is important in setting the right direction for a Degree program as it takes into account the type and quantum of knowledge necessary to be acquired by

a student to qualify for a award in his/her chosen branch or specialization.

- Besides, this also helps in assigning the credits for each course, sequencing the courses semester-wise and finally arriving at the total number of courses to be studied and the total number of credits to be earned by a student to fulfill the requirements for conferment of degree.
- Each theory course shall consist of five units.

1.3.2. Curriculum Structure

The curriculum structure is designed in such a way that it facilitates the courses required to attain the expected knowledge, skills and attitude by the time of their graduation as per the needs of the stakeholders. The curriculum structure consists of various course categories (as described in 1.6.3 to 1.6.9) to cover the depth and breadth required for the program and for the attainment of program outcomes of the corresponding program. Each Programme of study will be designed to have 40-45 theory courses and 16-18 laboratory courses. The distribution and types of courses offered from the above is indicated in the following table 3.

1.3.3. Induction Program

The Induction Program for two weeks is designed to make the newly joined students feel comfortable, sensitize them towards exploring their academic interests and activities, reducing competition and making them work for excellence, promote bonding within them, build relations between teachers and students and building of character. Induction program covers

Physical activity
Creative arts
Universal human values
Literary and Proficiency modules
Lectures by Eminent peoples

1.4Admission Criteria

The eligibility criteria for admission into UG engineering programs are as per the norms approved by government of Andhra Pradesh from time to time. The sanctioned seats in each program in the college are classified into CATEGORY-A and CATEGORY-B at first year level and Lateral Entry at second year level.

- **CATEGORY – A Seats:** These seats will be filled as per the norms approved by the Government of Andhra Pradesh.
- **CATEGORY – B Seats:** These seats will be filled by the College as per the norms approved by the Government of Andhra Pradesh.
- **CATEGORY – Lateral Entry Seats** : Lateralentry candidates shall be admitted into the Third semester directly as per the norms approved by government of Andhra Pradesh. The percentages of Category-A, Category-B and Lateral Entry Seats are decided time to time by the Government of Andhra Pradesh.

2. Award of B. Tech. Degree

a) A student will be declared eligible for the award of B. Tech. Degree if he fulfills the following academic regulations:
   i. A student shall be declared eligible for the award of B. Tech Degree, if he pursues a course of study in not less than four and not more than eight academic years. After eight academic years from the year of their admission, he/she shall forfeit their seat in B.Tech course and their admission stands cancelled.
   ii. The candidate shall register for 160 credits and secure all the 160 credits.
b) The medium of instruction for the entire under graduate programmer in Engineering &Technology will be in **English** only.

3. Programme Pattern:

a) Total duration of the of B. Tech (Regular) Programme is four academic years
b) Each Academic year of study is divided into Two Semesters.
c) Minimum number of instruction days in each semester is 90.
d) Grade points, based on percentage of marks awarded for each course will form the basis for calculation of SGPA (Semester Grade Point Average) and CGPA (Cumulative Grade Point Average).
e) The total credits for the Programme is 160.
f) Three week induction program is mandatory for all first year UG students and shall be conducted as per AICTE/UGC/APSCHE guidelines.
g) Student is introduced to "Choice Based Credit System (CBCS)".
h) A pool of interdisciplinary and job-oriented mandatory skill courses which are relevant to the industry are integrated into the curriculum of concerned branch of engineering (total five skill courses: two basic level skill courses, one on soft skills and other two on advanced level skill courses)
i) A student has to register for all courses in a semester.
j) All the registered credits will be considered for the calculation of final CGPA.
k) Each semester has - 'Continuous Internal Evaluation (CIE)' and 'Semester End Examination (SEE)'.Choice Based Credit System (CBCS) and Credit Based Semester System (CBSS) as indicated by UGC and course structure as suggested by AICTE are followed.
l) A 10 months industry/field mandatory internship, both industry and social, during the summer vacation and also in the final semester to acquire the skills required for job and make engineering graduates to connect with the needs of the industry and society at large.
m) All the students shall be mandatorily registered for NCC, NSS activities and Community Service Project as per the Government and University norms.
n) Each college shall assign a faculty advisor/mentor after admission to each student or group of students from same department to provide guidance in courses registration / career growth/placements/opportunities for higher studies/ GATE / other competitive exams etc.

4. Registration for Courses:

a) In each semester a student shall mandatorily register courses which he/she wishes to pursue within a week from the starting of the class work with the advice of Head of the Department and mentor of the student of the concerned department of the college.

b) If any student wishes to withdraw the registration of the course, he/she shall submit a letter to the Principal of the college through the Head of the Department and mentor within fifteen days.

c) The concerned college shall thoroughly verify and upload the data/courses registered by each student in the university examination center within 20 days. The Principal of the concerned college shall ensure that there no wrong registration courses by the student. The university registration portal will be closed after 20 days.

5. (a) Award of B. Tech. Degree: A student will be declared eligible for the award of B. Tech. Degree if he fulfills the following academic regulations:

i. A student shall be declared eligible for award of the B. Tech Degree, if he pursues a course of study in not less than four and not more than eight academic years. After eight academic years from the year of their admission, he/she shall **forfeit** their seat in B. Tech course and their admission stands cancelled.
ii. The student shall register for 160 credits and must secure all the 160 credits.

iii. All students shall mandatorily register for the courses like Environmental Sciences, Universal Human Values, Ethics, Indian Constitution, Essence of Indian Traditional Knowledge etc., shall be included in the curriculum as non-credit mandatory courses. Environmental Sciences is to be offered compulsorily as mandatory course for all branches. A student has to secure at least 40% of the marks allotted in the internal evaluation for passing the course and shall maintain 75% of attendance in the subject.

iv. All students shall mandatorily register for NCC/NSS activities and will be required to participate in an activity specified by NSS officer during second and third semesters. Grade shall be awarded as Satisfactory or Unsatisfactory in the mark sheet on the basis of participation, attendance, performance and behavior. If a student gets an unsatisfactory Grade, he/she shall repeat the above activity in the subsequent years, in order to complete the degree requirements.

v. Credits are defined as per AICTE norms.

(b) Award of B. Tech. (Honor):

- Students of a Department/Discipline are eligible to opt for Honors Programme offered by the same Department/Discipline
- A student shall be permitted to register for Honors program at the beginning of 4 th semester provided that the student must have acquired a minimum of 8.0 SGPA upto the end of 2 nd semester without any backlogs. In case of the declaration of the 3rd semester results after the commencement of the 4th semester and if a student fails to score the required minimum of 8 SGPA, his/her registration for Honors Programme stands cancelled and he/she shall continue with the regular Programme.
- Students can select the additional and advanced courses from their respective branch in which they are pursuing the degree and get an honors degree in the same. e.g. If a Mechanical Engineering student completes the selected advanced courses from same branch under this scheme, he/she will be awarded B. Tech. (Honors) in Mechanical Engineering.
- In addition to fulfilling all the requisites of a Regular B. Tech Programme, a student shall earn 20 additional credits to be eligible for the award of B. Tech (Honors) degree. This is in addition to the credits essential for obtaining the Under Graduate Degree in Major Discipline (i.e. 160 credits).
- Of the 20 additional Credits to be acquired, 16 credits shall be earned by undergoing specified courses listed as pools, with four courses, each carrying 4 credits. The remaining 4 credits must be acquired through two MOOCs, which shall be domain specific, each with 2 credits and with a minimum duration of 8/12weeks as recommended by the Board of studies.
- It is the responsibility of the student to acquire/complete prerequisite before taking the respective course. The courses offered in each pool shall be domain specific courses and advanced courses
- The concerned BoS shall decide on the minimum enrolments for offering Honors program by the department. If minimum enrolments criteria are not met then the students shall be permitted to register for the equivalent MOOC courses as approved by the concerned Head of the department in consultation with BoS.
- Each pool can have theory as well as laboratory courses. If a course comes with a lab component, that component has to be cleared separately. The concerned BoS shall 16 explore the possibility of introducing virtual labs for such courses with lab component.
- MOOC courses must be of minimum 8 weeks in duration. Attendance will not be monitored for MOOC courses. Students have to acquire a certificate from the agencies approved by the BOS with grading or marks or pass/fail in order to earn 4 credits. If the MOOC course is a pass/fail course without any grades, the grade to be assigned will be

as decided by the university/academic council.

- The concerned BoS shall also consider courses listed under professional electives of the respective B. Tech programs for the requirements of B. Tech (Honors). However, a student shall be permitted to choose only those courses that he/she has not studied in any form during the Programme.
- If a student drops or is terminated from the Honors program, the additional credits so far earned cannot be converted into free or core electives; they will remain extra. These additional courses will find mention in the transcript (but not in the degree certificate). In such cases, the student may choose between the actual grade or a "pass (P)" grade and also choose to omit the mention of the course as for the following: All the courses done under the dropped Minors will be shown in the transcript. None of the courses done under the dropped Minor will be shown in the transcript.
- In case a student fails to meet the CGPA requirement for Degree with Honors at any point after registration, he/she will be dropped from the list of students eligible for Degree with Honors and they will receive regular B.Tech degree only. However, such students will receive a separate grade sheet mentioning the additional courses completed by them.
- Honors must be completed simultaneously with a major degree program. A student cannot earn Honors after he/she has already earned bachelor's degree.

(c) **Award of B. Tech. (Minors):**

- a)Students who are desirous of pursuing their special interest areas other than the chosen discipline of Engineering may opt for additional courses in minor specialization groups offered by a department other than their parent department. For example, If Mechanical Engineering student selects subjects from Civil Engineering under this scheme, he/she will get Major degree of Mechanical Engineering with minor degree of Civil Engineering b) Student can also opt for Industry relevant tracks of any branch to obtain the Minor Degree, for example, a B.Tech Mechanical student can opt for the industry relevant tracks like Data Mining track, IOT track, Machine learning track etc.
- The BOS concerned shall identify as many tracks as possible in the areas of emerging technologies and industrial relevance / demand. For example, the minor tracks can be the fundamental courses in CSE, ECE, EEE,CE,ME etc or industry tracks such as Artificial Intelligence (AI), Machine Learning (ML), Data Science (DS), Robotics, Electric vehicles, Robotics, VLSI etc.
- The list of disciplines/branches eligible to opt for a particular industry relevant minor specialization shall be clearly mentioned by the respective BoS.
- There shall be no limit on the number of programs offered under Minor. The University/Institution can offer minor programs in emerging technologies based on expertise in the respective departments or can explore the possibility of collaborating with the relevant industries/agencies in offering the program.
- The concerned BoS shall decide on the minimum enrolments for offering Minor program by the department. If a minimum enrolments criterion is not met, then the students may be permitted to register for the equivalent MOOC courses as approved by the concerned Head of the department in consultation with BoS.
- A student shall be permitted to register for Minors program at the beginning of 4th semester subject to a maximum of two additional courses per semester, provided that the student must have acquired 8 SGPA (Semester Grade point average) upto the end of 2nd semester without any history of backlogs. It is expected that the 3rd semester results may be announced after the commencement of the 4th semester. If a student fails to acquire 8 SGPA upto 3rd semester or failed in any of the courses, his registration for Minors program shall stand cancelled. An SGPA of 8 has to be

maintained in the subsequent semesters without any backlog in order to keep the Minors registration active.

- A student shall earn additional 20 credits in the specified area to be eligible for the award of B. Tech degree with Minor. This is in addition to the credits essential for obtaining the Under Graduate Degree in Major Discipline (i.e. 160 credits).
- Out of the 20 Credits, 16 credits shall be earned by undergoing specified courses listed by the concerned BoS along with prerequisites. It is the responsibility of the student to acquire/complete prerequisite before taking the respective course. If a course comes with a lab component, that component has to be cleared separately. A student shall be permitted to choose only those courses that he/she has not studied in any form during the Programme.
- In addition to the 16 credits, students must pursue at least 2 courses through MOOCs. The courses must be of minimum 8 weeks in duration. Attendance will not be monitored for MOOC courses. Student has to acquire a certificate from the agencies approved by the BOS with grading or marks or pass/fail in order to earn 4 credits. If the MOOC course is a pass/fail course without any grades, the grade to be assigned as decided by the university/academic council.
- Student can opt for the Industry relevant minor specialization as approved by the concerned departmental BoS. Student can opt the courses from Skill Development Corporation (APSSDC) or can opt the courses from an external agency recommended and approved by concerned BOS and should produce course completion certificate. The Board of studies of the concerned discipline of Engineering shall review such courses being offered by eligible external agencies and prepare a fresh list every year incorporating latest skills based on industrial demand.
- A committee should be formed at the level of College/Universities/department to evaluate the grades/marks given by external agencies to a student which are approved by concerned BoS. Upon completion of courses the departmental committee should convert the obtained grades/marks to the maximum marks assigned to that course. The controller of examinations can take a decision on such conversions and may give appropriate grades.
- If a student drops (or terminated) from the Minor program, they cannot convert the earned credits into free or core electives; they will remain extra. These additional courses will find mention in the transcript (but not in the degree certificate). In such cases, the student may choose between the actual grade or a "pass (P)" grade and also choose to omit the mention of the course as for the following: All the courses done under the dropped Minors will be shown in the transcript. None of the courses done under the dropped Minor will be shown in the transcript.
- In case a student fails to meet the CGPA requirement for B.Tech degree with Minor at any point after registration, he/she will be dropped from the list of students eligible for degree with Minors and they will receive B. Tech degree only. However, such students will receive a separate grade sheet mentioning the additional courses completed by them.
- Minor must be completed simultaneously with a major degree program. A student cannot earn the Minor after he/she has already earned bachelor's degree.

6. Attendance Requirements

a) A student is eligible to write the University examinations if he acquires a minimum of 40% in each subject and 75% of attendance in aggregate of all the subjects.

b) Condonation of shortage of attendance in aggregate up to 10% (65% and above, and below 75%) may be granted by the College Academic Committee. However, this condonation concession is applicable only to any two semesters during the entire

programme.

c) Shortage of Attendance below 65% in aggregate shall not be condoned.
d) A student who is short of attendance in a semester may seek re-admission into that semester when offered within 4 weeks from the date of commencement of class work.
e) Students whose shortage of attendance is not condoned in any semester are not eligible to write their end semester examination of that class.
f) A stipulated fee of Rs. 1000/- in the concerned semester shall be payable towards condonation of shortage of attendance. Students availing condonation on medical ground shall produce a medical certificate issued by the competitive authority.
g) A student will be promoted to the next semester if he satisfies the (i) attendance requirement of the present semester and (ii) minimum required credits.
h) If any candidate fulfills the attendance requirement in the present semester, he shall not be eligible for readmission into the same class.
i) For induction programme attendance shall be maintained as per AICTE norms.
j) For non-credit mandatory courses the students shall maintain the attendance similar to credit courses

7. Evaluation-Distribution and Weightage of marks

i. Paper setting and evaluation of the answer scripts shall be done as per the procedures laid down by the University Examination section from time to time.
ii. To maintain the quality, external examiners and question paper setters shall be selected from reputed institutes like IISc, IITs, IIITs, IISERs, NITs and Universities.
iii. For non-credit mandatory courses, like Environmental Sciences, Universal Human Values, Ethics, Indian Constitution, Essence of Indian Traditional Knowledge, the student has to secure 40% of the marks allotted in the internal evaluation for passing the course. No marks or letter grade shall be allotted for all mandatory non-credit courses.
iv. A student is deemed to have satisfied the minimum academic requirements if he has earned the credits allotted to each theory/practical design/drawing subject/ project etc by securing not less than 35% of marks in the end semester exam and minimum 40% of marks in the sum total of the internal marks and end semester examination marks together.

v. **Distribution and Weightage of marks:**The assessment of the student's performance in each course will be as per the details given:

S.No	Components	Internal	External	Total
1	Theory	30	70	100
2	Engineering Graphics/Design/Drawing	30	70	100
3	Practical	15	35	50
4	Mini Project/Internship/Industrial Training/ Skill Development programs/Research Project	-	50	50
5	Project Work	60	140	200

vi. Continuous Internal Theory Evaluation:

a) For theory subjects, during a semester, there shall be two mid-term examinations. Each mid-term examination consists of (i) one online objective examination (20 multiple choice questions) for 10 marks for a duration of 20 minutes (ii) one descriptive examination (3 full questions for 5 marks each) for 15 marks for a duration of 90 minutes and (iii) one assignment for 05 marks. All the internal exams shall be conducted as per university norms from first 50% of the syllabi.
b) In the similar lines, the second online, descriptive examinations assignment shall be conducted on the rest of the 50% syllabus.

c) The total marks secured by the student in each mid-term examination are evaluated for 30 marks. The first mid marks (Mid-1) consisting of marks of online objective examination, descriptive examination and assignment shall be submitted to the University examination section within one week after completion of first mid examination.

d) The mid marks submitted to the University examination section shall be displayed in the concerned college notice boards for the benefit of the students.

e) If any discrepancy found in the submitted Mid-1 marks, it shall be brought to the notice of university examination section within one week from the submission.

f) Second mid marks (Mid-2) consisting of marks of online objective examination, descriptive examination and assignment shall also be submitted to University examination section within one week after completion of second mid examination and it shall be displayed in the notice boards. If any discrepancy found in the submitted mid-2 marks, it shall be brought to the notice of university examination section within one week from the submission.

g) Internal marks can be calculated with 80% weightage for better of the two mids and 20% Weightage for other mid exam.
   a. Example: **Mid-1 marks** = Marks secured in
   b. (Online examination-1 + descriptive examination-1 +one assignment-1)
   c. **Mid-2 marks** = Marks secured in
   d. (Online examination-2+descriptive examination-2+one assignment-2)
   e. **Final internal Marks** = (Best of (Mid-1/Mid-2) marks x 0.8 + Least of (Mid-1/Mid-2) marks x 0.2)

h) With the above criteria, university examination section will send mid marks of all subjects in consolidated form to all the concerned colleges and same shall be displayed in the concerned college notice boards. If any discrepancy found, it shall be brought to the notice of university examination section through proper channel within one week with all proofs. Discrepancies brought after the given deadline will not be entertained under any circumstances.

vii. Semester End Theory Examinations Evaluation:

a) The semester end examinations will be conducted university examination section for 70 marks consists of five questions carrying 14 marks each. Each of these questions is from one unit and may contain sub-questions. For each question there will be an "either" "or" choice, which means that there will be two questions from each unit and the student should answer either of the two questions.

b) For practical subjects there shall be continuous evaluation during the semester for 15 internal marks and 35 end examination marks. The internal 15 marks shall be awarded as follows: day to day work - 5 marks, Record-5 marks and the remaining 5 marks to be awarded by conducting an internal laboratory test. The end examination shall be conducted by the teacher concerned and external examiner appointed.

c) For the subject having design and / or drawing, (such as Engineering Graphics, Engineering Drawing, Machine Drawing) and estimation, the distribution shall be 30 marks for internal evaluation (15 marks for continuous Assessment (day–to–day work) and 15 marks for internal tests) and 70 marks for end examination. There shall be two internal tests in a Semester for 15 marks each and final marks can be calculated with 80% weightage for better of the two tests and 20% weightage for other test and these are to be added to the marks obtained in day to day work.

Evaluation of the summer internships:

- Two summer internships each with a minimum of six weeks duration, done at the end of second and third years, respectively are mandatory. The internship can be

done by the students at local industries, Govt. Organizations, construction agencies, Industries, Hydel and thermal power projects and also in software MNCs.

- Evaluation of the summer internships shall be through the departmental committee. A student will be required to submit a summer internship report to the concerned department and appear for an oral presentation before the departmental committee. The report and the oral presentation shall carry 40% and 60% weightages respectively.
- In the final semester, the student should mandatorily undergo internship and parallelly he/she should work on a project with well-defined objectives. At the end of the semester the candidate shall submit an internship completion certificate and a project report. A student shall also be permitted to submit project report on the work carried out during the internship. The project report shall be evaluated with an external examiner
- The College shall facilitate and monitor the student internship programs. Completion of internships is mandatory, if any student fails to complete internship, he/she will not be eligible for the award of degree. In such cases, the student shall repeat and complete the internship.
- It shall be evaluated for 50 external marks at the end of the semester. There shall be no internal marks for Summer Internship. A student shall secure minimum 40% of marks for successful completion.

d) Curricular Framework for Skill oriented :

- The job oriented skill courses may be registered at the college or at any accredited external agency. A student shall submit a record/report on the on the list skills learned. If the student completes job oriented skill course at external agency, a certificate from the agency shall be included in the report. The course will be evaluated at the end of the semester for 50 marks (record: 15 marks and viva-voce: 35 marks) along with laboratory end examinations in the presence of external and internal examiner (course instructor or mentor). There are no internal marks for the job oriented skill courses.

- For skill oriented/skill advanced course, one theory and 2 practical hours or two theory hours may be allotted as per the decision of concerned BOS.
- Out of the five skill courses two shall be skill-oriented courses from the same domain and shall be completed in second year. Of the remaining 3 skill courses, one shall be necessarily be a soft skill course and the remaining 2 shall be skill-advanced courses either from the same domain or Job oriented skill courses, which can be of inter disciplinary nature.
- A pool of interdisciplinary job-oriented skill courses shall be designed by a common Board of studies by the participating departments/disciplines and the syllabus along with the pre requisites shall be prepared for each of the laboratory infrastructure requirements. The list of such courses shall be included in the curriculum structure of each branch of Engineering, so as to enable the student to choose from the list
- The student shall be given an option to choose either the skill courses being offered by the college or to choose a certificate course being offered by industries/Professional bodies/APSSDC or any other accredited bodies as approved by the concerned BoS
- The Board of studies of the concerned discipline of Engineering shall review the skill advanced courses being offered by eligible external agencies and prepare a

fresh list every year incorporating latest courses based on industrial demand

- If a student chooses to take a Certificate Course offered by industries/Professional bodies/APSSDC or any other accredited bodies, in lieu of the skill advanced course offered by the Department, the credits shall be awarded to the student upon producing the Course Completion Certificate from the agency/professional bodies as approved by the Board of studies.
- If a student prefers to take a certificate course offered by external agency, the department shall mark attendance of the student for the remaining courses in that semester excluding the skill course in all the calculations of mandatory attendance requirements upon producing a valid certificate as approved by the concerned Board of Studies, the student is deemed to have fulfilled the attendance requirement of the course and acquire the credits assigned to the course.
- A committee shall be formed at the level of the college to evaluate the grades/marks given for a course by external agencies and convert to the equivalent marks/grades. The recommended conversions and appropriate grades/marks are to be approved by the University/Academic Council.

e) **Mandatory Course (M.C):** Environmental Sciences, Universal Human Values, Ethics, Indian Constitution, Essence of Indian Traditional Knowledge etc non-credit (zero credits) mandatory courses. Environmental Sciences shall be offered compulsorily as mandatory course for all branches. A minimum of 75% attendance is mandatory in these subjects. There shall be an external examination for 70 marks and it shall be conducted by the college internally. Two internal examinations shall be conducted for 30 marks and a student has to secure at least 40% of the marks for passing the course. There is no online internal exam for mandatory courses. No marks or letter grade shall be printed in the transcripts for all mandatory non-credit courses, but only Completed (Y)/Not-completed (N) will be specified.

f) **Procedure for Conduct and Evaluation of MOOC:** There shall be a Discipline Centric Elective Course through Massive Open Online Course (MOOC) as Program Elective course. The student shall register for the course (Minimum of 12 weeks) offered by SWAYAM/NPTEL through online with the approval of Head of the Department. The Head of the Department shall appoint one mentor for each of the MOOC subjects offered. The student needs to register the course in the SWAYAM/NPTEL portal. During the course, the mentor monitors the student's assignment submissions given by SWAYAM/NPTEL. The student needs to submit all the assignments given and needs to take final exam at the proctor center. The student needs to earn a certificate by passing the exam. The student will be awarded the credits given in curriculum only by submission of the certificate. In case if student does not pass subjects registered through SWAYAM/NPTEL, the same or alternative equivalent subject may be registered again through SWAYAM/NPTEL in the next semester with the recommendation of HOD and shall be pass.

g) ***Major Project (*****Project - Project work, seminar and internship in industry):**

In the final semester, the student should mandatorily register and undergo internship and in parallel he/she should work on a project with well-defined objectives. At the end of the semester the candidate shall submit an internship completion certificate and a project report. A student shall also be permitted to submit project report on the work carried out during the internship. The project report shall be evaluated with an external examiner.

Evaluation*:* The total marks for project work 200 marks and distribution shall be 60 marks for internal and 140 marks for external evaluation. The supervisor assesses the student for 30 marks (Report: 15 marks, Seminar: 15 marks). At the end of the

semester, all projects shall be showcased at the department for the benefit of all students and staff and the same is to be evaluated by the departmental Project Review Committee consisting of supervisor, a senior faculty and HOD for 30 marks. The external evaluation of Project Work is a Viva-Voce Examination conducted in the presence of internal examiner and external examiner and is evaluated for 140 marks.

8 Results Declaration:

i. Before results declaration, an academic council meeting shall be conducted and results shall be placed before the academic council for approval.
ii. With the approval of academic council, the results shall be submitted to the University to get the Approval from Honorable Vice-Chancellor.
iii. The University may normalize the result, if required, before declaration of the result (Guidelines for normalization will be provided separately)
iv. A copy of approved results in a CD shall be submitted to the University examination Center.

9. Academic Audit: Academic audit in each semester will be conducted as per norms.

10. Recounting or Re-evaluation of Marks in the End Semester Examination: A student can request for recounting of revaluation of his/her answer book on payment of a prescribed fee as per norms.

11. Supplementary Examinations: A student who has failed to secure the required credits can appear for a supplementary examination, as per the schedule announced by the University.

12. Malpractices in Examinations: Disciplinary action shall be taken in case of malpractices during Mid/End examinations as per the rules framed by the University.

13. Promotion Rules: The following academic requirements have to be satisfied in addition to the attendance requirements mentioned in item no.5 for promotion to higher classes

a) A student shall be promoted from first year to second year if he fulfills the minimum attendance requirement as per University norm.

b) A student will be promoted from II year to III year if he fulfills the academic requirement of 40% of credits up to either II year I-Semester or II year II-Semester from all the examinations, whether or not the candidate takes the examinations and secures prescribed minimum attendance in II year II semester.

c) A student shall be promoted from III year to IV year if he fulfills the academic requirements of 40% of the credits up to either III year I semester or III year II semester from all the examinations, whether or not the candidate takes the examinations and secures prescribed minimum attendance in III year II semester.

14. Course Pattern

a) The entire course of study is for four academic years; all years are on semester pattern.

b) A student eligible to appear for the end semester examination in a subject, but absent from it or has failed in the end semester examination, may write the exam in that subject when conducted next.

c) When a student is detained for lack of credits / shortage of attendance, he may be re-admitted into the same semester/year in which he has been detained. However, the academic regulations under which he was first admitted shall continue to be applicable to him.

15. Earning of Credit:

A student shall be considered to have completed a course successfully and earned the credits if he/she secures an acceptable letter grade in the range A+ to E as given below. Letter grade 'F' in any course implies failure of the student in that course and no credits earned. Absent is also treated as no credits earned. For project same % percentages will be followed for grading.

Marks Range Max:100	Marks range Max:50	Level	Letter Grade	Grade point
≥ 90	≥ 45	Outstanding	A+	10
≥80 to <89	≥40 to <44	Excellent	A	9
≥70 to <79	≥35 to <39	Very Good	B	8
≥60 to <69	≥30 to <34	Good	C	7
≥50 to <59	≥25 to <29	Fair	D	6
≥40 to <49	≥20 to <24	Satisfactory	E	5
<40	<20	Fail	F	0
-		Absent	AB	0

16. Award of Class:

After a student has satisfied the requirements prescribed for the completion of the program and is eligible for the award of B. Tech. Degree, he shall be placed in one of the following four classes:

Class Awarded	CGPA to be secured	Remarks
First Class with Distinction	≥7.75 (Without any supplementary appearance)	From the CGPA secured from 160 Credits
First Class	≥ 6.75	
Second Class	≥ 5.75 to < 6.75	
Pass Class	≥ 5.00 to < 5.75	

17. Minimum Instruction Days:

The minimum instruction days for each semester shall be 90 working days. There shall be no branch transfers after the completion of the admission process. There shall be no transfer from one college/stream to another within the Constituent Colleges and Units of Jawaharlal Nehru Technological University Kakinada.

18. Withholding of Results:

If the student is involved in indiscipline/malpractices/court cases, the result of the student will be withheld.

19. Transitory Regulations

a) Discontinued or detained candidates are eligible for re-admission as and when next offered.

b) The re-admitted candidate will be governed by the rules & regulations under which the candidate has been admitted.

c) In case of transferred students from other Universities, credits shall be transferred to JNTUK as per the academic regulations and course structure of JNTUK.

d) The students seeking transfer to colleges affiliated to JNTUK from various other Universities / Institutions haveto obtain the credits of any equivalent subjects as prescribed by JNTUK. In addition, the transferred candidates have to pass the failed subjects at the earlier Institute with already obtained internal/sessional marks to be conducted by JNTUK.

20. Gap – Year:

Gap Year concept of Student Entrepreneur in Residence shall be introduced and outstanding students who wish to pursue entrepreneurship are allowed to take a break of one

year at any time after I/II/III year to pursue entrepreneurship full time. This period shall be counted for the maximum time for graduation. An evaluation committee at university level shall be constituted to evaluate the proposal submitted by the student and the committee shall decide on permitting the student for availing the Gap Year.

21. General:

a) Wherever the words “he”, “him”, “his”, occur in the regulations, they include “she”, “her”, “hers”.

b) The academic regulation should be read as a whole for the purpose of any interpretation.

c) In case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Vice-Chancellor is final.

d) The University may change or amend the academic regulations or syllabi at any time and the changes or amendments made shall be applicable to all the students with effect from the dates notified by the University.

ACADEMIC REGULATIONS (SITE21) FOR B.Tech (LATERAL ENTRY SCHEME)

Applicable for the students admitted into II year B. Tech. from the Academic Year 2022-23 onwards

1. Award of B. Tech. Degree

A student will be declared eligible for the award of B. Tech. Degree if he fulfills the following academic regulations:

a) A student shall be declared eligible for the award of the B. Tech Degree, if he pursues a course of study in not less than three academic years and not more than six academic years. After six academic years from the year of their admission, he/she shall forfeit their seat in B. Tech course and their admission stands cancelled.

b) The candidate shall register for 121 credits and secure all the 122 credits.

2. The attendance regulations of B. Tech. (Regular) shall be applicable to B.Tech (lateral entry)
3. **Promotion Rules:** A student shall be promoted from second year to third year if he fulfills the minimum attendance requirement.

   A student shall be promoted from III year to IV year if he fulfills the academic requirements of 40% of the credits up to either III year I semester or III year II semester from all the examinations, whether or not the candidate takes the examinations and secures prescribed minimum attendance in III year II semester.

4. **Award of Class**

   After a student has satisfied the requirement prescribed for the completion of the program and is eligible for the award of B. Tech. Degree, he shall be placed in one of the following four classes:

Class Awarded	CGPA to be secured	Remarks
First Class with Distinction	≥ 7.75 (Without any supplementary appearance)	From the CGPA secured from 121 Credits from II Year to IV Year
First Class	≥ 6.75	
Second Class	≥ 5.75 to < 6.75	
Pass Class	≥ 5.00 to < 5.75	

The Grades secured, Grade points and Credits obtained will be shown separately in the memorandum of marks.

5. All the other regulations as applicable to **B. Tech. 4-year degree course (Regular) will hold good for B. Tech. (Lateral Entry Scheme**

COMMUNITY SERVICE PROJECT

Introduction

1. Community Service Project is an experiential learning strategy that integrates meaningful community service with instruction, participation, learning and community development
2. Community Service Project involves students in community development and service activities and applies the experience to personal and academic development.
3. Community Service Project is meant to link the community with the college for mutual benefit. The community will be benefited with the focused contribution of the college students for the village/ local development. The college finds an opportunity to develop social sensibility and responsibility among students and also emerge as a socially responsible institution.

Objective

Community Service Project should be an integral part of the curriculum, as an alternative to the 2 months of Summer Internships / Apprenticeships / On the Job Training, whenever there is an exigency when students cannot pursue their summer internships. The specific objectives are;

1. To sensitize the students to the living conditions of the people who are around them,
2. To help students to realize the stark realities of the society.
3. To bring about an attitudinal change in the students and help them to develop societal consciousness, sensibility, responsibility and accountability
4. To make students aware of their inner strength and help them to find new /out of box solutions to the social problems.
5. To make students socially responsible citizens who are sensitive to the needs of the disadvantaged sections.
6. To help students to initiate developmental activities in the community in coordination with public and government authorities.
7. To develop a holistic life perspective among the students by making them study culture, traditions, habits, lifestyles, resource utilization, wastages and its management, social problems, public administration system and the roles and responsibilities of different persons across different social systems.

Implementation of Community Service Project

1. Every student should put in a minimum of **180 hours** for the Community Service Project during the summer vacation
2. Each class/section should be assigned with a mentor.
3. Specific Departments could concentrate on their major areas of concern. For example, Dept. of Computer Science can take up activities related to Computer Literacy to different sections of people like - youth, women, house-wives, etc.
4. A log book has to be maintained by each of the student, where the activities undertaken/involved to be recorded. The log book has to be countersigned by the concerned mentor/faculty in charge.
5. Evaluation to be done based on the active participation of the student and grade could be awarded by the mentor/faculty member.
6. The final evaluation to be reflected in the grade memo of the student.
7. The Community Service Project should be different from the regular programs of NSS/NCC/Green Corps/Red Ribbon Club, etc.
8. Minor project report should be submitted by each student. An internal Viva shall also be conducted by a committee constituted by the principal of the college.
9. Award of marks shall be made as per the guidelines of Internship/apprentice/ on the job training

Procedure

1. A group of students or even a single student could be assigned for a particular habitation or village or municipal ward, as far as possible, in the near vicinity of their place of stay, so as to enable them to commute from their residence and return back by evening or so.
2. The Community Service Project is a twofold one –

a) First, the student/s could conduct a survey of the habitation, if necessary, in terms of their own domain or subject area. Or it can even be a general survey, incorporating all the different areas. A common survey format could be designed. This should not be viewed as a duplication of work by the Village or Ward volunteers, rather, it could be another primary source of data.

b) Secondly, the student/s could take up a social activity, concerning their domain or subject area. The different areas, could be like –

- Agriculture
- Health

- Marketing and Cooperation
- Animal Husbandry
- Horticulture
- Fisheries
- Sericulture
- Revenue and Survey
- Natural Disaster Management
- Irrigation
- Law & Order
- Excise and Prohibition
- Mines and Geology
- Energy
- Internet
- Free Electricity
- Drinking Water

EXPECTED OUTCOMES **BENEFITS OF COMMUNITY SERVICE PROJECT TO STUDENTS**

Learning Outcomes

1. Positive impact on students' academic learning.
2. Improves students' ability to apply what they have learned in "the real world".
3. Positive impact on academic outcomes such as demonstrated complexity of understanding, problem analysis, problem-solving, critical thinking, and cognitive development.
4. Improved ability to understand complexity and ambiguity.

Personal Outcomes

1. Greater sense of personal efficacy, personal identity, spiritual growth, and moral development.
2. Greater interpersonal development, particularly the ability to work well with others, and build leadership and communication skills

Social Outcomes

1. Reduced stereotypes and greater inter-cultural understanding
2. Improved social responsibility and citizenship skills
3. Greater involvement in community service after graduation

Career Development

1. Connections with professionals and community members for learning and career opportunities
2. Greater academic learning, leadership skills, and personal efficacy can lead to greater opportunity

Relationship with the Institution

1. Stronger relationships with faculty
2. Greater satisfaction with college
3. Improved graduation rates

BENEFITS OF COMMUNITY SERVICE PROJECT TO FACULTY MEMBERS

1. Satisfaction with the quality of student learning
2. New avenues for research and publication via new relationships between faculty and community
3. Providing networking opportunities with engaged faculty in other disciplines or institutions
4. A stronger commitment to one's research

BENEFITS OF COMMUNITY SERVICE PROJECT TO COLLEGES AND UNIVERSITIES

1. Improved institutional commitment
2. Improved student retention

3. Enhanced community relations

BENEFITS OF COMMUNITY SERVICE PROJECT TO COMMUNITY

1. Satisfaction with student participation
2. Valuable human resources needed to achieve community goals
3. New energy, enthusiasm and perspectives applied to community work
4. Enhanced community-university relations.

SUGGESTIVE LIST OF PROGRAMMES UNDER COMMUNITY SERVICE PROJECT

The following the recommended list of projects for engineering students. The lists are not exhaustive and open for additions, deletions and modifications. Colleges are expected to focus on specific local issues for this kind of projects. The students are expected to carry out these projects with involvement, commitment, responsibility and accountability. The mentors of a group of students should take the responsibility of motivating, facilitating, and guiding the students. They have to interact with local leadership and people and appraise the objectives and benefits of this kind of projects. The project reports shall be placed in the college website for reference. Systematic, Factual, methodical and honest reporting shall be ensured.

For Engineering Students

1. Water facilities and drinking water availability
2. Health and hygiene
3. Stress levels and coping mechanisms
4. Health intervention programs
5. Horticulture
6. Herbal plants
7. Botanical survey
8. Zoological survey
9. Marine products
10. Aqua culture
11. Inland fisheries
12. Animals and species
13. Nutrition
14. Traditional health care methods
15. Food habits
16. Air pollution
17. Water pollution
18. Plantation
19. Soil protection
20. Renewable energy
21. Plant diseases
22. Yoga awareness and practice
23. Health care awareness programs and their impact
24. Use of chemicals on fruits and vegetables
25. Organic farming
26. Crop rotation
27. Floury culture
28. Access to safe drinking water
29. Geographical survey
30. Geological survey
31. Sericulture
32. Study of species
33. Food adulteration
34. Incidence of Diabetes and other chronic diseases
35. Human genetics

36. Blood groups and blood levels
37. Internet Usage in Villages
38. Android Phone usage by different people
39. Utilization of free electricity to farmers and related issues
40. Gender ration in schooling level- observation.

Complementing the community service project, the students may be involved to take up some awareness campaigns on social issues/special groups. The suggested list of programs are;

Programs for School Children:

1. Reading Skill Programme (Reading Competition)
2. Preparation of Study Materials for the next class.
3. Personality / Leadership Development
4. Career Guidance for X class students
5. Screening Documentary and other educational films
6. Awareness Programme on Good Touch and Bad Touch (Sexual abuse)
7. Awareness Programme on Socially relevant themes.

Programs for Women Empowerment

1. Government Guidelines and Policy Guidelines
2. Women's' Rights
3. Domestic Violence
4. Prevention and Control of Cancer
5. Promotion of Social Entrepreneurship

General Camps

1. General Medical camps
2. Eye Camps
3. Dental Camps
4. Importance of protected drinking water
5. ODF awareness camp
6. Swatch Bharat
7. AIDS awareness camp
8. Anti-Plastic Awareness
9. Programs on Environment
10. Health and Hygiene
11. Hand wash programs
12. Coemoration and Celebration of important ***Programs for Youth Empowerment***

1. Leadership
2. Anti-alcoholism and Drug addiction
3. Anti-tobacco
4. Awareness on Competitive Examinations
5. Personality Development

Common Programs

1. Awareness on RTI
2. Health intervention programs
3. Yoga
4. Tree plantation
5. Programs in consonance with the Govt. Departments like –
    i. Agriculture
    ii. Health
    iii. Marketing and Cooperation
    iv. Animal Husbandry
    v. Horticulture

vi. Fisheries
vii. Sericulture
viii. Revenue and Survey
ix. Natural Disaster Management
x. Irrigation
xi. Law & Order
xii. Excise and Prohibition
xiii. Mines and Geology
xiv. Energy

Role of Students:

1. Students may not have the expertise to conduct all the programmes on their own. The students thencan play a facilitator role.
2. For conducting special camps like Health related, they will be coordinating with the Governmental agencies.
3. As and when required the College faculty themselves act as Resource Persons.
4. Students can work in close association with Non-Governmental Organizations like Lions Club, Rotary Club, etc or with any NGO actively working in that habitation.
5. And also, with the Governmental Departments. If the programme is rolled out, the District Administration could be roped in for the successful deployment of the programme.
6. An in-house training and induction programme could be arranged for the faculty and participating students, to expose them to the methodology of Service Learning.

Timeline for the Community Service Project Activity

Duration: 8 weeks

1. Preliminary Survey (One Week)

a) A preliminary survey including the socio-economic conditions of the allotted habitation to be conducted.

b) A survey form based on the type of habitation to be prepared before visiting the habitation with the help of social sciences faculty. (However, a template could be designed for different habitations, rural/urban.

c) The Governmental agencies, like revenue administration, corporation and municipal authorities and village secretariats could be aligned for the survey.

2. Community Awareness Campaigns (Two Weeks)

Based on the survey and the specific requirements of the habitation, different awareness campaigns and programmes to be conducted, spread over two weeks of time. The list of activities suggested could be taken into consideration.

3. Community Immersion Programme (Four Weeks)

Along with the Community Awareness Programmes, the student batch can also work with any one of the below listed governmental agencies and work in tandem with them. This community involvement programme will involve the students in exposing themselves to the experiential learning about the community and its dynamics. Programmes could be in consonance with the Govt. Departments.

4. Community Exit Report (One Week)

During the last week of the Community Service Project, a detailed report of the outcome of the 8 weeks works to be drafted and a copy shall be submitted to the local administration. This report will be a basis for the next batch of students visiting that particular habitation. The same report submitted to the teacher-mentor will be evaluated by the mentor and suitable marks are awarded for onward submission to the University.

Throughout the Community Service Project, a daily log-book need to be maintained by the students batch, which should be countersigned by the governmental agency representative and the teacher-mentor, who is required to periodically visit the students and guide them.

Course Numbering Scheme

The Course number code consists of 11alphabets. A typical course number code is illustrated in the followingFigure-1.

Mechanical Engineering (ME)

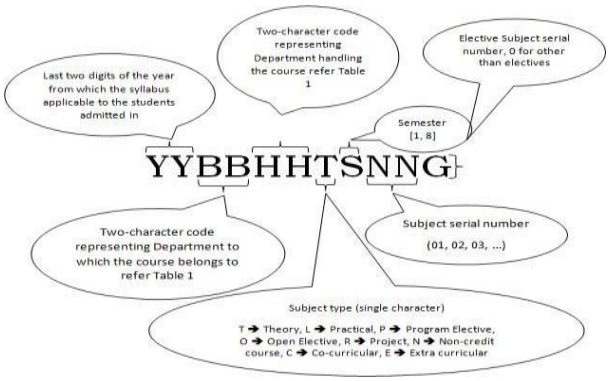


Figure 1: Course Numbering Scheme

The department codes are in given in following table 1.

Table 1: Department Codes

Department	**Two-character code**
Artificial Intelligence and Machine Learning	AM
Civil Engineering	CE
Electrical & Electronics Engineering	EE
Mechanical Engineering	ME
Electronics & Communications Engineering	EC
Electronics & Communications Technology	ET
Computer Science and Engineering(Artificial Intelligence and Machine Learning)	CA
Computer Science and Engineering(IoT and Cyber Security including Block Chain Technology)	CB
Computer Science and Engineering (Data Science)	CD
Computer Science and Engineering	CS
Computer Science and Technology	CT
Information Technology	IT
Management Science	MS

Mathematics	MA
Physics	PH
Chemistry	CH
English	EG
Biology	BI
Common to All Branches	CM

Example: ED in 3rd semester for ECT with S.No. 3

Course Code: 21ETETT3030

Table 2: Comparison of Number of credits given by AICTE and Approved credits

S. No.	Category	AICTE	APSCHE	Approved
1	Humanities and Social Sciences	12	10.5	10.5
2	Basic Science courses	25	21	21
3	Engineering Science courses	24	24	22.5
4	Professional Core courses	48	51	52.5
5	Professional Elective Courses	18	15	15
6	Open elective courses	18	12	12
7	Project work , Seminar and Internship	15	16.5	16.5
8	Mandatory Courses	-	-	-
9	Skill courses	0	10	10
Total Credits		160	160	160

Malpractice

DISCIPLINARY ACTION FOR MALPRACTICES/IMPROPER CONDUCT IN EXAMS

S. No.	Nature of Malpractices/Improper conduct	Punishment
	If the candidate:	
1. (a)	Possesses or keeps accessible in examination hall, any paper, note book, programmable calculators, Cell phones, pager, palm computers or any other form of material concerned with or related to the subject of the examination (theory or practical) in which he is appearing but has not made use of (material shall include any marks on the body of the candidate which can be used as an aid in the subject of the examination)	Expulsion from the examination hall and cancellation of the performance in that subject only.
1. (b)	Gives assistance or guidance or receives it from any other candidate orally or by any other body language methods or communicates through cell phones with any candidate or persons in or outside the exam hall in respect of any matter.	Expulsion from the examination hall and cancellation of the performance in that subject only of all the candidates involved. In case of an outsider, he will be handed over to the police and a case is registered against him.
2.	Has copied in the examination hall from any paper, book, programmable calculators, palm computers or any other form of material relevant to the subject of the examination (theory or practical) in which the candidate is appearing.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the subjects of that Semester/year. The Hall Ticket of the candidate is to be cancelled and sent to the University.
3.	Impersonates any other candidate in connection with the examination.	The candidate who has impersonated shall be expelled from examination hall. The candidate is also debarred and forfeits the seat. The performance of the original candidate who has been impersonated, shall be cancelled in all the subjects of the examination (including practicals and project work) already appeared and shall not be allowed to appear for examinations of the remaining subjects of that

		semester/year. The candidate is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. If the imposter is an outsider, he will be handed over to the police and a case is registered against him.
4.	Smuggles in the Answer book or additional sheet or takes out or arranges to send out the question paper during the examination or answer book or additional sheet, during or after the examination.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
5.	Uses objectionable, abusive or offensive language in the answer paper or in letters to the examiners or writes to the examiner requesting him to award pass marks.	Cancellation of the performance in that subject.
6.	Refuses to obey the orders of the Chief Superintendent/Assistant – Superintendent / any officer on duty or misbehaves or creates disturbance of any kind in and around the examination hall or organizes a walk out or instigates others to walk out, or threatens the officer-in charge or any person on duty in or outside the examination hall of any injury to his person or to any of his relations whether by words, either spoken or written or by signs or by visible representation, assaults the officer-in-charge, or any person on duty in or outside the examination hall or any of his relations, or indulges in any other act of misconduct or mischief which result in	In case of students of the college, they shall be expelled from examination halls and cancellation of their performance in that subject and all other subjects the candidate(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the subjects of that semester/year. The candidates also are debarred and forfeit their seats. In case of outsiders, they will be handed over to the police and a police case is registered against them.

	damage to or destruction of property in the examination hall or any part of the College campus or engages in any other act which in the opinion of the officer on duty amounts to use of unfair means or misconduct or has the tendency to disrupt the orderly conduct of the examination.	
7.	Leaves the exam hall taking away answer script or intentionally tears of the script or any part thereof inside or outside the examination hall.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
8.	Possess any lethal weapon or firearm in the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat.
9.	If student of the college, who is not a candidate for the particular examination or any person not connected with the college indulges in any malpractice or improper conduct mentioned in clause 6 to 8.	Student of the colleges expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat. Person(s) who do not belong to the College will be handed over to police and, a police case will be registered against them.

10.	Comes in a drunken condition to the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year.
11.	Copying detected on the basis of internal evidence, such as, during valuation or during special scrutiny.	Cancellation of the performance in that subject and all other subjects the candidate has appeared including practical examinations and project work of that semester/year examinations.
12.	If any malpractice is detected which is not covered in the above clauses 1 to 11 shall be reported to the University for further action to award suitable punishment.	

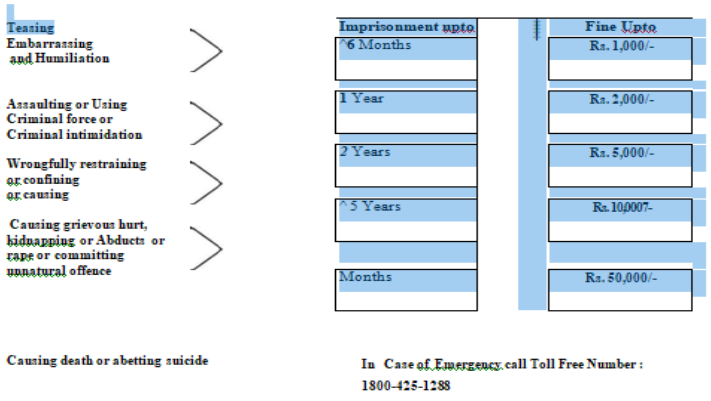
MALPRACTICES

- The Principal shall refer the cases of malpractices in Continuous Evaluation and Semester-End Examinations, to Malpractice Enquiry Committee, constituted by him/her for the purpose. Such committee shall follow the approved scales of punishment. The Principal shall take necessary action, against the erring students based on the recommendations of the committee.
- Any action on the part of student at an examination trying to get undue advantage in the performance or trying to help another, or derive the same through unfair means is punishable according to the provisions contained hereunder. The involvement of the Staff, who are in charge of conducting examinations, valuing examination papers and preparing/keeping records of documents relating to the examinations in such acts (inclusive of providing incorrect or misleading information) that infringe upon the course of natural justice to one and all concerned at the examination shall be viewed seriously and recommended for award of appropriate punishment after thorough enquiry.

Ragging

Prohibition of ragging in educational institutions Act 26 of 1997 Salient Features

- Ragging within or outside any educational institution is prohibited.
- Ragging means doing an act which causes or is likely to cause Insult or Annoyance of Fear or Apprehension or Threat or Intimidation or outrage of modesty or Injury to a student.



LET US MAKE SITE RAGGING FREE INSTITUTE

Program Outcomes for an Engineering Graduates:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **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.
3. **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.
4. **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.
5. **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.
6. 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.
7. **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.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **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.
11. **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.
12. **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.

COURSE STRUCTUREAND SYLLABUS

SITE-21 REGULATIONS

For
B. Tech.
In
Electrical & Electronics Engineering

Comparison of suggested breakup of AICTE, APSCHE and SITE Curriculum

Credit Distribution for B. Tech. EEE Program

Category Credits	BS	ES	HSS	PC	PE	OE	MC	SOC	I& Project	Total
SITE	**21**	**22.5**	**10.5**	**52.5**	**15**	**12**	**0**	**10**	**16.5**	**160**
APSCHE	21	24	10.5	51	15	12	0	10	16.5	160
Comparison	**0**	**-1.5**	**0**	**1.5**	**0**	**0**	**0**	**0**	**0**	**0**
AICTE	25	24	12	48	18	18	0	0	15	160
Comparison	**-4**	**-1.5**	**-1.5**	**4.5**	**-3**	**-6**	**0**	**10**	**1.5**	**0**

SITE - 21 Credit distribution										
Semester (Year)	**Category**									**Sem Credits**
	BS	**ES**	**HSS**	**PC**	**PE**	**OE**	**MC**	**SOC**	**SI&P**	
I (1)	3+2	2+1	-	-	-	-	0	-	-	19.5
II (1)	1	3+2	1+1	-	-	-	0	-	-	19.5
III (2)	1	-	-	4+3	-	-	1	1	-	21.5
IV (2)	1	1	1	2+3	-	-	-	1	-	21.5
V (3)	-	-	-	3+2	1	1	1	1	1	21.5
VI (3)	-	-	-	3+3	1	1	1	1	-	21.5
VII (4)	-	-	1	-	3	2	-	1	1	23
VIII (4)	Major Project (6 months Internship)								12	12
Category Credits	21	22.5	10.5	52.5	15	12	0	10	16.5	**160**
% Credit distribution	**13.125**	**14.063**	**6.56**	**32.813**	**9.38**	**7.5**	**0**	**6.25**	**10.31**	**100**

General Course Structure
Total credits (4 year course) - 160

Course Structure for I B. Tech I Semester Under the Regulations of SITE-21							
Common for (CE, EEE, ME, ECT, CST, AI & ML) I SEMESER							
S. No	**Course Category**	**Course code**	**Course Title**	**L**	**T**	**P**	**C**
1	BS	21CMMAT1010	Engineering Mathematics – I(Calculus and Differential Equations)	3	0	0	3
2	BS	21EEPHT1020	Engineering Physics	3	0	0	3
3	BS	21CMCHT1030	Engineering Chemistry	3	0	0	3
4	ES	21CMCST1040	Programming for Problem Solving	3	0	0	3
5	ES	21CMMEL1050	Engineering Graphics	2	0	2	3
6	BS LAB	21EEPHL1060	Engineering Physics Lab	0	0	3	1.5
7	BS LAB	21CMCHL1070	Engineering Chemistry Lab	0	0	3	1.5
8	ES LAB	21CMCSL1080	Programming for Problem Solving Lab	0	0	3	1.5
9	MC	21CMMSN1090	Constitution of India, Professional Ethics & Human Rights	2	0	0	0
TOTAL				**16**	**0**	**11**	**19.5**

Course Structure for I B. Tech II Semester Under the Regulations of SITE-21							
Common for (CE, EEE, ME, ECT, CST, AI & ML) I I SEMESER							
S. No	**Course Category**	**Course code**	**Course Title**	**L**	**T**	**P**	**C**
1	HS	21CMEGT2010	Technical English	3	0	0	3
2	BS	21CMMAT2020	Engineering Mathematics – II(Linear algebra, Laplace Transforms and Numerical Methods)	3	0	0	3
3	ES	21CMEET2030	**Basic Electrical Engineering**	3	0	0	3
4	ES	21CMCST2040	Python Programming	1	0	4	3
5	ES	21EEMET2050	Engineering Mechanics	3	0	0	3
6	HS LAB	21CMEGL2060	English Communication Skills Lab	0	0	3	1.5
7	ES LAB	21CMEEL2070	**Basic Electrical Engineering Lab**	0	0	3	1.5
8	ES LAB	21CMMEL2080	Engineering Workshop Lab	0	0	3	1.5
9	MC	21CMCHN2090	Environmental Science	2	0	0	0
			TOTAL	**15**	**0**	**13**	**19.5**

Course Structure for II B. Tech I Semester Under the Regulations of SITE-21							
III SEMESTER							
S. No	Course Category	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	BS	21EEMAT3010	Engineering Mathematics III (Vector Calculus and Complex Analysis)	3	0	0	3
2	PC	21EEEET3020	Electrical Circuits Analysis	3	0	0	3
3	PC	21EEEET3030	Analog Electronics	3	0	0	3
4	PC	21EEEET3040	Electrical Measurements & Instrumentation	3	0	0	3
5	PC	21EEEET3050	DC Machines & Transformers	3	0	0	3
6	PC LAB	21EEEEL3060	Analog Electronics Lab	0	0	3	1.5
7	PC LAB	21EEEEL3070	Electrical Circuit Analysis Lab	0	0	3	1.5
8	PC LAB	21EEEEL3080	DC Machines & Transformers Lab	0	0	3	1.5
9	SOC	21EEEES3090	Electrical Wiring & Installation	1	0	2	2
10	MC	21EEEEN3100	Electromagnetic Fields	2	0	0	0
			TOTAL	**18**	**0**	**11**	**21.5**

Course Structure for II B. Tech II Semester Under the Regulations of SITE-21							
IV SEMESTER							
S. No	**Course Category**	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	ES	21EEEET4010	Signals & Systems	3	0	0	3
2	PC	21EEEET4020	Digital Electronics	3	0	0	3
3	BS	21CMMAT4030	Engineering Mathematics-IV (Probability & Statistics)	3	0	0	3
4	PC	21EEEET4040	Induction & Synchronous Machines	3	0	0	3
5	HSS	21CMMST4050	Engineering Economics And Financial Management	3	0	0	3
6	PC LAB	21EEEEL4060	Digital Electronics Lab	0	0	3	1.5
7	PC LAB	21EEEEL4070	Electrical Measurements & Instrumentation Lab	0	0	3	1.5
8	PC LAB	21EEEEL4080	Induction & Synchronous Machines Lab	0	0	3	1.5
9	SOC	21EEEES4090	Design of Electrical Circuits using Engineering software tools	1	0	2	2
			TOTAL	**16**	**0**	**11**	**21.5**
10	H/M		Honor/Minor courses(The hours distribution can be 3-0-2 or 3-1-0)	4	0	0	4

Course Structure for III B. Tech I Semester Under the Regulations of SITE-21							
V SEMESTER							
S. No	**Course Category**	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	PC	21EEEET5010	Power Generation, Transmission & Distribution	3	0	0	3
2	PC	21EEEET5020	Power Electronics	3	0	0	3
3	PC	21EEEET5030	Control Systems	3	0	0	3
4	OE	21EEXXO504X	Open Elective-I	2	0	2	3
5	PE	21EEEEP505X	Professional Elective-I	3	0	0	3
6	PC LAB	21EEEEL5060	Power Systems Lab	0	0	3	1.5
7	PC LAB	21EEEEL5070	Power Electronics Lab	0	0	3	1.5
8	SAC/SC	21CMAHSx0x	Soft Skills & Aptitude Builder - 1	1	0	2	2
9	MC	21EEEEN5090	Energy studies	2	0	0	0
10	SI	21EEEEI5010	Summer Internship (1-2 months) after second year to evaluate in V semester	0	0	0	1.5
			TOTAL	**17**	**0**	**10**	**21.5**
11	H/M		Honor/Minor courses(The hours distribution can be 3-0-2 or 3-1-0)	4	0	0	4

Professional Elective – I

S. No	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	21EEEEP505A	Special Electrical Machines.	3	0	0	3
2	21EEEEP505B	Electrical Energy conservation & Auditing.	3	0	0	3
3	21EEEEP505C	Digital signal Processing	3	0	0	3

Course Structure for III B. Tech II Semester Under the Regulations of SITE-21							
VI SEMESR							
S. No	**Course Category**	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	PC	21EEEET6010	Power System Analysis, Operation & Control	3	0	0	3
2	PC	21EEEET6020	Microprocessors & Microcontrollers	3	0	0	3
3	PC	21EEEET6030	Power Semiconductor Drives	3	0	0	3
4	PE	21EEEEP604X	Professional Elective-II	3	0	0	3
5	OE	21EEXXO605X	Open Elective -II	2	0	2	3
6	PC	21EEEEL6040	Microprocessors & Microcontrollers Laboratory	0	0	3	1.5
7	PC LAB	21EEEEL6050	Control Systems Lab	0	0	3	1.5
8	PC LAB	21EEEEL6060	Power Systems Analysis Lab	0	0	3	1.5
9	SAC/SC	21CMAHSx0x	Soft Skills & Aptitude Builder - 2	0	0	0	2
10	I/RI	Industrial/Research Internship(Mandatory) 1-2 Months(No credits)					
			TOTAL	**14**	**0**	**11**	**21.5**
11	H/M		Honor/Minor courses(The hours distribution can be 3-0-2 or 3-1-0)	4	0	0	4

Professional Elective-II

S. No	Course Code	Course Title	L	T	P	C
1	21EEEEP604A	Electrical Machine Modeling & Analysis	3	0	0	3
2	21EEEEP604B	Power system Protection.	3	0	0	3
3	21EEEEP604C	Control system design.	3	0	0	3

Course Structure for IV B. Tech I Semester Under the Regulations of SITE-21							
VII SEMESTER							
S. No	**Course Category**	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	PE	21EEEEP701X	Professional Elective-III	3	0	0	3
2	PE	21EEEEP702X	Professional Elective -IV	3	0	0	3
3	PE	21EEEEP703X	Professional Elective -V	3	0	0	3
4	OE	21EEXXO704X	Open Elective –III	2	0	2	3
5	OE	21EEXXO805X	Open Elective –IV	2	0	2	3
6	H&SS	21EEEEOX0XX	Elective	3	0	0	3
7	SAC/SC	21EEEES7010	Design of Photovoltaic Systems	1	0	2	2
8	SI	21EEEEI7020	Industrial/Research Internship (1-2 Months) after third year to be evaluated in VII semester	0	0	0	3
TOTAL				**17**	**0**	**6**	**23**
9	H/M		Honor/Minor courses(The hours distribution can be 3-0-2 or 3-1-0)	4	0	0	4

Professional Elective-III

S.No.	Course Code	Course Title	L	T	P	C
1	21EEEEP701A	Switched Mode Power Converters	3	0	0	3
2	21EEEEP701B	Electrical & Hybrid Vehicles	3	0	0	3
3	21EEEEP701C	Artificial Intelligence Techniques	3	0	0	3

Professional Elective-IV

S.No.	Course Code	Course Title	L	T	P	C
1	21EEEEP702A	Wind & Solar Energy Systems	3	0	0	3
2	21EEEEP702B	Power Quality	3	0	0	3
3	21EEEEP702C	Digital Control Systems	3	0	0	3

Professional Elective-V

S.No.	Course Code	Course Title	L	T	P	C
1	21EEEEP703A	FACTS & HVDC Transmission Systems	3	0	0	3
2	21EEEEP703B	Smart Grid	3	0	0	3
3	21EEEEP703C	Optimization Techniques	3	0	0	3

Course Structure for IV B. Tech II Semester Under the Regulations of SITE-21							
VIII SEMESTER							
S.No.	**Course Category**	**Course Code**	**Course Title**	**L**	**P**	**T**	**C**
1	Project	21EEEER8010	Project, Seminar and Internship in Industry (6 months)	0	14	0	12
		Total		0	14	0	12

Open Electives offered by EEE department

S.No.	Course Code	Subject title	L	T	P	C
1	21XXEEOM0XA	Control system design	3	0	0	3
2	21XXEEOM0XB	Digital Control Systems	3	0	0	3
3	21XXEEOM0XC	Intelligent control & its applications	3	0	0	3
4	21XXEEOM0XD	Digital Signal Processing	3	0	0	3
5	21XXEEOM0XE	Electrical & Hybrid Vehicles	3	0	0	3
6	21XXEEOM0XF	Industrial Electrical Systems	3	0	0	3
7	21XXEEOM0XG	Electrical materials	3	0	0	3
8	21XXEEOM0XH	Optimization techniques	3	0	0	3
9	21XXEEOM0XI	Wind & Solar Energy Systems	3	0	0	3

Mandatory Courses

S.No.	Course Code	Subject title	L	T	P	C
1	21CMMSN1090	Constitution of India, ProfessionalEthics & Human Rights	2	0	0	0
2	21CMCHN2090	Environmental Science	2	0	0	0
3	21EEEEN3100	Electromagnetic Fields	2	0	0	0
4	21EEEEN5090	Energy studies	2	0	0	0

Skill oriented Courses

S.No.	Course Code	Subject title	L	T	P	C
1	21EEEES3090	Electrical Wiring & Installation	1	0	2	2
2	21EEEES4090	Design of Electrical Circuits using Engineering Software Tools	1	0	2	2
3	21CMAHSx0x	Soft Skills & Aptitude Builder - 1	1	0	2	2
4	21CMAHSx0x	Soft Skills & Aptitude Builder - 2	1	0	2	2
5	21EEEES7010	Design of Photovoltaic Systems	1	0	2	2

Course structure for Electrical & Electronics Engineering
Honors (for EEE Students)

II B. Tech II Semester:

S. No	Subject code	Name of the Subject	L	T	P	C
1	21EEEEH410A	Electrical Wiring, Estimation and Costing	3	1	0	4
2	21EEEEH410B	SCADA Energy Management Systems	3	1	0	4
3	21EEEEH410C	Linear IC Applications	3	1	0	4
4	21EEEEH410D	Renewable Energy Systems	3	1	0	4

III B. Tech I Semester:

S. No	Subject code	Name of the Subject	L	T	P	C
1	21EEEEH511A	Electrical Machine Design	3	1	0	4
2	21EEEEH511B	Utilization of Electrical Energy & Traction	3	1	0	4
3	21EEEEH511C	Solar & Advanced Energy Storage System	3	1	0	4
4	21EEEEH511D	Modern Control Systems	3	1	0	4

III B. Tech II Semester:

S. No	Subject code	Name of the Subject	L	T	P	C
1	21EEEEH611A	Modern Power Electronics	3	1	0	4
2	21EEEEH611B	AC Drives	3	1	0	4
3	21EEEEH611C	Power Quality & Custom Power Devices	3	1	0	4
4	21EEEEH611D	High Voltage Engineering	3	1	0	4

IV B. Tech I Semester:

S. No	Subject code	Name of the Subject	L	T	P	C
1	21EEEEH709A	EHV AC Transmission	3	1	0	4
2	21EEEEH709B	Line Commutated & Active Rectifiers	3	1	0	4
3	21EEEEH709C	Electrical Distribution Systems	3	1	0	4
4	21EEEEH709D	Power Systems Dynamics & Stability	3	1	0	4

Course structure for Electrical & Electronics Engineering
Minors to other Departments

II B. Tech II Semester:

S. No	Subject code	Name of the Subject	L	T	P	C
1	21XXEEM410A	Fundamental of Electrical Circuit Theory	3	1	0	4
2	21XXEEM410B	Fundamental of EMF Theory	3	1	0	4
3	21XXEEM410C	Fundamental of Control Systems	3	1	0	4

III B. Tech I Semester:

S. No	Subject code	Name of the Subject	L	T	P	C
1	21XXEEM511A	Fundamentals of Electrical Machines	3	1	0	4
2	21XXEEM511B	Fundamentals of Power Electronics	3	1	0	4
3	21XXEEM511C	Fundamental of Electrical Measurements & Instrumentation	3	1	0	4

III B. Tech II Semester:

S. No	Subject code	Name of the Subject	L	T	P	C
1	21XXEEM611A	Fundamentals of Electrical Power Generation & Economic Concepts	3	1	0	4
2	21XXEEM611B	Fundamentals of Renewable Energy Sources	3	1	0	4
3	21XXEEM611C	Fundamentals of Energy Storage Systems	3	1	0	4

IV B. Tech I Semester:

S. No	Subject code	Name of the Subject	L	T	P	C
1	21XXEEM709A	Fundamentals of Electrical Power Transmission & Distribution	3	1	0	4
2	21XXEEM709B	Fundamentals of Utilization of Electrical Energy	3	1	0	4
3	21XXEEM709C	Fundamentals of Electrical Safety	3	1	0	4

Course Structure for I B. Tech I Semester Under the Regulations of SITE-21						
I Semester						
S.No	**Subject Code**	**Course**	**Hours**			**Credits**
			L	**T**	**P**	
1	21CMEGT1010	Engineering Mathematics - I	3	0	0	3
2	21CMMAT1020	Engineering Physics	3	0	0	3
3	21CMEET1030	Engineering Chemistry	3	0	0	3
4	21CMCST1040	Programming for Problem Solving	3	0	0	3
5	21EEMEL1050	Engineering Graphics	2	0	2	3
6	21EEPHL1060	Engineering Physics Lab	0	0	3	1.5
7	21CMCHL1070	Engineering Chemistry Lab	0	0	3	1.5
8	21CMCSL1080	Programming for Problem Solving Lab	0	0	3	1.5
9	21CMMSN1090	Constitution of India, Professional Ethics & Human Rights	2	0	0	0
		Total	**16**	**0**	**11**	**19.5**

Course Structure for I B. Tech I Semester Under the Regulations of SITE-21						
II Semester						
S. No	**Subject Code**	**Course**	**Hours**			**Credits**
			L	**T**	**P**	
1	21CMEGT2010	Technical English	3	0	0	3
2	21CMMAT2020	Engineering Mathematics – II	3	0	0	3
3	21CMEET2030	Basic Electrical Engineering	3	0	0	3
4	21CMCST2040	Python Programming	1	0	4	3
5	21EEMET2050	Engineering Mechanics	3	0	0	3
6	21CMEGL2060	English Communication Skills Lab	0	0	3	1.5
7	21CMEEL2070	Basic Electrical Engineering Lab	0	0	3	1.5
8	21EEMEL2080	Engineering Workshop Lab	0	0	3	1.5
9	21CMCHN2090	Environmental Science	2	0	0	0
		Total	**16**	**0**	**11**	**19.5**

ENGINEERING MATHEMATICS-I
(Calculus & Differential Equations)
Common to all the branches
Semester I

Subject Code	21CMMAT1010	IA Marks	30
Number of Lecture Hours/Week	3	Exam Marks	70
Total Number of Lecture Hours	50	Exam Hours	03

Credits – 03

Course Objectives:

1. To solve the differential equations related to various engineering fields
2. To enlighten the learners in the concept of differential equations.
3. To familiarize with functions of several variables which is useful in optimization
4. To solve the partial partial differential equations of first order
5. To apply double integration techniques in evaluating areas bounded by region.

Unit -1	**Hours**
Differential Equations of first order and first degree : Linear differential equations - Bernoulli's equations – Exact equations and Equations reducible to exact form. Applications: Newton's law of cooling - Law of natural growth and decay - Orthogonal trajectories.	**10**
Unit -2	
Linear differential equations of higher order : Homogeneous and Non-homogeneous differential equations of higher order with constant coefficients – with non-homogeneous term of the type e^{ax}, sin ax, cos ax, polynomials in x^n, e^{ax} V(x) and x^n V(x) – Method of Variation of parameters. Applications: LCR circuit.	**10**
Unit – 3	
Partial differentiation: Introduction – Homogeneous function – Euler's theorem– Total derivative– Chain rule– Jacobian – Functional dependence –Taylor's and MacLaurin's series expansion of functions of two variables. Applications: Maxima and Minima of functions of two variables without constraints and Lagrange's method.	**10**
Unit – 4	
PDE of first order: Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions – Solutions of first order linear (Lagrange) equation and nonlinear (standard types) equations.	**08**
Unit – 5	
Multiple integrals: Double and Triple integrals – Change of order of integration in double integrals – Change of variables to polar, cylindrical and spherical coordinates. Applications: Finding Areas and Volumes.	**12**

Text Books/ Reference Books:

T1	B. S. Grewal, Higher Engineering Mathematics, 44th Edition, Khanna Publishers.
T2	B. V. Ramana, Higher Engineering Mathematics, 2007 Edition, Tata Mc. Graw Hill Education.
R1	Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, Wiley-India.
R2	Joel Hass, Christopher Heil and Maurice D. Weir, Thomas calculus, 14thEdition, Pearson.
R3	Lawrence Turyn, Advanced Engineering Mathematics, CRC Press, 2013.

R4	Srimantha Pal, S C Bhunia, Engineering Mathematics, Oxford University Press.
Course outcomes: On completion of this course, students are able to	
CO1	Solve the differential equations related to various engineering fields (L3)
CO2	Solve the differential equations of higher order related to various engineering fields (L3)
CO3	familiarize with functions of several variables which is useful in optimization (L3)
CO4	Solve the partial partial differential equations of first order (L3)
CO5	Apply double integration techniques in evaluating areas bounded by region (L3).

ENGINEERING PHYSICS

(Semiconductor Physics & Semiconductor Optoelectronics)(Common for AI&ML,CSA,CSB,CSD,CSE,CST,EEE&IT)

Semester I

Subject Code	21EEPHT1020	IA Marks	30
Number of LectureHours/Week	03	ExamMarks	70
Total Number ofLecture Hours	50	ExamHours	03

Credits – 03

COURSE OBJECTIVES:

The objectives of this course, help the students

- **To impart** the knowledge of Quantum mechanics forunderstanding the conducting mechanism in solids.
- **To understand** the physics of semiconductors and theirworking mechanism for their utility.

Unit -1	
Quantum Mechanics: Dual nature of matter, Significance and properties of wave function, Schrodinger time independent wave equations, Particle in a one dimensional infinite potential well. **Free Electron Theory and Band theory:** Classical free electron theory (Qualitative with discussion of merits and demerits), Quantum free electron theory, Equation forelectrical conductivity based on quantum free electron theory, Fermi-Dirac distribution, Density of states (3D), Fermi energy; Band theory of Solids -Bloch's theorem; Kronig - Penney model (Qualitative), Effective mass of electron.	**Hours –12**
Unit -2	
Semiconductors: Introduction; Intrinsic semiconductors- Density of charge carriers, Electrical conductivity, Fermi level; Extrinsic semiconductors-density of charge carriers, dependence of Fermi energy on carrier concentration and temperature; Drift and diffusion currents- Einstein's equation; Hall effect- Hall coefficient- Applications of Hall effect.	**Hours –11**
Unit – 3	
Light interaction with matter: Stimulated absorption, spontaneous emission, and stimulated emission, Einstein coefficients, Population inversion, Characteristics of lasers, Pumping mechanisms- Ruby laser, He-Ne laser, Direct and indirect band gap semiconductors, Optical transitions in bulk semiconductors Construction and working of laser diode and their applications.	**Hours –10**
Unit – 4	
Semiconductor light emitting diodes (LEDs) : Injection Electro luminescence; Construction and working of LED, characteristics of LED's - Internal efficiency, Extraction efficiency, External Efficiency, Power conversion efficiency, Responsivity & I V characteristics, Double junction Hetero structure and its importance, LED configurations-SLED's and ELED'S, applications of LEDs.	**Hours –9**
Unit – 5	
Photo diodes: Introduction- construction and working principle of PN photodiode, P-i-N photodiode, and Avalanche photodiode (APD), and their IV characteristics, Photovoltaic effect, construction and working of Solar cell, fill factor and efficiency of solar cell.	**Hours –8**

COURSE OUTCOMES:

On completion of the course student will able to

1. **Distinguish** the various harmonic motions and resonance.
2. **Apply** Newton's law of motion to understand the motions ofmechanical systems.
3. **Verify** the invariance of Newton's equation of motion.
4. **Understand** the concept of conservative and non-conservativemotions.
5. **Formulate** the rigid body dynamics.
6. **Study** the structure- elastic property correlation under loadwithin the elastic limits.

QUESTION PAPER PATTERN:

1. It will have 5 questions with internal choice.
2. Each question carries 14 marks.
   Each full question comprises sub questions covering alltopics under a unit.

TEXT BOOKS:

1. Introduction to Mechanics — MK Verma.
2. A Text Book of Engineering Physics- M.N.Avadhanulu, 11e ,S.CHAND,

REFERENCE BOOKS:

1. S.L Gupta& D.L. Gupta, Unified physics
2. An Introduction to Mechanics — D Kleppner & R Kolenkow
3. Principles of Mechanics — JL Synge & BA Griffiths.
4. Engineering Physics- Ch. Srinivas, Ch. Sesubabu Cengagelearning.

WEB SOURCES:

1. W1: http://www.physics.org/news.asp
2. W2: http://www.phys.lsu.edu/newwebsite/lecturedemo/
3. W3: http://www.nptl.ac.in
4. W3: American Association of Physics Teachers[http://www.aapt.org/]
5. W3: Society of Physics Students[http://www.aip.org/education/sps/sps.htm]

ENGINEERING CHEMISTRY Semester I			
Subject Code	21CMCHT1030	IA Marks	30
Number of Lecture Hours/Week	3	Exam Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
Credits – 03			

COURSE OBJECTIVES:

The objectives of this course, help the students to

1. Explain the mechanism of corrosion
2. Interpret various boiler troubles and importance of water quality standards.
3. Learn preparation of semiconducting materials, nano materials and liquid crystals – their applications
4. Acquire knowledge on nonconventional energy resources and different types of batteries
5. Know various spectroscopic techniques.
6. Acquire knowledge on volumetric analysis.

Module-1	**Hours**
Electrochemistry and Corrosion **Electro chemistry:** Introduction, electrode potential, standard electrodes – Hydrogen and Calomel electrodes, Nernst equation and applications. **Corrosion:** Introduction, Mechanism of Wet chemical corrosion, control methods – proper designing, cathodic protection- Sacrificial anodic and impressed current cathodic protection.	**9**
Module -2	
Water Chemistry and Surface Properties **Water chemistry:** Surface and subsurface water quality parameters – turbidity, pH, total dissolved salts, chloride content, Hardness of water, Temporary and Permanent hardness, Units, determination of hardness by complexometric method. Boiler troubles, Caustic Embrittlement, Priming and foaming, Boiler corrosion. Break point chlorination. **Surface properties:** Determination of surface tension and viscosity of liquids.	**9**
Module -3	
Material Chemistry **Non-elemental semiconducting materials:** Stoichiometric, controlled valency and chalcogen photo/semiconductors and preparation of semiconductors (distillation, zone refining, Czochralski crystal pulling, epitaxy, diffusion and ion implantation). **Liquid crystals:** Introduction, types and applications. **Nanoparticles**: Introduction, preparation methods – Sol-gel method, Chemical reduction method – Preparation of carbon nanotubes (Arc discharge, chemical vapour deposition and laser ablation methods) properties and applications.	**10**

Module – 4	
ENERGY SOURCES: **Non-conventional energy sources,** Design, working, schematic diagram, advantages and disadvantages of photovoltaic cell, hydropower, geothermal power, tidal and wave power, ocean thermal energy conversion. **Batteries and fuel cells:** Primary and secondary batteries - Dry cell, Lead Acid Cell, Lithium ion battery and Zinc air cells and fuel cells - H_2-O_2, CH_3OH-O_2, Phosphoric acid and molten carbonate.	**10**
Module – 5	
SPECTROSCOPY AND CHROMATOGRAPHY TECHNIQUES Regions of electromagnetic spectrum - Principles of vibrational and rotational spectroscopy. Vibrational and rotational spectroscopy of diatomic molecules: Rigid diatomic molecules - selection rule - simple Harmonic Oscillator - diatomic vibrating rotator. Nuclear magnetic resonance – Principle and Instrumentation. Principles of chromatography – Thin Layer & Paper Chromatography.	**10**

COURSE OUTCOMES: On completion of the course student will be able to	
CO1	Interpret the mechanism of corrosion
CO2	Summarize the problems faced in industries due to boiler troubles.
CO3	Recall the properties and applications of advanced materials.
CO4	Summarize the advantages of non-conventional energy resources and batteries.
CO5	Able to gain knowledge on spectroscopic techniques and the ranges of the electromagnetic spectrum used for exciting different molecular energy levels.
CO6	Determine the strength of acid, base and some elements by volumetric and instrumental analysis.
TEXT BOOKS / REFERENCE BOOKS:	
T1	P.C. Jain and M. Jain "**Engineering Chemistry**", 15/e, Dhanpat Rai & Sons, Delhi, (Latest edition).
T2	Shikha Agarwal, "**Engineering Chemistry**", Cambridge University Press, New Delhi, (2019).
T3	S.S. Dara, "**A Textbook of Engineering Chemistry**", S.Chand & Co, (2010).
T4	Shashi Chawla, "Engineering Chemistry", Dhanpat Rai Publicating Co. (Latest edition).
T5	Fundamentals of Molecular Spectroscopy, by C. N. Banwell.
R1	K. Sesha Maheshwaramma and Mridula Chugh, "**Engineering Chemistry**", Pearson India Edn.
R2	O.G. Palana, "**Engineering Chemistry**", Tata McGraw Hill Education Private Limited, (2009).
R3	CNR Rao and JM Honig (Eds) "**Preparation and characterization of materials**" Academic press, New York (latest edition)

PROGRAMMING FOR PROBLEM SOLVING Semester I			
Subject Code	21CMCST1040	IA Marks	30
Number of Lecture hours/Week	3	Exam Marks	70
Total Number of Lecture Hours	50	Exam Hours	03
Credits -03			

Course Objectives:

The Objectives of Programming for problem solving are:

- To learn about C programming language syntax, semantics, and the runtime environment.
- To be familiarized with general computer programming concepts like data types, conditional statements, loops and functions.
- To be familiarized with general coding techniques and procedure-oriented programming.

UNIT I	**Hours**
History& Hardware: (TB 1: 1-22) Computer Hardware, Components, Types ofSoftware, Memory Units. **Introduction to Problem solving:(TB1:33-50)** Algorithm, Characteristics of Algorithms, Basic Operations of Algorithms, Pseudo Code, Flowchart, Types of Languages, Relation between Data, Information, Input and Output. **Basics of C: (TB1:58-67)**History and Features of C, Importance of C, Procedural Language, Compiler versus Interpreter, Structure of C Program, Program Development Steps, Programming Errors.	**10**
UNIT II	
Overview of C:(TB:68-125) Character Set, C-Tokens, Data Types, Variables, Constants, Operators, Operator Precedence and Associativity, Converting Mathematical Expressions to C-expressions, Evaluation of C-Expressions, Input/Output Functions. **Conditional Branching:(TB1:143-152)** if statement, if...else statement, Nested if...else statement, if…else…if ladder, switch statement. **Unconditional Branching:(TB1:174-175)** goto. Control flow Statements: break, continue. **Looping Constructs:(TB1:156-170)** do-while statement, while statement, for statement.	**10**
UNIT III	
Arrays:(TB1:188-222) Introduction, 1-D Arrays, Character arrays and string representation, 2-D Arrays (Matrix), Multi-Dimensional Arrays. **Strings:** Working with Strings, String Handling Functions (both library and user defined). **Functions:(TB1:230-260)** Basics, Necessity and Advantages, Types of Functions, Parameter Passing Mechanisms, Recursion, Storage Classes, Command Line Arguments, Conversion from Recursion to Iteration and Vice-Versa.	**8**

UNIT IV	
Pointers:(TB1:288-347) Understanding Pointers, Pointer Expressions, Pointer and Arrays, Pointers and Strings, Pointers to Functions. Dynamic Memory Allocation: Introduction to Dynamic Memory Allocation- malloc (), calloc (), realloc (), free (). **Structures and Unions:(TB1:370-394)** Defining a Structure, typedef, Advantage of Structure, Nested Structures, Arrays of Structures, Structures and Arrays, Structures and Functions, Structures and Pointers, Defining Unions, Union within Union, Structure within Union, Union within Structure, Self-Referential Structures, Bitfields, Enumerations.	**12**
UNIT V	
Preprocessing Directives:(TB2:325-333) Macro Substitution, File Inclusion, Conditional Compilation and Other Directives **File Management In C:(TB1:408-422)** Introduction to File Management, Modes and Operations on Files, Types of Files, Error Handling during I/O Operations.	**10**

Text Books/ Reference Books:	
T1	Programming in C ,Pradip Dey, Manas Ghosh, OXFORD
T2	Programming in ,C Reema Thareja, Second Edition, OXFORD
T3	Programming for Problem Solving, Behrouz A. Forouzan, Richard F. Gilberg, CENGAGE.
R1	Computer Fundamentals and Programming, Sumithabha Das, Mc Graw Hill.
R2	Programming in C, Ashok N. Kamthane, Amit Kamthane, Pearson
Course Outcomes: Student can able to	
CO1	Demonstrate computer components, algorithms, translate them into programs.
CO2	Choose thesuitable control structures for the problem to besolved.
CO3	Make use of arrays, pointers, structures,and unions effectively.
CO4	Organize reusable code in a program into functions.
CO5	Demonstration of file operations.

ENGINEERING GRAPHICS

(Common to CE,EE &ME)

Semester I

SubjectCode	21EEMET1050	IA Marks	
Number of Lecture Hours / Week	1(L)+04(P)	ExamMarks	
Total Number of Lecture Hours	50	ExamHours	03

Credits – 03

COURSE OBJECTIVES:

On successful completionof the course, **s**tudents should be able to

1. construct polygons, scales, engineering curves (parabola, ellipse, hyperbola, cycloids, involutes)
2. draw orthographic projections of points, lines andplanes.
3. draw the orthographic projections of simple solids
4. draw sectional views of solids
5. convert given isometric view into orthographic viewand vice versa using AutoCAD software.

Unit -1	**Teaching Hours**
Introduction to Engineering Drawing covering Principles of Engineering Graphics and their significance, usage of drawing instruments, lettering, Conic sections – Ellipse, Parabola, Hyperbola (Eccentricity method only); plain Cycloid, and Involutes; Scales – Plain and Vernier scales only.	10
Unit -2	
Projections of Points, Projections of straight lines and the line inclined to bothplanes; Projections ofplanes (inclined to one reference plane only).	08
Unit – 3	
Projections of regular polyhedrons – tetrahedron,hexahedron, octahedron (axisinclined to one reference plane only). Projections of irregular polyhedrons – Prisms, Pyramids, Cones and Cylinders(axis inclined to one reference plane only).	08
Unit – 4	
Sectional Views of Right Angular Solids covering Prism, Cylinder, Pyramid andCone	12
Unit – 5	
Introduction to AutoCAD - The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension Tools), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and Windows. Isometric Projections, Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa.	12

COURSE OUTCOMES:

On the successful completionof this course, the students will be able to

1. construct polygons, scales and engineering curves
2. draw the orthographic views of points, lines andplanes
3. construct the projections of regular and irregularpolyhedrons
4. draw the sectional views of solids
5. draw isometric/orthographic views using AutoCAD

Text/Reference Books

1. N.D. Bhatt, Engineering Drawing, CharotarPublications
2. R.B.Choudary, Engineering Drawing, AnuradhaPublishers
3. Agarwal & Agarwal, Engineering Drawing, TataMcGraw Hill Publishers
4. K.L.Narayana & P.Kannaiah, EngineeringDrawing, Scitech Publishers
5. K.C. John, Engineering Graphics for Degree, PHIPublishers
6. PI Varghese, Engineering Graphics, Mc GrawHillPublishers
7. K Venugopal, V. Prabhu Raja, EngineeringDrawing + AutoCAD, New Age

ENGINEERING PHYSICS LAB

(Common to AI &ML,CSA,CSB,CSD,CSE,CST,EEE & IT)

Semester I

Subject Code	21EEPHL1060	Internal Marks	15
Number of Practice Hours/Week	03	Exam Marks	35
Total Number of Practice Hours	36	ExamHours	03

Credits – 1.5

COURSE OBJECTIVES:

The objectives of this course, help the students

- **To apply** the theoretical knowledge of Physics throughhands on the experimental instruments.
- **To improve** the experimental knowledge in the laterstudies.
- **To understand** the basic need of experiments.
- **To know** how to measure the different physicalquantities.
- **To gain** the knowledge about different electricalcomponents and basic electrical circuits.

List of Experiments

1. Determination of the Fermi energy of copper using meterbridge.
2. Determination of the Energy band gap of P-N junctiondiode.
3. Study of the spectral response of photo cell-Planck'sconstant.
4. Study of V-I characteristics of LED (Light Emitting Diode) and to determine knee voltage, frequency of thelight emitting diode.
5. Determination of the frequency of electrical vibrator-Melde's experiment.
6. Determination of the wavelength of Laser diode usingdiffraction.
7. Determination of the V-I characteristics of photo diode andto find the variation of photo current as a function of light intensity.
8. Study of the characteristics of a photo voltaic cell (Solarcell) and to find Fill factor and efficiency.
9. Study of the V-I characteristics of Semiconductor diode, and to determine barrier potential and forward resistance.
10. Study of the I/V Characteristics of Zener diode.

Demonstration experiments:

1. Determination of the resistivity of a semiconductor usingfour probes method.
2. Estimation of the Hall coefficient of a semiconductor-Halleffect.

COURSE OUTCOMES:

On completion of the course student will able to

1. **Compare** the theory and correlated with experiments.
2. **Design** experiments.
3. **Analyze** the experimental result.
4. **Apply** appropriate techniques to perform the experiments.
5. **Understand** the interaction of the light withsemiconductor.
6. **Study** the characteristic curves of the optoelectronicsemiconductor devices.

TEXT BOOKS:

1. "Physics Laboratory Manual" Prepared by Department of Physics, SITE.

REFERENCE BOOKS:

1. S. Balasubrahmanian, M.N. Srinivasan ''A Text book of Practical Physics''- S. Chand Publishers, 2017.
2. Advanced Practical Physics Vol 1& 2 SP Singh & M.S Chauhan Pragati Prakashan, Meerut

ENGINEERING CHEMISTRY LABORATORY (Common to All) **Semester I**			
Subject Code	21CMCHL1070	IA Marks	15
Number of Practice Hr/Week	3	Exam Marks	35
Total Number of Practice Hr	36	Exam Hours	03
Credits – 1.5			

List of Experiments

(Any 10 experiments must be conducted)

Determination of HCl using standard Na2CO3 solution

Determination of alkalinity of a sample containing Na2CO3 and NaOH

Determination of surface tension

Determination of viscosity of a liquid by Ostwald viscometer

Determination of chloride content of water

Determination total hardness of water by EDTA. Determination of Mg^{+2}using standard oxalic acid solution.Determination of Cu^{+2}using standard hypo solution.

Determination of the rate constant of first order reaction (Ester hydrolysis)Determination of strength of strong acid using conductometeric titration. Determination of strength of weak acid using conductometeric titration . Determination of Ferrous iron using potentiometer.

Chemical oscillations- Iodine clock reactionEstimation of Vitamin C.

Demonstration Experiments

Thin Layer Chromatography

Determination of $Fe^{+3}$by a colorimetric method.

Question paper pattern:

Ten questions are given, and student should choose one question (blind option),which carries 50 marks in total.

a. 10 marks are allotted for procedure including circuit diagrams and modelgraphs.
b. 10 marks for conduction of the experiment.
c. 05 marks for results and conclusions.10 marks for viva voce.

PROGRAMMING FOR PROBLEM SOLVING LAB Semester I			
Subject Code	21CMCSL1080	IA Marks	15
Number of Lecture hours/Week	3	Exam Marks	35
Total Number of Lecture Hours	48	Exam Hours	03
Credits -1.5			

Course Objectives:

1. To understand the various steps in Program development.
2. To understand the basic concepts in C Programming Language.
3. To learn how to write modular and readable C Programs.
4. To learn to write programs (using structured programming approach) in C to solve problems.
5. To introduce basic data structures such as lists, stacks and queues.

Exercise 1 (Familiarization with programming environment)

a) Familiarization of CODE BLOCKS C++ Editor to edit, compile, execute, test and debugging C programs.

b) Familiarization of RAPTOR Tool to draw flow charts and understand flow of control.

c) Acquaintance with basic LINUX commands.

Exercise 2 (Simple computational problems using arithmetic expressions)

a) Write a C Program to display real number with 2 decimal places.

b) Write a C Program to convert Celsius to Fahrenheit and vice versa.

c) Write a C Program to calculate the area of triangle using the formula
area = $\sqrt{}$ (s(s−a)(s−b)(s −c) where s=a+b+c/2.

d) Write a C program to find the largest of three numbers using ternary operator.

e) Write a C Program to swap two numbers without using a temporary variable.

Exercise 3 (Problems involving if-then-else structures)

a) Write a C Program to check whether a given number is even or odd using bitwise operator, shift operator and arithmetic operator.

b) Write a C program to find the roots of a quadratic equation.

c) Write a C Program to display grade based on 6 subject marks using if…else…if ladder.

d) Write a C program, which takes two integer operands and one operator form the user, performs the operation and then prints the result using switch control statement.(Consider the operators +, -,*,/, %)

Exercise 4 (Iterative problems)

a) Write a C Program to count number of 0's and 1's in a binary representation of a given number.

b) Write a C program to generate all the prime numbers between two numbers supplied by the user.

c) Write a C Program to print the multiplication table corresponding to number supplied as input

Exercise 5 (Iterative problems)

a) Write a C Program to Find Whether the Given Number is i)Armstrong Number ii) Palindrome Number

b) Write a C Program to print sum of digits of a given number

Exercise 6 (Series examples)

a) Write a C Program to calculate sum of following series

b) 1+2+3+…. n b)1+1/2+1/3+……+1/n c)1+x+x2+x3……+xn

Exercise 7 (1D Array manipulation)

a) Write a C program to interchange the largest and smallest numbers in the array.

b) Write a C program to search an element in an array (linear search).

c) Write a C Program to print the following pattern using a character array SA SAS SASI

Exercise 8 (Matrix problems, String operations)

a) Write a C program to add two matrices.

b) Write a C program to multiply two matrices if they are compatible or print an error message "incompatible matrix sizes" otherwise.

c) Write a C program to check given matrix is symmetric or not.

d) Implement the following string operations with and without library functions. i)copy ii) concatenate iii) lengthiv) compare

Exercise 9 (Simple functions)

a) Write a C Program demonstrating the following function types

i. With arguments and with return value.

ii. With arguments and without return value.

iii. Without arguments and without return value.

iv. Without arguments and with return value.

b) Write a C Program illustrating call by reference.

Exercise 10 (Recursive functions)

Write a C Program illustrating the following with Recursion without Recursion

a) Factorial b) GCD c) Power d) Fibonacci

Exercise 11(Pointers and structures)

a) Write a C program to find sum of n elements entered by user. To perform this program, allocate memory dynamically using malloc () function.

b) Write a C program to find sum of n elements entered by user. To perform this program, allocate memory dynamically using calloc () function.

Note: Understand the difference between the above two programs.

c)Write a C Program to read and print student details using structures.

Exercise 12 (File operations)

a) Write a C program to open a file and to print it contents on screen.

b) Write a C program to copy files.

c) Write a C program merges two files onto a new file.

d) Write a C program to delete a file.

Course Outcomes:	
CO1	Attain knowledge on using CODE BLOCKS and RAPTOR tools in solving problems.
CO2	Examine and analyze alternative solutions to a problem.
CO3	Design an algorithmic solution to a problem using problem decomposition and step- wise refinement.
CO4	Demonstrate conversion of iterative functions to recursive and vice-versa.

CO5	Implement the concepts of arrays, structures, Unions and files.

CONSTITUTION OF INDIA, PROFESSIONAL ETHICS & HUMAN RIGHTS (Common to all Branches) **Semester I**			
Subject Code	21CMMST2090	IA Marks	30
Number of Lecture Hours/Week	03	Exam Marks	70
Total Number of Lecture Hours	50	Exam Hours	03
Credits – 00			

COURSE OBJECTIVES:

The objectives of this course help the students to

1. To provide basic information about Indian constitution.
2. To identify individual role and ethical responsibility towards society.
3. To understand human rights and its implications.

Unit - I	
Introduction to the Constitution of India, The Making of the Constitution and Salient features of the Constitution. Preamble to the Indian Constitution Fundamental Rights & its limitations.	**10**
Unit - II	
Directive Principles of State Policy & Relevance of Directive Principles State Policy Fundamental Duties. Union Executives – President, Prime Minister Parliament Supreme Court of India.	**10**
Unit – III	
State Executives – Governor, Chief Minister, State Legislature High Court of State. Electoral Process in India, Amendment Procedures, 42nd, 44th, 74th, 76th, 86th &91st Amendments.	**10**
Unit –IV	
Special Provision for SC & ST Special Provision for Women, Children & Backward Classes Emergency Provisions. Human Rights –Meaning and Definitions, Legislation Specific Themes in Human Rights- Working of National Human Rights Commission in India Powers and functions of Municipalities, Panchyats and Co - Operative Societies.	**10**
Unit – V	
Scope & Aims of Engineering Ethics, Responsibility of Engineers Impediments to Responsibility. Risks, Safety and liability of Engineers, Honesty, Integrity & Reliability in Engineering.	**10**

TEXT BOOKS / REFERENCE BOOKS

T1	Durga Das Basu: **"Introduction to the Constitution on India",** (Students Edn.) Prentice –Hall EEE, 19th / 20th Edn., 2001
T2	Charles E. Haries, Michael S Pritchard and Michael J. Robins **"Engineering Ethics"** Thompson Asia, 2003-08-05.
T3	M.V.Pylee, "An Introduction to Constitution of India", Vikas Publishing, 2002.
R1	M.Govindarajan, S.Natarajan, V.S.Senthilkumar, **"Engineering Ethics",** Prentice – Hall of India Pvt. Ltd. New Delhi, 2004
R2	Brij Kishore Sharma,**" Introduction to the Constitution of India"**, PHI Learning Pvt. Ltd., New Delhi, 2011.
R3	Latest Publications of Indian Institute of Human Rights, New Delhi

COURSE OUTCOMES: On completion of the course student will	
CO1	Have general knowledge and legal literacy and thereby to take up competitive examinations.
CO2	Understand state and central policies, fundamental duties.
CO3	Understand Electoral Process, special provisions.
CO4	Understand powers and functions of Municipalities, Panchayats and Co-operative Societies, and
CO5	Understand Engineering ethics and responsibilities of Engineers
CO6	Understand Engineering Integrity & Reliability

TECHNICAL ENGLISH Semester II			
Subject Code	21CMEGT 2010	IA Marks	30
Number of Lecture Hours/ Week	03	Exam Marks	70
Total Number of Lecture Hours	50	Exams Hours	03
Credits -03			

Course Objectives:

To enable the students to learn and apply fundamental principles in Technical English & Communication by focusing on:

1. Technical English Vocabulary
2. Writing Skills
3. Common Errors in Writing
4. Nature and Style of Sensible Technical Writing
5. Writing Technical Reports and Letters

Unit I	
Principles of Scientific Vocabulary • Principles of Scientific vocabulary: short and simple words-compact substitutes for wordy phrases- redundant words and expressions-Avoid hackneyed and stilted phrases, verbosity and incorrect use of words • The role of roots in word building, prefixes and suffixes, confusing words and expressions.	10 hours
Unit II	
Writing Skills • Distinguishing between academic and personal styles of writing • Use of clauses in technical phrases and sentences • Techniques of Sentence and paragraph writing • Measuring the clarity of a text through Fog Index or Clarity Index	10 hours
Unit III	
Common Errors in Writing • Subject-verb agreement and concord of nouns, pronouns and possessive adjectives • Common errors in the use of articles, prepositions, adjectives and adverbs • Punctuation • Technical Guidelines for Communication • Avoiding the pitfalls	10 hours
Unit IV	
Nature and Style of Sensible Technical Writing • Academic Writing Process • Describing, processes and products • Defining, Classifying • Effective use of charts, graphs, and tables	10 hours
Unit V	
Report writing and Letter writing • Writing Technical Reports • Précis writing • Letter Writing • Essay writing	10 Hours

Text Books

1. Effective Technical Communication by Barun K Mitra, Oxford University Publication

Non-detailed Text

1. Karmayogi: A Biography of E Sreedharan by M S Ashokan

Reference Books

1. *Communication Skills* by Sanjay Kumar & Pushpa Latha, OUP
2. Study Writing by Liz Hamp-Lyons and Ben Heasly, Cambridge University Press.
3. Remedial English Grammar by F T Wood, Macmillian 2007
4. Practical English Usage by Michael Swan Oxford University Press
5. English Collocations in Use by Michael McCarthy & Felicity O'Dell
6. Effective Technical Communication by Arsahf Rizvi,
7. Essential English Grammar by Raymond Murphy, CUP, 2017

ENGINEERING MATHEMATICS-II

(Linear algebra, Laplace transforms & Numerical Methods)

Common to all the branches

Semester II

Subject Code	21CMMAT2020	IA Marks	30
Number of Lecture Hours/Week	3	Exam Marks	70
Total Number of Lecture Hours	50	Exam Hours	03

Credits – 03

Course objectives:

To enable students to apply the knowledge of Mathematics in various engineering fields by making them to learn the following'

1. To develop the use of matrix algebra techniques that is needed by engineers for practical applications and solve system of linear equations
2. To find the inverse and power of a matrix by Cayley-Hamilton theorem and reduce the Quadratic form
3. To solve initial value problems by using Laplace transforms
4. To find the solution of algebraic/ transcendental equations and also interpolate the functions.
5. To apply different algorithms for approximating the solutions of ordinary differential equations with initial conditions to its analytical computations.

Unit -1	**Hours**
Solving systems of linear equations: Rank of a matrix by echelon form and normal form – Solving system of homogeneous and non homogeneous linear equations – Gauss Elimination method- Jacobi and Gauss-Seidel methods for solving system of equations numerically.	**10**
Unit -2	
Eigen values and Eigen vectors, Cayley–Hamilton theorem and Quadratic forms: Eigen values and Eigen vectors and properties- Cayley-Hamilton theorem (without proof) – Reduction to Diagonal form – Quadratic forms and nature of the quadratic forms – Reduction of quadratic form to canonical forms by orthogonal transformation, Diagonalisation and Lagrange's reduction	**10**
Unit – 3	
Laplace Transforms: Laplace transforms – Definition and Laplace transforms of some certain functions– Shifting theorems – Transforms of derivatives and integrals – Unit step function –Dirac's delta function Periodic function – Inverse Laplace transforms– Convolution theorem (without proof). Applications: Solving ordinary differential equations (initial value problems) using Laplace transforms.	**10**
Unit – 4	
Numerical Methods: Introduction - Method of false position - Newton-Raphson method (One Variable) Introduction– Errors in polynomial interpolation – Finite differences– Forward differences– Backward differences –Central differences – Relations between operators – Newton's forward and backward formulae for interpolation – Interpolation with unequal intervals – Lagrange's interpolation formula.	**10**
Unit – 5	
Numerical integration, Solution of ordinary differential equations with initial conditions: Trapezoidal rule - Simpson's 1/3rd and 3/8th rule - Solution of initial value problems by Taylor's series– Picard's method of	**10**

successive approximations– Euler's method – Runge -Kutta method (second and fourth order).		
Course outcomes: On completion of this course, students are able to,		
CO1	Develop the use of matrix algebra techniques that is needed by engineers for practical applications and solve system of linear equations (L6)	
CO2	Find the inverse and power of a matrix by Cayley-Hamilton theorem and reduce the Quadratic form (L3)	
CO3	Solve initial value problems by using Laplace transforms (L3)	
CO4	Find the solution of algebraic/ transcendental equations and also interpolate the functions(L3)	
CO5	Apply different algorithms for approximating the solutions of ordinary differential equations with initial conditions to its analytical computations (L3).	
Text Books / Reference Books:		
T1	B. S. Grewal," Higher Engineering Mathematics", Khanna publishers, 44th Edition, 2016.	
T2	Kreyszig, "Advanced Engineering Mathematics " - Wiley, 9th Edition, 2013.	
T3	B.V.Ramana "Higher Engineering M athematics" Tata Mc Graw-Hill, 2006	
R1	Dr.K.V.Nageswara Reddy and Dr.B.Rama Bhupal Reddy, "Engineering Mathematics, Volume II" Scitech Publications, 2017.	
R2	Steven C. Chapra, Applied Numerical Methods with MATLAB for Engineering and Science, Tata McGraw Hill Education, 4th Edition, 2018	
R3	M. K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Methods for Scientific and Engineering Computation, New Age International Publications, 3rd Edition, 2020.	
R4	Lawrence Turyn, Advanced Engineering Mathematics, CRC Press, 1st Edition 2014.	

Basic Electrical Engineering Common to All Semester II			
Subject Code	21CMEET2030	IA Marks	30
Number of Lecture Hours/Week	3L + 1T	Exam Marks	70
Total Number of Lecture Hours	50	Exam Hours	03
Credits-03			

Course Objectives:

This course will enable student to

1. Understand basic electrical circuit operation.
2. Understand the concept of Alternating Voltage and Current.
3. Understand the operation of DC machines.
4. Understand the working of measuring instruments.
5. Understand the operation of different types of ac machines.
6. Understand the concept of Electrical Safety.

Unit -1	**Hours**
Basic Electrical Circuits: Basic definitions(Electric Charge, Current, Electro Magnet Force, Potential Difference; Electric Power and Energy) – types of network elements – Ohm's Law – Kirchhoff's Laws –series & parallel circuits - network theorems (Super position, Thevinen's, Norton's, Maximum power transfer theorems)	**10**
Unit -2	
AC Fundamentals & Basic Electromagnetic Laws: Study of AC Voltage and Current, RMS and Average Values, Three phase Star-Delta connections, Alternating Voltage applied to Pure Resistance, Inductance, Capacitance and their combinations, Concept of Power and Power Factor in AC Circuit. Concept of Magnetic Field, Magneto Motive Force (MMF), Permeability; Self and Mutual Induction, Basic Electromagnetic laws,	**10**
Unit – 3	
DC Machines: DC Machine -Principle of operation & construction – emf equation- torque equation - speed control methods – losses and efficiency – brake test. applications of DC motors.	**10**
Unit – 4	
AC Machines: Single Phase Transformers - Construction and Operation- Principles - Classification - Applications-OC & SC test of single phase transformer-regulation & Efficiency. Three Phase Induction Motors: working principle- construction, speed-torque characteristics-losses and efficiency.	**Hours – 10**
Unit – 5	
Electrical Safety: Electrical Shock and Precautions against it, Treatment of Electric Shock; Concept of Fuses and Their Classification, Selection and Application; Concept of Earthing.	**Hours – 10**

Text Books / Reference Books:	
T1	Electrical Circuit Theory and Technology by John Bird, Routledge Taylor &Francis Group.
T2	Principles of Electrical Machines by V.K. Mehta & Rohit Mehta, S.Chand and Company Limited.
R1	Theory and Performance of Electrical Machines by J.B. Gupta, S.K.Kataria & Sons.
R2	A Textbook of Electrical Technology – Volume II: AC & DC Machines by B.L.Theraja & A.K. Theraja, S.Chand and Company Limited.
R3	Basic Electrical Engineering by Nagsarkar, Sukhija, Oxford Publications, 2nd edition.
R4	Basic Electrical Engineering by M.S.Naidu and S.Kamakshiah, TMH Publications
R5	Fundamentals of Electrical Engineering by Rajendra Prasad, PHI Publications, 2nd edition.
R6	Electrical Technology by Surinder Pal Bali, Pearson Publications.
Course Outcomes: The student should be able to	
CO1	Understand basic electrical circuit operation.
CO2	Understand the concept of Alternating Voltage and Current.
CO3	Understand the operation of DC machines.
CO4	Understand the working of measuring instruments.
CO5	Understand the operation of different types of ac machines.

PYTHON PROGRAMMING Semester II			
Subject Code	21CMCST2040	IA Marks	30
Number of Lecture hours/Week	3	Exam Marks	70
Total Number of Lecture Hours	50	Exam Hours	03
Credits -03			

Course Objectives:

The Objectives of Python Programming are:

- To learn about Python programming language syntax, semantics, and the runtime environment.
- To be familiarized with general computer programming concepts like data types, conditional statements, loops and functions.
- To be familiarized with general coding techniques and object-oriented programming and Graphical User Interfaces.

UNIT I	**Hours**
Introduction:(TB1:22-30, TB2:1.1-1.4, TB2:1.21-1.33) Introduction to Python, Program Development Cycle, Input, Processing, and Output, Displaying Output with the Print Function, Variables, Reading Input from the Keyboard, Operators. **Data Types, and Expression: (TB1:41-59)** Strings Assignment, and Comment, Numeric Data Types andCharacter Sets, Type conversions, Expressions, Using functions and Modules. **Decision Structures and Boolean Logic:(TB1:77-85)** if, if-else, if-elif-else Statements, Nested Decision Structures, Comparing Strings, Logical Operators, Boolean Variables.	**10**
UNIT II	
Control Statement:(TB1:65-72, TB1:86-91) Definite iteration for Loop Formatting Text for output, Selection if and if else Statement Conditional Iteration, The While Loop, Nested Loops. **Strings and Text Files:(TB1:103-125)** Accessing Character and Substring in Strings, Data Encryption, Strings and Number Systems, String Methods, Text Files.	**8**
UNIT III	
List and Dictionaries:(TB1:135-145, TB1:153-158) Lists,Tuples,Sets, Dictionaries. **Design with Function:(TB1:146-149, TB1:169-190)** Functions as Abstraction Mechanisms, Problem Solving with Top-Down Design, Design with Recursive Functions, Case Study Gathering Information from aFile System. **Modules**: **(TB2:8.1-8.5)** Modules, Standard Modules, Packages.	**8**
UNIT IV	
File Operations:(TB1:122-123) Reading config files in python, Writing log files in python, Understanding read functions, read(), readline() and readlines(), Understanding write functions, write() and writelines().**Object Oriented Programming:(TB2:5.1-5.20, TB2:6.1-6.17)** Concept of class, object and instances, Constructor, class attributes and destructors, Inheritance. **Design with Classes:(TB1:294-301, TB1:309-330)** Objects and Classes, Data modeling Examples, Case Study an ATM.	**12**
UNIT V	
Errors and Exceptions:(TB2:7.1-7.8) Syntax Errors, Exceptions, Handling Exceptions, Raising Exceptions, User-defined Exceptions, Defining Clean-up Actions, Redefined Clean-up Actions.	12

Graphical User Interfaces:(TB1:245-288) The Behavior of Terminal Based Programs and GUI -Based,Programs, Coding Simple GUI-Based Programs, Other Useful GUI Resources.	

Text Books / References:	
T1	Fundamentals of Python First Programs, Kenneth. A. Lambert, Cengage.
T2	Python Programming: A Modern Approach, Vamsi Kurama, Pearson.
R1	Introduction to Python Programming, Gowrishankar.S, Veena A, CRC Press.
R2	Introduction to Programming Using Python, Y. Daniel Liang, Pearson.
W1	https://www.tutorialspoint.com/python3/python_tutorial.pdf
Course Outcomes: After completion of this course student will able to learn	
CO1	Explain thefundamental concepts in the Python language.
CO2	Implementation of python iterative statements and strings.
CO3	Demonstrate python lists, dictionaries, and functions.
CO4	Understand the concepts of modules and packages in python.
CO5	Complete coding challenges related to object-oriented programming.
CO6	Apply variety of error handling and GUI programming techniques.

ENGINEERING MECHANICS Semester II			
Subject Code	21EEMET2050	IA Marks	30
Number of Lecture Hours/Week	3(L)	Exam Marks	70
Total Number of LectureHours	50	Exam Hours	03
Credits - 03			

Course objectives

On successful completion of the course, the students should be able to

1. understand the effect of forces and moments on the solid rigid bodies
2. analyze static problems using free body diagrams by consideringfriction.
3. locate centroid and calculate moment of inertia for different crosssections.
4. calculate velocity and acceleration of particles having rectilinearmotion and rotation
5. analyze dynamic problems using work energy method and impulse-momentum method.

Unit -1	**Hours**
Introduction to engineering mechanics: Basic terminologies in mechanics, laws of mechanics, characteristics of force, system of force. **Resultant system of forces**: Resolution of forces, method of composition of forces, resultant of coplanar concurrent force system, moment of a force and couple. **Friction:** Frictional force, laws of Coulomb friction, angle of friction, limiting friction and angle of repose, problems on blocks resting on horizontal and inclined planes.	10 Hours
Unit -2	
Equilibrium of system of forces: Equilibrium of a rigid bodysubjected to coplanar concurrent forces and coplanar non-concurrent forces, free body diagrams, Lami's theorem,equilibrium of connected bodies.	9 Hours
Unit – 3	
Centroid and centre of gravity: Centre of gravity, centroid, use of axis symmetry determination of centroid of simple figures from first principles, centroid of composite sections. **Moment of inertia**: Moment of inertia, polar moment of inertia,theorems of moment of inertia, moment of inertia of rectangle,triangle, circle, semi circle, quarter circle from first principles,moment of inertia of L, T and I sections only. Mass moment of inertia, radius of gyration, mass moment of inertia of uniform rod, rectangular plate and circular plate only.	12 Hours
Unit-4 **Kinematics:** General principles in dynamics, types of motion, rectilinear motion, motion curves, motion with uniform velocity, motion with uniform acceleration, motion with varying acceleration, angular motion, relationship between linear and angular motions. **Kinetics:** Bodies in rectilinear translation, kinetics of bodies rotating about fixed axes, Newton's second law of motion, D-Alembert's principle.	10 Hours

Unit - 5 Work-Energy Method: Equation of Translation, work energyapplication to particle motion, connected system - Fixed axisrotation and plane motion, Impulse momentum method.	9 Hours

Course outcomes

On completion of this course, students will be able to

1. Determine resultant force and moment for different force systems.
2. analyse the rigid bodies associated with frictional forces using conditions of equilibrium
3. Locate the centroid / center of gravity and determine the moment of inertia of planesections/solids.
4. Understand the behavior of moving bodies in rectilinear motion and solve kinematic equations of motion curves.
5. Solve the problem using work energy method and impulse momentum method.

Text Books

1. S.S. Bhavikatti and K.G. Rajashekarappa, Engineering Mechanics,New Age, 2012.
2. N.H. Dubey, Engineering Mechanics, Mc Graw Hill, 2012

Reference Books

1 F. L. Singer, Engineering Mechanics, Harper–Collins, 1994
2. B. Bhattacharya, Engineering Mechanics, Oxford University Press,2008
3. A.K.Tayal, Engineering Mechanics, Umesh Publications, 2012.
4. R.K.Bansal, Engineering Mechanics, Laxmi Publications, 1996.
5. R.K.Rajput, A Text book of Applied Mechanics, Laxmi Publications,2011.
6. S.Timoshenko and D.H.Young, Engineering Mechanics, 4th Ed. , McGraw Hill
7. A.Nelson, Engineering Mechanics - Statics and Dynamics, TMG, NewDelhi, 2009.

WEB REFERENCES

W1. https://nptel.ac.in/coursesW2.
http://learnmech.com/

ENGLISH LANGUAGE COMMUNICATION SKILLS LAB **Semester II**		
Subject Code	18CMEGL2050	IA Marks
Number of Practical Hr./week	02	Exam Marks
Total Number of Practical Hr	32	Exam Hours
Credits – 01		

Objectives: To enable the students to learn communication skills of Listening, Speaking, Reading and Writing by focusing on:

- Listening Comprehension
- Pronunciation
- Functional English in formal and Informal Situations
- Interpersonal Communication Skills
- Presentation Skills

List of Experiments

UNIT I: Listening Comprehension

UNIT II: Pronunciation , Stress, Intonation & Rhythm

UNIT III: Common Everyday Situations: Conversations & Dialogues, Communication at Workplace

UNIT IV: Interpersonal Communication Skills- Group discussions and debates

UNIT V: Formal Presentations

Outcomes:

By the end of the course the students will be able to acquire basic Proficiency in English by practicing the following:

- Listening Comprehension, Pronunciation, Dialogues, Interpersonal Communication Skills ,Presentation Skills & Discussions and Debate

Learning Resources:

- Interact – English Lab Manual for Undergraduate Students by Orient Black Swan
- Ted Talks, Interviews with Achievers and select movies
- Toastmaster's speeches and table topics
- Book Reviews and movie reviews
- Exercises in Spoken English Parts: I-III, CIEFL, Hyderabad.
- Oxford Guide to Effective Writing and Speaking by John Seely
- https://www.ted.com/talk

Basic Electrical Engineering Laboratory Common for All Semester II			
Subject Code	21CMEEL1070/2070	IA Marks	50
Number of Lecture Hours/Week	3P	Exam Marks	50
Total Number of Lecture Hours	36	Exam Hours	03
Credits-1.5			

Course Objectives:

This course will enable the student to

1. Verify the Kirchoff's laws, network theorems for a given circuit.
2. Analyze the performance of DC shunt generator.
3. Control the speed of DC motor.
4. Predetermine the efficiency DC machine.
5. Analyze performance of three phase induction motor.
6. Determine the regulation of an alternators.

List of Experiments(Any ten experiments must be conducted)

1. Verification of Kirchoff's laws.
2. Verification of Thevenin's Theorem.
3. Verification of Norton's Theorem.
4. Verification of Superposition theorem.
5. Verification of Maximum Power Transfer Theorem.
6. Speed control of D.C. shunt motor.
7. Brake test on DC shunt motor.
8. Calibration of wattmeter.
9. OC & SC tests on single-phase transformer.
10. Brake test on 1-phase Induction motor.
11. Brake test on 3-phase Induction motor.
12. Study experiment on Ear thing.

COURSE OUTCOMES: On completion of the course student will be able to:	
CO1	Verify the Kirchoff's laws.
CO2	Verify network theorems for a given circuit.
CO3	Control the speed of DC motor.
CO4	Analyze performance of single phase induction motor
CO5	Analyze performance of three phase induction motor.
CO6	Identify different types of earthings

ENGINEERING WORKSHOP LAB Semester II			
Subject Code	21EEMEL2080	IA Marks	15
Number of Lecture Hours/Week	L(0)+T(0)+P(3)	Exam Marks	35
Total Number of Lecture Hours	36	Exam Hours	3

Credits – 1.5

Course objectives: On completion of the course students should be able to

1. Learn basic use of hand tools along with the techniques and methods applicable to the carpentry trade
2. Learn basic use of hand tools along with the techniques and methods applicable to the fitting trade
3. Learn basic use of hand tools along with the techniques and methods applicable to the forging trade
4. Learn basic use of hand tools along with the techniques and methods applicable to the casting trade
5. Learn basic use of hand tools along with the techniques and methods applicable to the welding trade

EXPERIMENTS

1. Preparation of T Lap joint using carpentry.
2. Preparation of Cross Lap joint using carpentry.
3. Preparation of Square fit using mild steel specimen.
4. Preparation of V fit using mild steel specimen.
5. Conversion of round rod to square rod by forging operation.
6. Preparation of *S* hooks by forging operation.
7. Preparation of green sand mould for a single piece pattern
8. Preparation of green sand mould for a split piece pattern
9. Preparation of a Butt joint using arc welding
10. Preparation of a Lap joint using arc Welding

ADDITIONAL EXPERIMENTS

1. Preparation of electrical wiring connections using wiring (one lamp controlled by one switch)
2. Preparation of house wiring (stair case wiring)

Course outcomes: On successful completion of this course, the students will be able to

1. Perform the joinery work of wooden pieces using carpentry.
2. Perform the joinery work of metallic pieces using fitting.
3. Produce the required shaped metallic products using black smithy.
4. Make the green sand moulds using different patterns
5. Fabricate different components using welding.

Question paper pattern:

Ten questions are given, and student should choose one question (blind option), which carries 50 marks in total.

a. 15 marks are allotted for procedure including circuit diagrams and model graphs.
b. 15 marks for conduction of the experiment.
c. 10 marks for results and conclusions.
d. 10 marks for viva voce.

ENVIRONMENTAL SCIENCE Semester II			
Subject Code	21CMESN1090/2090	IA Marks	30
Number of Lecture Hours/Week	2	Exam Marks	70
Total Number of Lecture Hours	32	Exam Hours	03
Credits – 00			

COURSE OBJECTIVES:

The objectives of this course, help the students to

1. Acquire knowledge on global environmental challenges.
2. Learn different types of natural resources
3. Create awareness on biodiversity and ecology.
4. Gain scientific knowledge on environmental pollution
5. Acquire knowledge on water conservation methods and environmental legislation

Module -1	**Hours**
MULTIDISCIPLINARY NATURE OF ENVIRONMENTAL STUDIES **Environment -** Definition, Introduction - Scope and Importance - Global environmental challenges, global warming & climate change - Acid rains, ozone layer depletion - Role of Information Technology in Environment and human health.	**6**
Module -2	
NATURAL RESOURCES Renewable and non-renewable resources – Natural resources and associated problems – Forest resources – Use, deforestation - Timber extraction – Mining, dams and other effects on forest and tribal people Water resources – Floods, drought, , dams – benefits and problems Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources. Food resources: Effects of modern agriculture - fertilizer-pesticide problems, water logging, eutrophication, biological magnification and salinity. Energy resources: Renewable and non-renewable energy resources Role of an individual in conservation of natural resources.	**6**
Module – 3	
ECOSYSTEM AND BIODIVERSITY **Ecosystem** - Concept of an ecosystem. - Structure and function of an ecosystem. - Producers, consumers and decomposers. - Energy flow in the ecosystem - Food chains, food webs and ecological pyramids. - Introduction, types, characteristic features, structure and function of the Forest and grassland ecosystem. **Biodiversity** - Introduction - Definition: genetic, species and ecosystem diversity. – Value of biodiversity: consumptive use, productive use, social, ethical and optional values - Hot-spots ofbiodiversity - Threats to biodiversity: habitat loss - Endangered andendemic species of India – Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.	**8**
Module – 4	

ENVIRONMENTAL POLLUTION Definition, Cause, effects and control measures of : a. Air pollution b. Water pollution c. Soil pollution d. Noise pollution e. Nuclear hazards Solid waste Management: Causes, effects and control measures of urban and industrial wastes - Role of an individual in prevention of pollution.	**6**
Module – 5	
SOCIAL ISSUES AND THE ENVIRONMENT Urban problems related to energy -Water conservation, rain water harvesting, Resettlement and rehabilitation of people its problems and concerns. Environment Protection Act - Air (Prevention and Control of Pollution) Act. – Water (Prevention and control of Pollution) Act -Wildlife Protection Act -Forest Conservation Act .	**6**

TEXT BOOKS / REFERENCE BOOKS:	
T1	E. Bharucha (2003), "Environmental Studies", University Publishing Company, New Delhi.
T2	J.G. Henry and G.W. Heinke (2004), "Environmental Science and Engineering", Second Edition, Prentice Hall of India, New Delhi.
T3	G.M. Masters (2004)" Introduction to Environmental Engineering and Science", Second Edition, Prentice Hall of India, New Delhi
R1	Text Book of Environmental Studies by Deeksha Dave & P. Udaya Bhaskar, Cengage Learning.
R2	Environmental Studies by K.V.S.G. Murali Krishna, VGS Publishers, Vijayawada
R3	Environmental Studies, P.N. Palaniswamy, P. Manikandan, A. Geeta and K. Manjula Rani, Pearson Education, Chennai.
COURSE OUTCOMES: On completion of the course student will be able to	
CO1	Obtain knowledge on global warming & climate change - Acid rains, ozone layer depletion.
CO2	Preserve several natural resources
CO3	Summarize the concept of ecosystem
CO4	Control different types of pollution
CO5	Understand social issues and environmental legislation

Course Structure for II B. Tech I Semester Under the Regulations of SITE-21							
III SEMESTER							
S. No	Course Category	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	BS	21CMMAT3010	Engineering Mathematics-III	3	0	0	3
2	PC	21EEEET3020	Electrical Circuits Analysis	3	0	0	3
3	PC	21EEEET3030	Analog Electronics	3	0	0	3
4	PC	21EEEET3040	Electrical Measurements & Instrumentation	3	0	0	3
5	PC	21EEEET3050	DC Machines & Transformers	3	0	0	3
6	PC LAB	21EEEEL3060	Analog Electronics Lab	0	0	3	1.5
7	PC LAB	21EEEEL3070	Electrical Circuit Analysis Lab	0	0	3	1.5
8	PC LAB	21EEEEL3080	DC Machines & Transformers Lab	0	0	3	1.5
9	SOC	21EEEES3090	Electrical Wiring & Installation	1	0	2	2
10	MC	21EEEEN3100	Electromagnetic Fields	2	0	0	0
			TOTAL	**18**	**0**	**11**	**21.5**

Course Structure for II B. Tech II Semester Under the Regulations of SITE-21							
IV SEMESTER							
S. No	**Course Category**	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	ES	21EEEET4010	Signals & Systems	3	0	0	3
2	PC	21EEEET4020	Digital Electronics	3	0	0	3
3	BS	21CMMAT4030	Engineering Mathematics-IV	3	0	0	3
4	PC	21EEEET4040	Induction & Synchronous Machines	3	0	0	3
5	HSS	21CMMST4050	Engineering Economics & Financial Management	3	0	0	3
6	PC LAB	21EEEEL4060	Digital Electronics Lab	0	0	3	1.5
7	PC LAB	21EEEEL4070	Electrical Measurements & Instrumentation Lab	0	0	3	1.5
8	PC LAB	21EEEEL4080	Induction & Synchronous Machines Lab	0	0	3	1.5
9	SOC	21EEEES4090	Design of Electrical Circuits using Engineering software tools	1	0	2	2
			TOTAL	**16**	**0**	**11**	**21.5**
10	H/M		Honor/Minor courses(The hours distribution can be 3-0-2 or 3-1-0)	4	0	0	4

MATHEMATICS-III
(Vector Calculus and Complex analysis)
Common to CE, EEE, ME, ECE and ECT
SEMESTER - II/I
SEMESTER III

Subject Code	21CMMAT3010/20	IA Marks	30
Number of Lecture Hours/Week	3	Exam Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
Credits – 03			

Course Objectives:

1. To Interpret the physical meaning of different operators such as gradient, curl and divergence.
2. To Estimate the work done against a field, verify integral theorems.
3. To apply Cauchy-Riemann equations to complex functions in order to determine whether a given continuous function is analytic
4. To find the differentiation and integration of complex functions used in engineering problems.
5. To make use of the Cauchy residue theorem to evaluate certain integrals.

Unit -1	
Vector Differentiation: Gradient– Directional derivative – Divergence – Curl - Scalar Potential .	**Hours – 08**
Unit -2	
Vector Integration: Line integral - Work done – Area - Surface and volume integrals – Vector integral theorems: Greens, Stokes and Gauss Divergence theorems (without proof) and problems on above theorems.	**Hours – 10**
Unit – 3	
Function of a complex variable Introduction –continuity –differentiability- analyticity – properties – Cauchy – Riemann equations in Cartesian and polar coordinates. Harmonic and conjugate harmonic functions – Milne – Thompson method.	**Hours – 10**
Unit – 4	
Integration and series expansions Complex integration: Line integral – Cauchy's integral theorem, Cauchy's in integral formula, generalized integral formula (all without proofs) Radius of convergence – expansion in Taylor's series, Maclaurin's series and Laurent series.	**Hours – 10**
Unit – 5	
Singularities and Residue Theorem Zeros of an analytic function, Singularity, Isolated singularity, Removable singularity, Essential singularity, pole of order m, simple pole, Residues, Residue theorem, Calculation of residues, Residue at a pole of order m**,** Evaluation of real definite integrals: Integration around the unit circle**,** Integration around semi circle.	**Hours – 10**

Course outcomes:

On completion of this course, students are able to

1. Interpret the physical meaning of different operators such as gradient , curl and divergence(L5)
2. Estimate the work done against a field, and verify integral theorems (L5)
3. apply Cauchy-Riemann equations to complex functions in order to determine whether a given continuous function is analytic (L3)
4. find the differentiation and integration of complex functions used in engineering problems(L3)
5. make use of the Cauchy residue theorem to evaluate certain integrals (L3)

Question paper pattern:

Question paper consists of 10 questions.

1. Each full question carrying 14 marks.
2. Each full question will have sub question covering all topics under a unit.
3. The student will have to answer 5 full questions selecting one full question from each unit.

Text Books:

1. B. S. Grewal, Higher Engineering Mathematics, 44th Edition, Khanna Publishers.
2. B. V. Ramana, Higher Engineering Mathematics, 2007 Edition, Tata Mc. Graw Hill Education.

Reference Books:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, Wiley-India.
2. Srimantha Pal, S C Bhunia, Engineering Mathematics, Oxford University Press.
3. J. W. Brown and R. V. Churchill, Complex Variables and Applications, 9th edition,
4. N.P.Bali and Manish Goyal, "A text book of Engineering mathematics", Laxmi publications, 7th Edition.
5. H.K. Dass and Er. RajnishVerma, "Higher Engineerig Mathematics", S.Chand publishing, 1st edition, 2011.

ELECTRICAL CIRCUIT ANALYSIS SEMESTER III			
Subject Code	**21EEEET3020**	**IA Marks**	**30**
Number of Lecture Hours/Week	**3L**	**Exam Marks**	**70**
Total Number of Lecture Hours	**45**	**Exam Hours**	**03**
Credits-03			

COURSE OBJECTIVES:

This course will enable students :

1. To understand the applications of network theorems for analysis of electrical networks.
2. To study the transient& steady state behavior of electrical networks
3. To understand the behavior of RLC networks for sinusoidal excitations.
4. To understand the application of Laplace transforms for analysis of electrical circuits.
5. To understand the realization of electrical network function into electrical equivalent passive elements.

Unit -1	
Network Theorems: Circuit Analysis with dependent and independent current and voltage sources. Node and Mesh Analysis. Superposition theorem, Thevenin's theorem, Norton theorem, Milliman theorem, Maximum power transfer theorem, Reciprocity theorem, Compensation theorem for AC Excitation	**Hours-10**
Unit -2	
Solution of First and Second order networks: Solution of first and second order differential equations for Series and parallel R-L, R-C, R- L-C circuits, initial and final conditions in network elements, forced and free response, time constants, steady state and transient state response.	**Hours-10**
Unit – 3	
Sinusoidal steady state analysis: Representation of sine function as rotating phasor, phasor diagrams, impedances and admittances, AC circuit analysis, effective or RMS values, average power and complex power. Three-phase circuits. Mutual coupled circuits, Dot Convention in coupled circuits.	**Hours-08**
Unit – 4	
Electrical Circuit Analysis Using Laplace Transforms: Review of Laplace Transform, Analysis of electrical circuits using Laplace Transform for standard inputs, convolution integral, inverse Laplace transform, transformed network with initial conditions. Series and parallel resonances	**Hours-07**
Unit – 5	
Two Port Network: Two Port Networks, terminal pairs, relationship of two port variables, impedance parameters, admittance parameters, transmission parameters and hybrid parameters, interconnections of two port networks.	**Hours-10**

COURSE OUTCOMES:

On completion of the course student will be able to:

1. Apply network theorems for the analysis of electrical circuits.
2. Analyze transient and steady state response of electrical circuits
3. Solve single phase circuits and three- phase circuits
4. Analyze electrical circuits using Laplace Transforms
5. Find parameters for different types of Two Port Networks.

TEXT BOOKS:

1. M. E. Van Valkenburg, "Network Analysis", Prentice Hall, Third edition 2006.
2. D.Roy Choudhury, "Networks and Systems", New Age International Publications, 1998.
3. W. H. Hayt and J. E. Kemmerly, "Engineering Circuit Analysis", McGraw Hill Education, 2013.

REFERENCE BOOKS:

1. C. K. Alexander and M. N. O. Sadiku, " Electric Circuits", McGraw Hill Education,
2. K. V. V. Murthy and M. S. Kamath, "Basic Circuit Analysis", Jaicoishers,1999.
3. Electrical circuit analysis by A.Sudhakar and Shyam Mohan S palli.
4. Basic Engineering Circuit Analysis, by J. David Irwin, R. Mark Nelms, John Wiley & Sons

ANALOG ELECTRONICS SEMESTER III			
Course Code	**21EEEET3030**	**IA Marks**	**30**
Number of Lecture Hours/Week	**3L**	**Exam Marks**	**70**
Total Number of Lecture Hours	**45**	**Exam Hours**	**03**
Credits-03			

COURSE OBJECTIVES:

This course will enable students:

1. To Understand the characteristics of Diode &Transistors
2. To Understand the design of wave shaping circuits
3. To Understand the characteristics of BJT and working as a amplifier
4. To Understand the analysis and characteristics of Operational Amplifier
5. To Understand the classification of Power Amplifiers

Unit -1	
Introduction to Semi-conductor Switches: Introduction, static characteristics of PN- Junction diode, zener diode, BJT, FET and MOSFETs, clipping circuits using diodes-single level and two-level clipping, clamping circuits using diodes **Power Supplies:** Single phase half wave, full wave and bridge rectifiers with filters (LC andπ), and Regulated power supply.	**Hours – 10**
Unit -2	
Transistor Characteristics and Amplifiers: Junction transistor, transistor current components, transistor equation, transistor configurations, transistor as an amplifier, characteristics of transistor in Common Base, Common Emitter and Common Collector configurations, Bias stability and thermal runway, CE amplifier response, low frequency response of an RC coupled amplifier, gain-band width product, high frequency response of two cascaded CE stages.	**Hours –10**
Unit – 3	
Feedback Amplifiers and Oscillators: Analysis of voltage series, voltage shunt, current series, current shunt, feedback amplifiers, stability of negative feedback amplifiers, analysis of RC phase-shift, Wien bridge, LC oscillators (using BJT's only) and crystal oscillators.	**Hours –08**
Unit – 4	
Differential, multi-stage and operational amplifiers Analysis of differential amplifier configurations, CMRR, stability and drift problems, compensation techniques, direct coupled multi-stage amplifier; internal structure of an operational amplifier, ideal op-amp, non-idealities in an op-amp (Output offset voltage, input bias current, input offset current, slew rate, gain band width product).	**Hours – 10**

Unit – 5	
Power amplifiers: Classification of power amplifiers, analysis of class-A, class-B and class-AB operations, push-pull amplifiers and complementary symmetry, harmonic distortion, and cross-over distortion in power amplifiers.	**Hours – 07**

COURSE OUTCOMES:

On completion of the course student will be:

1. Ability to understand the characteristics of Diode &Transistors.
2. Ability to design the wave shaping circuits using diodes.
3. Ability to analyze feedback amplifier and Oscillator circuits.
4. Ability to understand the non idealities of Op-amp.
5. Ability to understand operation of power amplifiers.

TEXT BOOKS:

1. Electronic Devices and Circuits – J. Millman, C.C. Halkias, Tata Mc-Graw Hill
2. Stanley: Operational Amplifiers with Linear Integrated Circuits, Edition 4, Pearson Education India, 2002.
3. U. A. Bakshi, A. P. Godse: Linear integrated, Technical Publications, 2010.

REFERENCE BOOKS:

1. A Hand Book of Analog Electronics Circuit Design by Dennis L Feucht
2. OP-AMPS & Linear integrated circuits by Ramakanth A Gayakwad (PHI)
3. Linear integrated circuits by D Roy Chowdary, New age International
4. OP-Amp's & Linear Integrated Circuit Concepts and Applications by Janet M.Fiore, Cenagelearning
5. Operational Amplifiers & Linear Integrated circuits by Robert F. Coughlin, Frederick F.Driscoll, Prentice-Hall

ELECTRICAL MEASUREMENTS & INSTRUMENTATION SEMESTER III			
Subject Code	21EEEET5050	IA Marks	30
Number of Lecture Hours/week	3L	Exam Marks	70
Total Number of Lecture Hours	45	Exam Hours	03
Credits – 03			

Course Objectives:

This course will enable student:

1. To study the principle of operation and working of different types of instruments.
2. To study the working principle & operation of different types of instruments for measurement of power and energy.
3. To understand the working of various types of bridges for measurement of R-L-C parameters.
4. To understand the working principle & operation of dc and ac potentiometers.
5. To study the principle of operation and working various transducers.
6. To apply the use of digital meters and study the Lissajous patterns in CRO

Unit-1	
Measuring Instruments: Classification –Deflecting, control and damping torques – Ammeters and Voltmeters PMMC and Moving iron type instruments, dynamometer type and electrostatic instruments – Expression for the deflecting torque and control torque – Errors and compensations – Extension of range using shunts and series resistance – CT and PT: Ratio and phase angle errors.	**Hours – 08**
Unit – 2	**Hours – 10**
Measurement of Power and Energy: Single phase and Three Phase dynamometer type wattmeter, LPF and UPF, expression for deflecting and control torques – Extension of range of wattmeter using instrument transformers – Measurement of active and reactive powers in balanced and unbalanced systems. Single phase induction type energy meter – driving and braking torques – errors and compensations – testing by phantom loading, Three Phase Energy meter.	
Unit – 3	**Hours – 12**
Measurements of R, L & C Elements: Method of measuring low, medium and high resistance – sensitivity of Wheat-stone's bridge – Carey Foster's bridge, Kelvin's double bridge for measuring low resistance, measurement of high resistance – loss of charge method. Measurement of inductance- Q-Factor - Maxwell's bridge, Hay's bridge, Anderson's bridge, Owen's bridge. Measurement of capacitance and loss angle. Wien's bridge – Schering Bridge. **Potentiometers** Principle and operation of D.C. Crompton's potentiometer – Standardization – Measurement of unknown resistance – Current – Voltage – AC Potentiometers: polar and coordinate types –Standardization – Applications.	

Unit – 4	**Hours – 07**
Digital Meters: Digital frequency meter – Digital Voltmeters – Successive approximation DVM - Ramp type DVM and Integrating type DVM – Digital frequency meter - Digital multi meter - Digital tachometer - Digital Energy Meter - Q meter - Power Analyzer. CRO- measurement of phase difference & Frequency using lissajious patterns - Numerical Problems.	
Unit – 5	**Hours – 08**
Transducers Introduction to transducers – Classification of transducers – Advantages of Electrical transducers – Characteristics and choice of transducers – Principle operation of resistor, inductor and capacitor transducers – LVDT and its applications – Strain gauge and its principle of operation – Guage factor – Thermistors – Thermocouples– Piezoelectric transducers – Photo diodes, Hall effect sensors.	

Course outcomes:

On completion of the course student will be able to:

1. Analyze PMMC and mi meters and instrument transformers.
2. Calculate load consumption using energy meters.
3. Determine unknown physical parameters such as R, L and C.
4. Explain the working of DC and AC potentiometers.
5. Apply the use of different digital meters.
6. Analyze the performance of various transducers.

Text Books:

1. Electrical Measurements and measuring Instruments – by E.W. Golding and F.C.Widdis, fifth Edition, Wheeler Publishing.
2. Modern Electronic Instrumentation and Measurement Techniques – A.D. Helfrick and W.D. Cooper, PHI, 5th Edition, 2002.
3. Electrical and Electronic Measurements and instrumentation by R. K. Rajput, S. Chand.

Reference Books:

1. Electrical & Electronic Measurement & Instruments by A.K. Sawhney, Dhanpat Rai & Co. Publications.
2. Electrical Measurements – by Buckingham and Price, Prentice – Hall
3. Electrical Measurements by Forest K. Harris. John Wiley and Sons
4. Electrical Measurements: Fundamentals, Concepts, Applications – by Reissland, M.U, New Age International (P) Limited, Publishers.
5. Electrical and Electronic Measurements –by G. K. Banerjee, PHI Learning Private Ltd., New Delhi–2012.

DC MACHINES & TRANSFORMERS
(Syllabus for the academic year 2022-23)
SEMESTER III

Course Code	**21EEEET3050**	**IA Marks**	**30**
Number of Lecture Hours/week	**3L**	**Exam Marks**	**70**
Total Number of Lecture Hours	**45**	**Exam Hours**	**03**

Credits-03

Course Objectives:

This course will enable student to :

1. To understand the construction, principle of operation and performance of DC machines.
2. To learn the characteristics and performance of DC motors
3. To understand the speed control methods and testing methods of DC motors.
4. To predetermine the performance of single phase transformers with equivalent circuit models.
5. To Analyze the three phase transformers and achieve three phase to two phase conversion.

Unit-1	
Electromechanical Energy Conversion and introduction to DC machines: Principles of electromechanical energy conversion - singly excited and multi excited systems- calculation of force and torque using the concept of co-energy**.** Construction and principle of operation of DC machines – EMF equation for generator –Excitation techniques– characteristics of DC shunt generator – applications of DC Generators	**Hours-10**
Unit – 2	**Hours-09**
Operation of DC motors Back-emf and torque equations of dc motors – Armature reaction and commutation – characteristics of separately-excited, shunt, series and compound motors – losses and efficiency – applications of dc motors. Necessity of a starter – starting by 3 point and 4-point starters.	
Unit – 3	**Hours-11**
Speed Control of motors and Testing of DC Machines Speed control by armature voltage and field control – testing of DC machines – brake test, Swinburne's method – principle of regenerative or Hopkinson's method – retardation test –field's test- separation of losses.	
Unit – 4	**Hours-08**
1-Phase Transformers: Regulation – losses and efficiency – effect of variation of frequency and supply voltage on losses – all day efficiency. Tests on single phase transformers – open circuit and short circuit tests – Sumpner's test – separation of losses – parallel operation with equal voltage ratios – auto transformer – equivalent circuit – comparison with two winding transformers.	

Unit – 5	
3-Phase Transformer: Polyphase connections- Y/Y, Y/ Δ, Δ/Y, Δ/ Δ and open Δ- third harmonics in phase voltages – three winding transformers- transients in switching –off load and on load tap changers- Scott connection.	**Hours-07**

Course outcomes:

On completion of the course student will be able to:

1. Assimilate the concepts of electromechanical energy conversion.
2. Mitigate the ill-effects of armature reaction and improve commutation in dc machines.
3. Understand the torque production mechanism and control the speed of dc motors.
4. Analyze the performance of single phase transformers.
5. Parallel transformers, control voltages with tap changing methods and achieve three-phase to two-phase transformation.

Text Books:

1. E. Fitzgerald and C. Kingsley,"Electric Machinery" , New York, McGraw Hill Education,2013.
2. P.S.Bimbhra, "Electrical Machinery", Khanna Publishers,2011.

Reference Books:

1. E. Clayton and N. N. Hancock, "Performance and design of DC machines", CBS Publishers,2004.
2. M. G. Say, "Performance and design of AC machines", CBS Publishers,2002.
3. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw HillEducation,2010.

ANALOG ELECTRONICS LAB SEMESTER III			
Course Code	**21EEEEL3060**	**I A Marks**	**15**
Number of Practice Hours/Week	**3P**	**Exam Marks**	**35**
Total Number of Practice Hours	**36**	**Exam Hours**	**03**
Credits-1.5			

COURSEOBJECTIVES:

This course will enable student to:

1. To Understand the VI characteristics of Diode & working of various Rectifier, clipping & Clamping circuits
2. To Understand VI characteristics of BJT & amplifier circuits
3. To Understand VI characteristics of MOSFET & Frequency Response of Common source amplifier circuit
4. To Understand the Linear Applications of Operational Amplifier
5. To Understand the Non Linear Applications of Operational Amplifier

List of Experiments(Any twelve experiments must be conducted)

1. Plot the VI characteristics of using P-N junction Diode (b) Zener Diode
2. Plot the VI characteristics of Zener Diode
3. To determine ripple factor and rectifier efficiency for a Half wave Rectifier
4. To determine ripple factor and rectifier efficiency for a Full Wave Rectifier
5. Non Linear Wave Shaping – Clippers
6. Non Linear Wave Shaping – Clampers
7. Plot the input and output characteristics of BJT in Common Emitter Configuration
8. Transistor CE configuration
9. RC- phase shift Oscillator
10. Function generator using Op-amp's.
11. Op-amp IC 741 inverting and non- inverting amplifiers
12. Op AMP Applications – Adder, Subtractor, Comparator circuits.
13. FET characteristics (CS configuration)
14. FET –CS Amplifier

COURSEOUTCOMES:

On completion of the course student will be able to:

1. Ability to understand the characteristics of Diode & Applications of Diode (working of rectifier, Clipping & Clamping circuits.
2. Ability to Understand the characteristics of BJT & analyze the different amplifier circuits
3. Ability to Understand the characteristics of MOSFET & analyze the Frequency Response of Common source amplifier circuit
4. Ability to analyze the Working of Phase shift oscillators
5. Ability to analyze the working of OPAMP based circuits like Square Wave and Triangular wave Generators

ELECTRICAL CIRCUITS ANALYSIS LAB SEMESTER III			
Course Code	**21EEEEL3070**	**1A-Marks**	**15**
Number of Practice Hours/Week	**3P**	**Exam Marks**	**35**
Total Number of Practice Hours	**36**	**Exam Hours**	**03**
Credits-1.5			

COURSEOBJECTIVES:

This course will enable student to:

1. To verify and demonstrate various theorems.
2. To determine the transient analysis of single phase circuits
3. To verify and determine the parameters of two port networks.
4. To measure three phase active and reactive power for poly phase circuits.
5. To verify and determine node voltages for electrical circuit using Simulation tool.

List of Experiments(Any ten experiments must be conducted)

1. Verification of Kirchhoff's laws.
2. Verification of Thevenin's and Norton's Theorems
3. Verification of Superposition theorem and Maximum Power Transfer Theorem
4. Verification of Compensation Theorem
5. Verification of Reciprocity, Millmann's Theorems
6. Transient Analysis of Series RL and RC circuit using PSPICE Software.
7. Measurement of 3 phase Power by two Wattmeter Method for unbalanced loads
8. Measurement of 3 phase reactive power for star and delta connected load
9. Determination of Self, Mutual Inductances and Coefficient of coupling
10. Z and Y Parameters
11. Transmission and hybrid parameters
12. Verification of nodal analysis using MATLAB software Tool.

COURSEOUTCOMES:

On completion of the course student will be able to:

1. Apply various theorems to electrical circuit
2. Analyze the transient response of single phase circuits
3. Determine parameters for two port networks.
4. Measure active and reactive power of Poly phase Circuits.
5. Analyze nodal analysis using simulation software tool

DC MACHINES & TRANSFORMERS LAB SEMESTER III			
Course Code	**21EEEEL3080**	**IA Marks**	**15**
Number of Lecture Hours/week	**3P**	**Exam Marks**	**35**
Total Number of Lecture Hours	**36**	**Exam Hours**	**03**
Credits-1.5			

Course Objectives:

This course will enable student to:

1. Gain knowledge on pre determination tests conducted on DC machines.
2. Gain knowledge on load tests conducted on DC machines.
3. Gain knowledge on various methods of controlling the speed of DC shunt motor.
4. Gain knowledge on pre determination tests conducted on single phase transformer.
5. Gain knowledge on operating two transformers in parallel and to achieve three phase to two phase transformation.

List of Experiments (Any ten experiments must be conducted)

1. Magnetization characteristics of DC shunt generator. Determination of critical field resistance and critical speed.
2. Brake test on DC shunt motor. Determination of performance curves.
3. Hopkinson's test on DC shunt machines. Predetermination of efficiency.
4. Swinburne's test and Predetermination of efficiencies as Generator and Motor.
5. Load test on DC compound generator. Determination of characteristics
6. Separation of losses in DC shunt motor
7. Load test on DC series generator. Determination of characteristics.
8. Brake test on DC compound motor. Determination of performance curves.
9. Load test on DC shunt generator. Determination of characteristics.
10. Sumpner's test on single phase transformer.
11. Scott connection of transformers
12. Parallel operation of Single phase Transformers
13. Separation of core losses of a single phase transformer

Course Outcomes:

On completion of the course student will be able to:

1. Pre determine the regulation, performance and efficiency on DC machines.
2. No load and Load test of the DC machine to obtain the characteristics, torque, output andefficiency.
3. Control the speed of DC shunt motor by using armature control and field control methods.
4. Pre determine the regulation and efficiency for a single phase transformer.
5. Operate two transformers in parallel and to achieve three phase to two phase transformation.

Electrical Wiring & Installation (Skill Oriented Course) SEMESTER III			
Course Code	**21EEEES3090**	**IA Marks**	**15**
Number of Lecture Hours/Week	**1L+2P**	**Exam Marks**	**35**
Total Number of Lecture Hours	**36**	**Exam Hours**	**03**
Credits-02			

Course Objectives:

This course will enable student to:

1. Learn the Concept of basic Electricity, Single phase & three phase circuits.
2. Identify the cable sizes and perform cable jointing.
3. Perform House wiring
4. Identify the Ground – Fault circuit interrupters.
5. Measure Earth resistance testing and maintenance.

Knowledge about installation of electrical appliance

1. Studies of diagram & Symbols used in basic Electrical Circuits
2. Single phase Industrial Electrical circuits.
3. Three phase Industrial Electrical circuits.
4. Measuring tools, wire gauges, Classification.
5. Identification of the electrical equipment cables, wires and electrical accessories.
6. Single phase domestic wiring.
7. Different types of wires & conductors, Load carrying capacity.
8. Different electrical wiring systems(Residential, Offices, Hospitals and Go-downs)
9. Earth resistance testing.
10. Maintenance of electrical appliances.

Course Outcomes:

On completion of the course student will be able to:

1. Demonstrate the Concept of basic Electricity, Single phase & three phase circuits.
2. Identify the cable sizes and perform cable jointing.
3. Perform House wiring
4. Demonstrate the operation Ground – Fault circuit interrupters.
5. Estimate Earth resistance value and its maintenance

ELECTRO MAGNETIC FIELDS SEMESTER III			
Course Code	**21EEEEN3100**	**IA Marks**	**--**
Number of Lecture Hours/Week	**2L**	**Exam Marks**	**--**
Total Number of Lecture Hours	**36**	**Exam Hours**	**03**
Credits-0			

COURSEOBJECTIVES:

This course will enable students to:

1. Understand the basic laws of electromagnetism.
2. Obtain the electric and magnetic fields for simple configurations under staticconditions.
3. Analyze boundary conditions.
4. Understand Maxwell's equation in different form sand different media.
5. Analyze time varying electric and magnetic fields.

Unit-1	
Review of Vector Calculus Vector algebra, addition, subtraction, components of vectors, scalar and vector multiplications, triple products, three orthogonal coordinate systems(rectangular, cylindricaland spherical).Vector operator del, gradient, divergence and curl; integral theoremsof vectors. Conversion of a vector from one coordinate system to another.	**Hours-08**
Unit-2	
Static Electric Field Coulomb's law, Electric field intensity, Electrical field due to point charges. Line, Surface and Volume charge distributions. Gauss law and its applications. Absolute Electric potential, Potential difference, Calculation of potential differences for different configurations. Electric dipole, Electrostatic Energy and Energy density.	**Hours-08**
Unit–3	
Conductors, Dielectrics and Capacitance Current and current density, Ohms Law in Point form, Continuity of current, Boundary conditions of perfect dielectric materials. Permittivity of dielectric materials, Capacitance, Capacitance of at two wire line, Poisson's equation, Laplace's equation, Solution of Laplace andPoisson's equation, Application of Laplace's and Poisson's equations	**Hours-08**
Unit–4	
Static Magnetic Fields Biot Savart Law, Ampere Law, Magnetic flux and magnetic flux density, Scalar and Vector Magnetic potentials. Steady magnetic fields produced by current carrying conductors. Force on a moving charge, Force on a differential current element, Force between differential current elements.	**Hours-06**
Unit–5	
Magnetic Forces, Materials and Inductance Nature of magnetic materials, Magnetization and permeability, Magnetic boundary conditions, inductances and mutual inductances. **Time Varying Fields and Maxwell's Equations, Electromagnetic Waves** Faraday' slaw for Electromagnetic induction, Displacement current, Point form of Maxwell's equation, Integral form of Maxwell's equations, Motional Electromotive forces. Boundary Conditions. Poynting theorem,	**Hours-06**

COURSE OUTCOMES:

At the end of the course, students will demonstrate the ability

1. To understand the basic laws of electromagnetism.
2. Toobtaintheelectricandmagneticfieldsforsimpleconfigurationsunderstaticconditions.
3. To analyze boundary conditions
4. To understand Maxwell's equation in different forms and different media.
5. To analyze time varying magnetic fields.

TEXT BOOKS:

1.M.N.O.Sadiku,"ElementsofElectromagnetics" Oxford University Publication, 2014.

REFERENCE BOOKS:

1. A. Pramanik, "Electromagnetism Theory and applications", PHI LearningPvt. L td, New Delhi, 2009.
2. A.Pramanik,"ElectromagnetismProblemswithsolution",PrenticeHallIndia,2012.
3. G.W.Carter,"Theelectromagneticfieldinitsengineeringaspects",Longmans,1954.
4. W.J.Duffin,"ElectricityandMagnetism",McGrawHillPublication,1980.
5. W.J.Duffin,"AdvancedElectricityandMagnetism",McGrawHill,1968.

SIGNALS & SYSTEMS SEMESTER IV			
Course Code	**21EEEET4010**	**IA Marks**	**30**
Number of Lecture Hours/Week	**3L**	**Exam Marks**	**70**
Total Number of Lecture Hours	**45**	**Exam Hours**	**03**
Credits-03			

Course objectives:

This course will enable students to:

1. Introduce the terminology of signals and systems
2. Analyze behavior of continuous and discrete time LTI systems
3. Introduce Fourier tools through the analogy between vectors and signals.
4. Analyze discrete time signals and systems using Z transforms
5. Introduce the concept of sampling and reconstruction of signals.

Unit–1	
Introduction to Signals and Systems: Classification of Signals and Systems. Basic operations on signals. Test signals impulse, step, ramp and sinusoid signals. Properties of signals. Energy and power signal. Transformation of independent variables.	**Hours-07**
Unit–2	
Behavior of continuous and discrete time LTI systems: Impulse response and step response, convolution, input output behavior with periodic convergent inputs, cascade interconnections. Characterization of causality and stability of LTI systems. System representation through differential equations and difference equations.	**Hours-10**
Unit–3	
Fourier series and fourier transform: Fourier series representation of periodic signals, Wave form Symmetries, Calculation of Fourier Coefficients. Fourier Transform, convolution /multiplication and their effect in the frequency domain, magnitude and phase response. The Discrete Time Fourier Transform (DTFT) and the Discrete Fourier Transform (DFT). Parseval's Theorem.	**Hours-08**
Unit–4	
Laplace and Z Transforms: Review of the Laplace Transform for continuous time signals and systems, system functions, poles and zeros of system functions and signals, Laplace domain analysis, solution to differential equations and system behavior, Inverse Laplace Transform. The z-Transform for discrete time signals and systems, system functions, poles and zeros of systems and sequences, z-domain analysis, Inverse Z Transform	**Hours-10**

Unit–5

Sampling and Reconstruction: The Sampling Theorem and its implications. Spectra of sampled signals. Reconstruction: ideal inter polar, zero order hold, first order hold. Aliasing and its effects. Relation between continuous and discrete time systems.	**Hours-08**

Course outcomes:

On completion of the course student will be able to:

1. Distinguish the signals and systems and System properties
2. Analyze behavior of continuous and discrete time LTI systems
3. Analyze the continuous time signals and continuous time systems using Fourierseries and Fourier transform
4. Analyze discrete time signals and systems using Z transforms
5. Introduce the concept of sampling and reconstruction of signals.

Textbooks:

1. A.V.Oppenheim, A.S.Willskyand S.H.Nawab, "Signals and systems", Prentice Hall India, 1997.
2. J.G.Proakis and D.G.Manolakis, "Digital Signal Processing: Principles, Algorithms, and Applications", Pearson, 2006.
3. H.P.Hsu, "Signals and systems", Schaum's series, McGraw Hill Education,2010.

Reference books:

1. Signals & Systems Simon Haykin and VanVeen,Wiley,2nd Edition.
2. Principles of Linear Systems and Signals–BP Lathi, Oxford University Press,2015
3. Signals and Systems–K Raja Rajeswari,
4. BVisweswara Rao, PHI,2009 Fundamentals of Signals and Systems Michel J.Robert, MGH International Edition, 2008.

Web references:

1. https://nptel.ac.in/courses/117104074/8
2. https://nptel.ac.in/courses/117101055/
3. http://14.139.172.204/nptel/CSE/Web/117104074/Signals%20and%20Systems.pdf
   http://www.satishkashyap.com/2012/04/iit-video-lectures-on-signals-and.html

DIGITAL ELECTRONICS SEMESTER IV			
Course Code	**21EEEET4020**	**IA Marks**	**30**
Number of Lecture Hours/Week	**3L**	**Exam Marks**	**70**
Total Number of Lecture Hours	**45**	**Exam Hours**	**03**
Credits–03			

COURSE-OBJECTIVES:

This course will enable student to:

1. To understand the working of Logic families and Logic gates
2. To understand the working of Combinational Logic Circuits
3. To understand the working of Sequential Logic Circuits
4. To understand the use of PLD to implement the given logic.
5. To understand working of Semiconductor memories

Unit-1	
Review of Number Systems & Codes: Representation of numbers of different radix, conversation from one radix to another radix, r-1's compliments and r's compliments of signed numbers, problem solving. 4 bit codes, BCD, Excess-3, 2421, 84-2-1 9s & 10s compliment code etc., Logic operations and error detection & correction codes; Basic logic operations -NOT, OR, AND, Universal building blocks, EX-OR, EX-NOR - Gates, Standard SOP and POS, Forms, Gray code, error detection, error correction codes (parity checking, even parity, odd parity, Hamming code) NAND-NAND and NOR-NOR realizations.	**Hours-10**
Unit-2	
Combinational Digital Circuits: Standard representation for logic functions, K-map representation, and simplification of logic functions using K-map, minimization of logical functions. Don't care conditions, Multiplexer, DeMultiplexer/Decoders, Adders, Subtractors, BCD arithmetic, carry look ahead adder, serial adder, digital comparator, parity checker/generator, code converters, priority encoders,decoders/drivers for display devices, Q-M method of function realization.	**Hours-08**
Unit-3	
Sequential circuits and systems: A1bit memory, the circuit properties of Bi-stable latch, the clocked SR flip flop, JK, T and D type flip flops, applications of flip-flops, shift registers, applications of shift registers, serial to parallel converter, parallel to serial converter, ring counter, sequence generator, ripple (Asynchronous) counters, synchronous counters, counters design using flip flops, special counter IC's, synchronous sequential counters, applications of counters.	**Hours-07**
Unit–4	
A/D and D/A Converters:	
Digitaltoanalogconverters:weightedresistor/converter,R2RLadderD/Aconverter, specifications for D/A converters, examples of D/A converter ICs, sample and hold circuit, analog to digital converters: quantization and encoding, parallel comparator A/D converter, successive approximation A/D converter, counting A/D converter, dual slope A/D converter, A/D converter using voltage to frequency and voltage to time conversion, specifications of A/D converters, example of A/D converter ICs	**Hours-10**

Unit–5

Semi-conductor memories and Programmable logic devices: Memory organization and operation, expanding , classification and characteristics of memories, sequential memory, read only memory (ROM), read and write memory(RAM),content addressable memory(CAM)RAM, ROM (Cell Structures and Organization on Chip),ROM as a PLD, Programmable logic array, Programmable array logic.	**Hours-10**

COURSE OUTCOMES:

On completion of the course student will be:

1. Understand working of logic families and logic gates.
2. Design and implement Combinational logic circuits.
3. Design and implement Sequential logic circuits.
4. Understand the process of Analog to Digital conversion and Digital to Analog conversion.
5. Be able to use PLDs to implement the given logical problem.

TEXT BOOKS:

1. R.P.Jain, "Modern Digital Electronics", McGrawHillEducation,4th edition
2. M.M.Mano, "Digital logic and Computer design", Pearson Education India, 2016.
3. A.Kumar, "Fundamentals of Digital Circuits", Prentice Hall India, 2016.

REFERENCE BOOKS:

1. Fundamentals of Logic Design by Charles H Roth Jr, Jaico Publisher
2. Switching Theory and Logic Design by Hill and Peterson McGrawHill MH Edition
3. Switching Theory and Logic Design by M V Subramanyam

MATHEMATICS-IV (Probability and Statistics) SEMESTER IV			
Subject Code	21CMMAT4030	IA Marks	30
Number of Lecture Hours/Week	3	Exam Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
Credits – 03			

Course Objectives:

1. To apply least squares method to fit a curve.
2. To know the Basic Concepts of Probability and corresponding Discrete distributions
3. To apply Continuous probability distributions
4. To obtain the estimate of a parameter from sample statistic
5. To test the hypothesis.

Unit -1	
Curve fitting: Method of least squares – fitting to Straight line – parabola – Exponential and Power curves.	**Hours – 08**
Unit -2	
Discrete random Variables and Distributions: Introduction Random variables -Discrete random variables-Distribution function-Mathematical Expectation. Discrete distributions: Binomial and Poisson distributions and their fitting to data	**Hours – 10**
Unit – 3	
Continuous random Variables and Distributions: Introduction - Continuous random variables-Distribution function- Expectation. Continuous distributions: Uniform and Normal distributions, Normal approximation to Binomial distribution.	**Hours – 10**
Unit – 4	
Sampling theory Introduction-Population and samples-Sampling distribution of means and Variance (definition only)-Central limit theorem (without proof).	**Hours – 10**
Unit – 5	
Test of Hypothesis: Introduction-Hypothesis-Null and Alternative Hypothesis-Type I and Type II errors-Level of Significance-One tail and two tail tests-Tests concerning one mean and two means(Large and Small samples) - z test, t-distribution, Test of Goodness of fit - Tests on proportions : z-test and t-test..	**Hours – 10**

Course outcomes:

On completion of this course, students are able to

1. Apply least squares method to fit a curve (L5)
2. Apply the Concepts of Probability and Find the statistical Parameters of Discrete and Continuous distributions (L3)
3. Apply Continuous probability Distributions (L3)
4. Estimate the properties of population from samples. (L5)
5. Design the Components of classical Hypothesis test, Conclude the statistical inferential methods based on small and large samples. (L6)

Question paper pattern:

1. Question paper consists of 10 questions.
2. Each full question carrying 14 marks.
3. Each full question will have sub question covering all topics under a unit.
4. The student will have to answer 5 full questions selecting one full question from each

unit.

Text Books:

1. Miller and Freund's, Probability and Statistics for Engineers,7/e, Pearson, 2008.
2. S.C.Gupta and V.K.Kapoor, Fundamentals of Mathematical Statistics, 11/e, Sultan Chand & Sons Publications, 2012.
3. B.V.Ramana "Higher Engineering Mathematics" Tata Mc Graw-Hill, 2006.

Reference Books:

1. Shron L.Myers, Keying Ye, Ronald E Walpole, Probability and Statistics for Engineers and the Scientists,8th edition, Pearson 2007.
2. Jay L Devore, Probability and Statistics for Engineering and the Sciences, 8thEdition, Cengage.
3. Sheldon M.Ross, Introduction to probability and statistics Engineers and Scientists,4thEdition, Academic Foundation, 2011.
4. Johannes Ledolter and Robert V.Hogg, Applied Staistics for Engineers and Physical Scientists, 3rd Edition, Pearson, 2010.
5. Srimanta Pal and Subodh C. Bhunia, Engineering Mathematics, Oxford University Press.

INDUCTION & SYNCHRONOUS MACHINES SEMESTER IV			
Course Code	**21EEEET4040**	**IA Marks**	**30**
Number of Lecture Hours/week	**3L**	**Exam Marks**	**70**
Total Number of Lecture Hours	**45**	**Exam Hours**	**03**
Credits -3			

Course Objectives:

Enable the students

1. Understand the Physical arrangement of windings.
2. Quantify the performance of induction motor and induction generator in terms of torque and slip.
3. To understand the torque producing mechanism of a three phase induction motor.
4. To understand the torque producing mechanism of a single phase induction motor.
5. To understand the operation, performance and starting methods of synchronous machines.

Unit 1	
Fundamentals of AC machine windings Physical arrangement of windings in stator and cylindrical rotor; slots for windings; single turn coil active portion and overhang; full pitch coils, concentrated winding, distributed winding. Sinusoidally distributed winding, winding factors.	**Hours-07**
Unit 2	**Hours-06**
3-Phase Induction Motors Construction details of squirrel cage and slip ring induction motors – production of rotating magnetic field – principle of operation – Equivalent circuit –phasor diagram- slip speed-rotor emf and rotor frequency – rotor current and pf at standstill and during running conditions – rotor power input, rotor copper loss and mechanical power developed and their interrelationship.	
Unit 3	**Hours-09**
Testing and Starting methods of 3-phase induction motors Torque equation – expressions for maximum torque and starting torque – torque slip characteristic – double cage and deep bar rotors – crawling and cogging – speed control of induction motor with V/f control method No load and blocked rotor tests circle diagram for predetermination of performance – induction generator operationDOL, Auto transformer, Star-Delta and rotor resistance methods.	
Unit 4	**Hours-13**
Single phase induction motors: Constructional features, double revolving field theory, equivalent circuit, Methods of starting. AC series motors. **Synchronous Machines:** Constructional features of non-salient and salient pole machines – phasor diagrams voltage regulation by synchronous impedance method –MMF method and Potier triangle method– two reaction analysis of salient pole machines and phasor diagram Parallel operation with infinite bus and other alternators – synchronizing power – load sharing – control of real and reactive power-numerical problems.	

Unit 5	
Synchronous motor – operation, starting and performance Synchronous motor principle and theory of operation – phasor diagram – starting torque – variation of current and power factor with excitation – capability curves – synchronous condenser – mathematical analysis for power developed – hunting and its suppression – methods of starting – applications.	**Hours-10**

Course outcomes:

On completion of the course student will be able to:

1. Illustrate the structure of AC machines and identify the various types of windings.
2. Explain the operation and performance of three phase induction motor.
3. Analyze the torque-speed relation, performance of induction motor.
4. Implement the starting of single phase induction motors and Analyze the operation of synchronous machines.
5. Explain hunting phenomenon, implement methods of staring and correction of power factor with synchronous motor.

Text Books:

1. E. Fitzgerald and C. Kingsley, "Electric Machinery" , McGraw HillEducation,2013.
2. M. G. Say, "Performance and design of AC machines", CBS Publishers,2002.
3. P.S.Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.

Reference Books:

1. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw HillEducation,2010.
2. S. Langsdorf, "Alternating current machines", McGraw HillEducation,1984.
3. P. C. Sen, "Principles of Electric Machines and Power Electronics", John Wiley & Sons, 2007.

ENGINEERING ECONOMICS AND FINANCIAL MANAGEMENT SEMESTER IV			
Subject Code	21CMMST4050	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	50	Exam Hours	03

Credits-03

Course objectives:

1. To understand the concept and nature of Managerial Economics and Concept of Demand and Demand forecasting.
2. To understand the concept of Production function, Input Output relationship, Cost Concepts and Concept of Cost-Volume-Profit Analysis.
3. To understand the Market structures, significance of various pricing methods and different forms of Business organization and the concepts of Business Cycles.
4. To understand the different Accounting Systems preparation of Financial Statements and uses of different tools for performance evaluation
5. To understand the concept of Capital, Capitalization, Capital Budgeting and to know the techniques used to evaluate Capital Budgeting proposals by using different methods.

Unit -I: Introduction to Managerial Economics and demand Analysis	
Definition of Managerial Economics and Scope-Managerial Economics and its relation with other subjects-Concepts of Demand-Types-Determents-Law of Demand its Exception-Elasticity of Demand-Types and Measurement- Demand forecasting and its Methods.	**10 Hours**
Unit -II: Production and Cost Analysis	
Production function- Law of Variable proportions- Isoquants and Isocost-Cobb-Douglas Production function-Economics of Scale-Cost Concepts-Cost Volume Profit analysis- Determination of Break-Even Point (Simple Problems).	**10 Hours**
Unit-III: Introduction To Markets, Pricing Policies & forms Organizations and Business Cycles	
Market Structures: Perfect Competition, Monopoly and Monopolistic and Oligopoly – Features – Price,Output Determination – Methods of Pricing: Strategies of Pricing & process for selecting final price-. Features and Evaluation of Sole Trader – Partnership – Joint Stock Company – State/Public Enterprises and their forms – Business Cycles –Phases of Business Cycle	**10 Hours**
Unit –IV: Introduction to Accounting & Financing Analysis	
Introduction to Double Entry Systems – Journal entry-Ledger-Trail Balance-Final Accounts-Preparation of Financial Statements- Analysis and Interpretation of Financial Statements-Ratio Analysis.	**10 Hours**
Unit-V: Capital and Capital Budgeting	
Capital Budgeting: Meaning of Capital-Capitalization-Meaning of Capital Budgeting-Need for Capital Budgeting-Techniques of Capital Budgeting-Traditional and Modern Methods.	**10 Hours**

Course outcomes:

1. Students are equipped with the knowledge of managerial economics and estimating demand for a product.
2. Students understand Production and Cost concepts, estimating Cost Break even Analysis.
3. Students are equipped with the knowledge on Markets and Pricing methods along with Business Cycles.
4. Students are able to understand Accounting Concepts and Prepare Financial Statements-Analysis
5. Students are able to analyse various investment project proposals with the help of Capital Budgeting techniques.

Question paper pattern:

Section A:

1. This section contains ten one or two line answer question carrying 1 mark each.
2. Two questions from each unit should present.

Section B:

4. This Section will have 10 questions.
5. Each full question carry 12 marks.
6. Each full question will have sub question covering all topics under a unit.

The student will have to answer 5 full questions selecting one full question from each unit.

Text Books:

1. Dr. A. R. Aryasri – Managerial Economics and Financial Analysis, TMH 2011.
2. B. Kuberadu Managerial Economics and Financial Analysis, 1/e, HPH, 2013
3. Dr. P. Vijaya Kumar & Dr. N. Apparao Management Science Cengage, Delhi, 2012.

Reference Books:

1. Ambrish Gupta, Financial Accounting for Management, Pearson Education, New Delhi.
2. H. Craig Peterson & W. Cris Lewis, Managerial Economics, PHI, 4th Ed.
3. Koontz and weihrich: Essentials of management, TMH 2011
4. Seth& Rastogi: Global management systems, cengage learning,delhi,2011
5. V. Maheswari: Managerial Economics, Sultan Chand.
6. Dr. B. Kuberudu and Dr. T. V. Ramana: Managerial Economics & Financial Analysis, Himalaya Publishing House 2011.
7. Vanitha Agarwal : Managerial Economics, Pearson Publications 2011.
8. Sanjay Dhameja: Financial Accounting for Managers, Pearson.
9. Maheswari : Financial Accounting, Vikas Publications.
10. S. A. Siddiqui & A. S. Siddiqui: Managerial Economics and Financial Analysis, New Age International Publishers, 2012.

DIGITAL ELECTRONICS LAB SEMESTER IV			
Course Code	**21EEEEL4060**	**1AMarks**	**15**
Number of Practice Hours/Week	**3P**	**Exam Marks**	**35**
Total Number of Practice Hours	**36**	**Exam Hours**	**03**
Credits-1.5			

COURSEOBJECTIVES:

This course will enable students:

1. To understand De-Morgan's Theorem SOP, POS Forms.
2. To understand Full/Parallel Adders, Sub tractors and Magnitude Comparators, Multiplexer using gates,
3. To understand De-Multiplexers and Decoders, Flip Flops, Shift Registers and Counters
4. To understand A-D and D-A Converters.
5. To understand the Semi-Conductor Memories

List of Experiments (Any twelve experiments must be conducted)

1. Design and implementation of Adders and Sub tractors using logic gates.
2. Design and implementation of code converters using logic gates (i) BCD to excess3code and vice versa (ii) Binary to gray and vice versa
3. Design and implementation of 4bit binary Adder/subtract or and BCD adder using IC7483
4. Design and implementation of 2Bit Magnitude Comparator using logic gates 4 bit Magnitude Comparator using IC7485
5. Design and implementation of 8bit odd/even parity checker generator using IC74180.
6. Design and implementation of Multiplexer and De-multiplexer using logic gates
7. Design and implementation of encoder and decoder using logic gates and study of IC7445 and IC74147
8. Construction and verification of 4bit ripple counter and Mod10/Mod12 Ripple counters
9. Design and implementation of 3bit synchronous up/down counter
10. Implementation of SISO,SIPO, PISO and PIPO shift registers using flip-flops.
11. To design and build DAC using Op-Amp.
12. To design and build ADC using Op-Amp
13. Realize the Ring Counter and Johnson Counter using IC7476

COURSEOUTCOMES:

On completion of the course student will be:

1. Demonstrate the truth table of various Expressions and Combinational Circuits using logic gates.
2. Design, test and evaluate various Combinational Circuits such as Adders, Subtractors, Comparators, Multiplexers and De-multiplexers.
3. Construct Flip flops, Counters and Shift Registers.
4. Construct A-D & D-A Converters using Op-Amp.
5. Construct different types of Memories

ELECTRICAL MEASUREMENTS & INSTRUMENTATION LAB SEMESTER-IV			
Course Code	**21EEEEL4070**	**1A-Marks**	**15**
Number of Practice Hours/Week	**3P**	**Exam Marks**	**35**
Total Number of Practice Hours	**36**	**Exam Hours**	**03**
Credits-1.5			

COURSE-OBJECTIVES:

1. To analyze various-measuring instruments.
2. To determine R-L-C by using suitable bridge.
3. To analyze performance of CT and PT.
4. To determine non electrical parameters.
5. To measure displacement using LVDT.

List-of-Experiments-(Any-ten-experiments-must-be-conducted)

1. Calibration and Testing of single phase energy Meter
2. Calibration LPF wattmeter by using Phantom loading
3. Calibration of dynamometer wattmeter using phantom loading
4. Crompton D.C. Potentiometer- Calibration of PMMC voltmeter and Ammeter
5. Kelvin's double Bridge- Measurement of resistance- Determination of Tolerance.
6. Capacitance Measurement using Schering Bridge.
7. Inductance Measurement using Anderson bridge
8. C.T. testing using mutual Inductor – Measurement of %ratio error and phase angle of given C.T.by Null method
9. Measurement of displacement using LVDT
10. Measurement of weight using strain gauge based transducer.
11. Measurement of temperature by RTD.
12. Measurement of temperature by thermocouple

COURSE-OUTCOMES:

1. To be able to apply various-Measuring instruments.
2. To be able to analyze the Performance of Measuring instruments.
3. To be able to apply suitable bridge to determine unknown quantity.
4. To be able to determine-Physical Parameters.
5. To be able analyze the performance of C.

INDUCTION & SYNCHRONOUS MACHINES LAB SEMESTER-IV			
Course Code	**21EEEEL4080**	**IA Marks**	**15**
Number of Lecture Hours/week	**3P**	**Exam Marks**	**35**
Total Number of Lecture Hours	**36**	**Exam Hours**	**03**
Credits 1.5			

Course Objectives:

This course will enable student to :

1. Obtain efficiency by conducting direct and indirect tests on three phase induction motor.
2. Obtain regulation of alternator by E.M.F, M.M.F, Z.P.F methods and also performance curves.
3. Obtain V and Inverter V Curves of a three phase synchronous motor.
4. Control the speed of the three phase induction motor and to obtain equivalent circuit.
5. Improve the power factor of single phase induction motor and to obtain its performance.

List of Experiments (Any ten experiments must be conducted)

1. Brake test on three phase Induction Motor
2. No–load & Blocked rotor tests on three phase Induction motor
3. Regulation of a three –phase alternator by synchronous impedance & m.m.f. Methods
4. Regulation of three–phase alternator by Potier triangle method
5. V and Inverted V curves of a three phase synchronous motor.
6. Determination of X_d and $X_q$of a salient pole synchronous machine
7. Equivalent circuit of single phase induction motor
8. Speed control of induction motor by V/f method.
9. Determination of efficiency of three phase alternator by loading with three phase inductionmotor.
10. Power factor improvement of single phase induction motor by using capacitors and load teston single phase induction motor.
11. Measurement of sequence impedance of a three–phase alternator.
12. Break test on split phase induction motor.

Course outcomes:

On completion of the course student will be able to:

1. Obtain efficiency by conducting direct and indirect tests on three phase induction motor.
2. Obtain regulation of alternator by E.M.F, M.M.F, Z.P.F methods and also performance curves.
3. Obtain the V and Inverter V Curves of a three phase synchronous motor.
4. Control the speed of the three phase induction motor and to obtain equivalent circuit.
5. Improve the power factor of single phase induction motor and to obtain its performance.

DESIGN OF ELECTRICAL CIRCUITS USING ENGINEERING SOFTWARE TOOLS
(Skill Oriented Course)
SEMESTER IV

Course Code	**21EEEES4090**	**IA Marks**	
Number of Lecture Hours/week	**2P**	**Exam Marks**	
Total Number of Lecture Hours	**36**	**Exam Hours**	**03**
Credits 2			

Course Objectives:

This course will enable student :

1. To Learn the fundamentals of MATLAB Tools
2. To generate various waveform signals and sequences
3. To verify and simulate various electrical circuits using Mesh and Nodal Analysis
4. To verify and simulate various theorems
5. To verify and simulate RLC series and parallel resonance.
6. To determine self and mutual inductance of a magnetic circuit, parameters of a given coil.

List of Experiments (Any 10 of the following experiments are to be conducted)

Note: MATLAB/SIMULINK fundamentals shall be explained during the first week before starting of the course

1. Generation of various signals and sequences (Periodic and Aperiodic), such as unit
2. Impulse, Step, Square, Saw tooth, Triangular, Sinusoidal, Ramp.
3. Operations on signals and sequences such as Addition, Multiplication, Scaling, Shifting,
4. Folding, Computation of Energy, and Average Power
5. Verification of Kirchhoff's current law and voltage law using simulation tools.
6. Verification of mesh analysis using simulation tools.
7. Verification of nodal analysis using simulation tools.
8. Determination of average value, rms value, form factor, peak factor of sinusoidal
9. wave, square wave using simulation tools.
7. Verification of super position theorem using simulation tools.
8. Verification of reciprocity theorem using simulation tools.
9. Verification of maximum power transfer theorem using simulation tools.
10. Verification of Thevenin's theorem using simulation tools.
11. Verification of Norton's theorem using simulation tools.
12. Verification of compensation theorem using simulation tools.
13. Verification of Milliman's theorem using simulation tools.
14. Verification of series resonance using simulation tools.
15. Verification of parallel resonance using simulation tools.
16. Verification of self-inductance and mutual inductance by using simulation tools.

COURSE OUTCOMES:

On completion of the course student will be able to:

1. write the MATLAB programs to simulate the electrical circuit problems
2. simulate various circuits for electrical parameters
3. simulate various wave form for determination of wave form parameters
4. simulate RLC series and parallel resonance circuits for resonant parameters
5. simulate magnetic circuits for determination of self and mutual inductances

ELECTRICAL WIRING, ESTIMATION & COSTING (Honors Engineering Course) SEMESTER IV			
Course Code	**21EEEEH1001**	**IA Marks**	**30**
Number of Lecture Hours/Week	**03+1T**	**Exam Marks**	**70**
Total Number of Lecture Hours	**45**	**Exam Hours**	**03**

Credits-04	
COURSE OBJECTIVES: 1. Introduce the electrical symbols and simple electrical circuits 2. Able to learn the design of electrical installations. 3. Able to learn the design of electrical installation for different types of buildings and smallindustries. 4. Learn the basic components of electrical substations. 5. Familiarize with the motor control circuits	
Unit -1	
Electrical Symbols and Simple Electrical Circuits Identification of electrical symbols - Electrical wiring Diagrams - Methods of representation of wiring diagrams - introduction to simple light and fan circuits - system of connection of appliances and accessories.	**Hours-08**
Unit -2	
Design Considerations of Electrical Installations Electric supply system - Three-phase four wire distribution system - protection of electric installation against overload - short circuit and earth fault - earthing - neutral and earth wire - types of loads - systems of wiring - permissible of voltage drops and sizes of wires - estimating and costing of electrical installations.	**Hours-10**
Unit – 3	
Electrical Installation for Different Types of Buildings and Small Industries Electrical installations for electrical buildings - estimating and costing of material - simple examples on electrical installation for residential buildings - electrical installations for commercial buildings - electrical installation for small industries-case study.	**Hours-07**
Unit – 4	
Substations Introduction - types of substations - outdoor substations-pole mounted type - indoor substations-floormounted type - simple examples on quantity estimation-case study.	**Hours-10**
Unit – 5	
Motor control circuits Introduction to AC motors - starting of three phase squirrel cage induction motors - starting of wound rotor motors - starting of synchronous motors - contractor control circuit components - basic control circuits - motor protection.	**Hours-10**

Course Outcomes:

After the completion of the course the student should be able to:

1. Demonstrate the various electrical apparatus and their interconnections.
2. Examine various components of electrical installations.
3. Estimate the cost for installation of wiring for different types of building and small industries.
4. Illustrate the components of electrical substations.
5. Design suitable control circuit for starting of three phase induction motor and synchronous motor.

Text Books:

1. Electrical Design and Estimation Costing - K. B. Raina and S.K.Bhattacharya – New AgeInternational Publishers - 2007.

References Books:

1. Electrical wiring estimating and costing – S.L.Uppal and G.C.Garg – Khanna publishers - 6th edition - 1987.
2. A course in electrical installation estimating and costing – J.B.Gupta –Kataria SK & Sons - 2013.

SCADA ENERGY MANAGEMENT SYSTEMS
(Honors Engineering Course)
SEMESTER IV

Course Code	**21EEEEH1002**	**IA Marks**	**30**
Number of Lecture Hours/Week	**03+1T**	**Exam Marks**	**70**
Total Number of Lecture Hours	**45**	**Exam Hours**	**03**

Credits-04

COURSE OBJECTIVES:

1. overview of data acquisition system and terms related
2. control function of SCADA and applications of functions
3. different communication channels and related terms
4. data base management systems and network data bases
5. energy management center and load management

Unit -1	
General Concepts Introduction to distribution systems - Distribution system losses – Coincidence factor – Contribution factor – loss factor – Relationship between the load factor and loss factor – Numerical Problems – Load Modeling and Characteristics – Classification and characteristics of loads (Residential - commercial - Agricultural and Industrial).	**Hours-10**
Unit -2	
Supervisory and Control Functions: Data acquisitions, status indications, measured values, energy values, monitoring alarm and event application processing. Control function: ON/OFF control of lines, transformers, capacitors and applications in process industry, valve, opening, closing etc. Regulatory functions: set points and feed-back loops, time tagged data, disturbance data collection and analysis, calculation and report preparation.	**Hours-8**
Unit – 3	
Man- Machine Communication: Operator consoles and VDUs, displays, operator dialogues, alarm and event loggers, mimic diagrams, report and printing facilities	**Hours-7**
Unit – 4	
Data Bases - Scada, Ems And Network Data Bases: SCADA system structure - local system, communication system and central system, Configuration- non- redundant single processor, redundant dual processor, multi control centers, system configuration. Performanceconsiderations, real time operation system requirements, languages.	**Hours-10**

Unit – 5

Energy Management Center Functions performed at a centralized management center, production control and load management, economic dispatch, distributed centers and power pool management.	**Hours-10**
Course Outcomes: The students should be able to: 1. Analyze the general terms related to SCADA. 2. Apply the Supervisory and control functions. 3. Know the different communication modes and functions. 4. Configure the data bases related to SCADA and Networks systems. 5. Analyze the load and energy management.	
Text Books: 1. Stuart A. Boyer, SCADA: Supervisory Control And Data Acquisition, The Instrumentation, Systems andAutomation Society, 4th edition, 2009. 2. Krishna Kant, Computer-Based Industrial Control, PHI Learning,2nd edition, 2013	

LINEAR IC APPLICATIONS
(Honors Engineering Course)
SEMESTER IV

Course Code	**21EEEEH1003**	**IA Marks**	**30**
Number of Lecture Hours/Week	**03+1T**	**Exam Marks**	**70**
Total Number of Lecture Hours	**45**	**Exam Hours**	**03**

Credits-04

COURSE OBJECTIVES:

1. To understand the basic operation &performance parameters of differential amplifiers.
2. To understand & learn the measuring techniques of performance parameters of OP-AMP
3. To learn the linear and non-linear applications of operational amplifiers.
4. To understand the analysis & design of different types of active filters using opamps
5. To learn the internal structure, operation and applications of different analog ICs

UNIT-I	
INTEGRATED CIRCUITS: Differential Amplifier- DC and AC analysis of Dual input Balanced output Configuration, Properties of other differential amplifier configuration (Dual Input Unbalanced Output, Single Ended Input – Balanced/ Unbalanced Output), DC Coupling and Cascade Differential Amplifier Stages, Level translator.	**Hours-10**
UNIT-II	
Characteristics of OP-Amps, Integrated circuits-Types, Classification, Package Types and Temperature ranges, Power supplies, Op-amp Block Diagram, ideal and practical Op-amp Specifications, DC and AC characteristics, 741 op-amp & its features, Op-Amp parameters & Measurement, Input & Out put Off set voltages & currents, slew rate, CMRR, PSRR, drift, Frequency Compensation techniques.	**Hours-10**
UNIT-III	
LINEAR and NON-LINEAR APPLICATIONS OF OP-AMPS: Inverting and Noninverting amplifier, Integrator and differentiator, Difference amplifier, Instrumentation amplifier, AC amplifier, V to I, I to V converters, Buffers. Non- Linear function generation, Comparators, Multivibrators, Triangular and Square wave generators, Log and Anti log Amplifiers, Precision rectifiers.	**Hours-7**
UNIT-IV	
ACTIVE FILTERS, ANALOG MULTIPLIERS AND MODULATORS: Design & Analysis of Butterworth active filters – 1st order, 2nd order LPF, HPF filters. Band pass, Band reject and all pass filters. Four Quadrant Multiplier, IC 1496, Sample & Hold circuits.	**Hours-8**
UNIT-V	
TIMERS & PHASE LOCKED LOOPS: Introduction to 555 timer, functional diagram, Monostable and Astable operations and applications, Schmitt Trigger; PLL - introduction, block schematic, principles and description of individual blocks, 565 PLL, Applications of PLL – frequency multiplication, frequency translation, AM, FM & FSK demodulators. Applications of VCO (566)	**Hours-10**

OUTCOMES

1. Design circuits using operational amplifiers for various applications.
2. Analyze and design amplifiers and active filters using Op-amp.
3. Diagnose and trouble-shoot linear electronic circuits.
4. Understand the gain-bandwidth concept and frequency response of the amplifier configurations.
5. Understand thoroughly the operational amplifiers with linear integrated circuits.

TEXT BOOKS:

1. Linear Integrated Circuits – D. Roy Choudhury, New Age International (p) Ltd, 2nd Edition,2003.
2. Op-Amps & Linear ICs - Ramakanth A. Gayakwad, PHI,1987.
3. Operational Amplifiers–C.G. Clayton, Butterworth & Company Publ. Ltd./Elsevier, 1971

REFERENCES :

1. Operational Amplifiers & Linear Integrated Circuits –Sanjay Sharma ;SK Kataria&Sons;2nd Edition,2010
2. Design with Operational Amplifiers & Analog Integrated Circuits – Sergio Franco,McGraw Hill, 1988.
3. OP AMPS and Linear Integrated Circuits concepts and Applications, James M Fiore,Cenage Learning India Ltd.
4. Operational Amplifiers & Linear Integrated Circuits–R.F.Coughlin & Fredrick Driscoll,PHI, 6th Edition.
5. Operational Amplifiers & Linear ICs – David A Bell, Oxford Uni. Press, 3rd Edition

RENEWABLE ENERGY SYSTEMS
(Honors Engineering Course)
SEMESTER IV

Course Code	**21EEEEH1004**	**IA Marks**	**30**
Number of Lecture Hours/Week	**3L+1T**	**Exam Marks**	**70**
Total Number of Lecture Hours	**45**	**Exam Hours**	**03**

Credits-04

COURSE OBJECTIVES:

1. To study the solar radiation data, extraterrestrial radiation, radiation on earth's surface.
2. To study solar thermal collections.
3. To study solar photo voltaic systems.
4. To study maximum power point techniques in solar pv and wind energy.
5. To study basic principle and working of hydro, tidal, biomass, fuel cell and Geothermal systems.

UNIT-I **Fundamentals of Energy Systems and Solar energy** Energy conservation principle – Energy scenario (world and India) – various forms of renewable energy - Solar radiation**:** Outside earth's atmosphere – Earth surface – Analysis of solar radiation data – Geometry – Radiation on tilted surfaces – Numerical problems.	**Hours-08**
UNIT-II **Solar Photovoltaic Systems, Thermal Collectors & Evacuation Strategies:** **Solar Photovoltaic Systems:** Solar photovoltaic cell, module, array – construction – Efficiency of solar cells – Developing technologies – Cell I-V characteristics – Equivalent circuit of solar cell – Series resistance – Shunt resistance – Applications and systems – Balance of system components – System design**:** storage sizing – PV system sizing – Maximum power point techniques**:** Perturb and observe (P&O) technique – Hill climbing technique. **Solar Thermal Collectors:** Flat plate and concentrating collectors-Solar Power Plant – Central tower receiving system. **Evacuation Strategies:** Strategies of Solar Power Evacuation	**Hours-10**
UNIT-III **Wind, Ocean, Wave & Tidal Energy:** **Wind Energy:** Basic principles of Wind energy conversion, Classification of WEC systems, Horizontal and Vertical axis windmills-Performance characteristics – Betz criteria. **Ocean, Wave & Tidal Energy:** OTEC Principle – Open and closed cycle of OTEC – Wave and Tidal Energy – Potential and conversion techniques **Evacuation Strategies:** Wind & Tidal Power Evacuation	**Hours-10**
UNIT-IV **Hydro power systems** Basic working principle – Classification of hydro systems**:** Large, small, micro measurement of head and flow – Energy equation – Types of turbines – Numerical problems.	**Hours-07**

UNIT-V	
Biomass, fuel cells and geothermal systems Biomass Energy**:** Fuel classification – Pyrolysis – Direct combustion of heat – Different digesters and sizing. Fuel cell**:** Classification of fuel for fuel cells – Fuel cell voltage– Efficiency – V-I characteristics. Geothermal**:** Classification – Dry rock and hot acquifer – Energy analysis – Geothermal based electric power generation	**Hours-10**

1. Analyze solar radiation data, extraterrestrial radiation, and radiation on earth's surface.
2. Design solar photo voltaic systems and solar thermal collectors.
3. Explain basic principle and working of Wind, Ocean, Wave & Tidal Energy systems.
4. Describe the various hydro power generating systems.
5. Explain basic principle and working of hydro, tidal, biomass, fuel cell and geothermal systems.

TEXT BOOKS:

1. Solar Energy**:** Principles of Thermal Collection and Storage, S. P. Sukhatme and J. K. Nayak, TMH, New Delhi, 3rd Edition.

2. Renewable Energy Resources, John Twidell and Tony Weir, Taylor and Francis - second edition,2013.

REFERENCES :

1. Energy Science**:** Principles, Technologies and Impacts, John Andrews and Nick Jelly, Oxford University Press.
2. Renewable Energy- Edited by Godfrey Boyle-oxford university.press,3rd edition,2013.
3. Handbook of renewable technology Ahmed and Zobaa, Ramesh C Bansal, World scientific, Singapore.
4. Renewable Energy Technologies /Ramesh & Kumar /Narosa.
5. Renewable energy technologies – A practical guide for beginners – Chetong Singh Solanki, PHI.Non conventional energy source –B.H.khan- TMH-2nd edition

FUDAMENTAL OF ELECTRICAL CIRCUIT THEORY
(Minor Engineering Course)
SEMESTER IV

Course Code	21EEEEM1001	**IA Marks**	**30**
Number of Lecture Hours/Week	**03+1T**	**Exam Marks**	**70**
Total Number of Lecture Hours	**45**	**Exam Hours**	**03**

Credits-04

COURSE OBJECTIVES:

1. Concepts of passive elements, types of sources and various network reduction techniques andapplications of electrical circuits.
2. Behavior of RLC networks for sinusoidal excitations.
3. Performance of R-L, R-C and R-L-C circuits with variation of one of the parameters and to understandthe concept of resonance.
4. Applications of network theorems for analysis of electrical networks.
5. Concepts of balanced and unbalanced three-phase circuits

UNIT-I	**Hours-10**
Introduction to Electrical Circuits Basic Concepts of active and passive elements and their V-I relations, Sources (dependent), Kirchhoff's laws, Network reduction techniques (series, parallel, series - parallel, star-to-delta and delta-to-star transformation), source transformation technique, nodal analysis and mesh analysis, Principles of Duality	
UNIT-II	**Hours-7**
Single Phase A.C Systems Periodic waveforms (determination of rms, average value, peak factor and form factor), concept of phase angle, phase difference – waveforms and phasor diagrams, lagging and leading networks, rectangular and polar forms of representations, steady state analysis of R, RL and RC circuits, power factor and its significance, real, reactive and apparent power, waveforms of instantaneous power and complex power.	
UNIT-III	**Hours-8**
Analysis of AC Networks Extension of node and mesh analysis to AC networks, numerical problems on sinusoidal steady state analysis, series and parallel resonance, selectivity, band width and Quality factor, Current Locus diagrams of RL, RC and RLC circuits	
UNIT-IV	**Hours-10**
Network theorems Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum-power transfer theorem, Reciprocity theorem, Millman's theorem, Tellegen's theorem and Compensation theorem.	
UNIT-V	**Hours-10**
Balanced and Unbalanced Three phase circuits Phase sequence, star and delta connection of sources and loads, relation between line and phase voltages and currents, analysis of balanced three phase circuits, measurement of active and reactive power. Analysis of three phase unbalanced circuits: Loop method, Star-Delta transformation technique, two wattmeter method for measurement of three phase power.	

OUTCOMES

The students should be able to:

1. Analyze various electrical networks in presence of active and passive elements
2. Explore RLC networks with sinusoidal excitation.
3. Analyze resonance conditions in electrical circuits.

4. Verify various network theorems.
5. Solve three- phase circuits under balanced and unbalanced condition

TEXT BOOKS:

1. Engineering Circuit Analysis by William Hayt and Jack E.Kemmerley, McGraw Hill Company, 6th edition.
2. Network Analysis: Van Valkenburg; Prentice-Hall of India Private Ltd.

REFERENCES :

1. Fundamentals of Electrical Circuits by Charles K.Alexander and Mathew N.O.Sadiku, McGraw HillEducation (India).
2. Linear Circuit Analysis by De Carlo, Lin, Oxford publications.
3. Electric Circuits – (Schaum's outlines) by Mahmood Nahvi & Joseph Edminister, adapted by K.Uma Rao, 5th Edition – McGraw Hill.
4. Electric Circuits by David A. Bell, Oxford publications.
5. Introductory Circuit Analysis by Robert L Boylestad, Pearson Publications.
6. Circuit Theory (Analysis and Synthesis) by A.Chakrabarthi, Dhanpat Rai&Co.

FUNDAMENTALS OF ELECTROMAGNETIC FIELD THEORY
(Minor Engineering Course)
SEMESTER IV

Course Code	**21EEEEM1002**	**IA Marks**	**30**
Number of Lecture Hours/Week	**3L+1T**	**Exam Marks**	**70**
Total Number of Lecture Hours	**60**	**Exam Hours**	**03**

Credits-04

COURSE OBJECTIVES:

1. Electric field and potentials due to different configurations of static charges.
2. Properties of conductors and dielectrics, calculate the capacitance of different configurations.
3. Understand the concept of conduction and convection current densities.
4. Magnetic fields produced by currents in different configurations, application of Ampere's law and the
5. Maxwell's second and third equations and to study the magnetic force and torque through Lorentz force equation in magnetic field environment like conductors and other current loops.
6. Concept of self and mutual inductances and the energy stored.

UNIT-I	
Electrostatics Electrostatic Fields – Coulomb's Law – Electric Field Intensity (EFI) – EFI due to a line and a surface charge,work done in moving a point charge in an electrostatic field, electric potential – properties of potential function potential gradient, Guass's law – Maxwell's first law, div(D)=ρ_V Laplace's and Poison's equations andsolution of Laplace's equation in one variable	**Hours-10**
UNIT-II	
Conductors – Dielectrics and Capacitance Electric dipole – dipole moment – potential and EFI due to an electric dipole, Torque on an Electric dipole in an electric field conductors and Insulators – their behavior in electric field. Polarization, boundary conditions between conduction to dielectric and dielectric to dielectrics. Capacitance of parallel plates, spherical and coaxial cables with composite dielectrics, energy stored and energy density in a static electric field, current density, conduction and convection current densities, Ohm's law in point form – equation of continuity	**Hours-10**
UNIT-III	
Conductors – Dielectrics and Capacitance Electric dipole – dipole moment – potential and EFI due to an electric dipole, Torque on an Electric dipole in an electric field conductors and Insulators – their behavior in electric field. Polarization, boundary conditions between conduction to dielectric and dielectric to dielectrics. Capacitance of parallel plates, spherical and coaxial cables with composite dielectrics, energy stored and energy density in a static electric field, current density, conduction and convection current densities, Ohm's law in point form – equation of continuity	**Hours-10**

UNIT-IV	
Self and mutual inductance Self and mutual inductance – determination of self-inductance of a solenoid and toroid and mutual inductance between a straight long wire and a square loop wire in the same plane – energy stored and density in a magneticfield.	**Hours-10**
UNIT-V	
Time Varying Fields Time varying fields: Faraday's laws of electromagnetic induction – its integral and point forms, Maxwell's fourth equation, Curl (E)=-∂B/∂t, statically and dynamically induced EMF – simple problems, modification of Maxwell's equations for time varying fields, displacement current, Poynting theorem and Poynting vector.	**Hours-10**

OUTCOMES

The student should be able to

1. Determine electric fields and potentials using guass's law or solving laplace's or possion's equations, forvarious electric charge distributions.
2. Calculate and design capacitance, energy stored in dielectrics.
3. Calculate the magnetic field intensity due to current, the application of ampere's law and the maxwell'ssecond and third equations and determine the magnetic forces and torque produced by currents in magnetic field.
4. Determine self and mutual inductances and the energy stored in the magnetic field.
5. Calculate induced emf, understand the concepts of displacement current and poynting vector.

TEXT BOOKS:

1. Engineering Electromagnetics" by William H. Hayt& John. A. Buck
Mc. Graw-HillCompanies, 7th Editon.2006.

REFERENCES :

1. "Principles of Electro Magnetics" by Sadiku, Oxford Publications,4th edition
2. "Introduction to Electro Dynamics" by D J Griffiths, Prentice-Hall of India Pvt.Ltd, 2ndedition
3. "Electromagnetic Field Theory" by Yaduvir Singh,Pearson.
4. Fundamentals of Engineering Electromagnetics by Sunil Bhooshan, Oxford higher Education.

FUNDAMENTALS OF CONTROL SYSTEMS
(Minor Engineering Course)
SEMESTER IV

Course Code	**21EEEEM1003**	**IA Marks**	**30**
Number of Lecture Hours/Week	**3L+1T**	**Exam Marks**	**70**
Total Number of Lecture Hours	**60**	**Exam Hours**	**03**

Credits-04

COURSE OBJECTIVES:

The objective of this course is to acquire knowledge on

1. Mathematical modeling of physical systems and to use block diagram algebra and signal flow graph to determine overall transfer function
2. Time response of first and second order systems and improvement of performance by proportional plus derivative and proportional plus integral controllers and to investigate the stability of closed loop systems using Routh's stability criterion and the analysis by root locus method.
3. Frequency Response approaches for the analysis of linear time invariant (LTI) systems using Bode plots,polar plots and Nyquist stability criterion.
4. Basic aspects of design and compensation of linear control systems using Bode plots.
5. State models and analyze the systems and also to learn the concepts of Controllability and Observability.

UNIT-I	
Mathematical modeling of control systems Classification of control systems, open loop and closed loop control systems and their differences, Feedback characteristics, transfer function of linear system, differential equations of electrical networks, translational androtational mechanical systems, transfer function of DC servo motor – AC servo motor – synchro, transmitter and receiver – block diagram algebra – representation by signal flow graph – reduction using Mason's gain formula	**Hours-10**
UNIT-II	
Time response analysis Standard test signals – time response of first and second order systems – time domain specifications, steady state errors and error constants, effects of proportional (P), proportional-integral (PI), proportional-integral- derivative (PID) systems. Stability and root locus technique The concept of stability – Routh's stability criterion – limitations of Routh's stability, root locus concept –construction of root loci (simple problems), Effect of addition of Poles and zeros to the transfer function.	**Hours-10**
UNIT-III	
Frequency response analysis Introduction to frequency domain specifications – Bode diagrams – transfer function from the Bode diagram –phase margin and gain margin – stability analysis from Bode plots, Polar plots, Nyquist stability criterion.	**Hours-10**
UNIT-IV	
Classical control design techniques Lag, lead, lag-lead compensators, design of compensators using Bode plots.	**Hours-10**
UNIT-V	
State space analysis of LTI systems Concepts of state, state variables and state model, state space representation of transfer function, diagonalization, solving the time invariant state equations, State	**Hours-10**

Transition Matrix and it's Properties, conceptsof controllability and observability.	

OUTCOMES

The student should be able to

1. Derive the transfer function of physical systems and determination of overall transfer function usingblock diagram algebra and signal flow graphs.
2. Determine time response specifications of second order systems and absolute and relative stability of
3. LTI systems using Routh's stability criterion and the root locus method.
4. Analyze the stability of LTI systems using frequency response methods.
5. Represent physical systems as state models and determine the response. Understanding the concepts ofcontrollability and observability.

TEXT BOOKS:

1. Control Systems principles and design by M.Gopal, Tata McGraw Hill education Pvt Ltd., 4th Edition.
2. Automatic control systems by Benjamin C.Kuo, Prentice Hall of India, 2nd Edition.

REFERENCES :

1. Modern Control Engineering by Kotsuhiko Ogata, Prentice Hall of India.
2. Control Systems by ManikDhanesh N, Cengage publications.
3. Control Systems Engineering by I.J.Nagarath and M.Gopal, Newage International Publications, 5th Edition.
4. Control Systems Engineering by S.Palani, Tata McGraw Hill Publications.

Course Structure for III B. Tech I Semester Under the Regulations of SITE-21							
V SEMESTER							
S. No	**Course Category**	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	PC	21EEEET5010	Power Generation, Transmission & Distribution	3	0	0	3
2	PC	21EEEET5020	Power Electronics	3	0	0	3
3	PC	21EEEET5030	Control Systems	3	0	0	3
4	OE	21EEXXO504X	Open Elective-I	2	0	2	3
5	PE	21EEEEP505X	Professional Elective-I	3	0	0	3
6	PC LAB	21EEEEL5060	Power Systems –I Lab	0	0	3	1.5
7	PC LAB	21EEEEL5070	Power Electronics Lab	0	0	3	1.5
8	SAC/SC	21EEXXS5080	PDPC / Aptitude Builder - 1	1	0	2	2
9	MC	21EEEEN5090	Energy studies	2	0	0	0
10	SI	21EEEEI5010	Summer Internship (1-2 months) after second year to evaluate in V semester	0	0	0	1.5
TOTAL				**17**	**0**	**10**	**21.5**
11	H/M		Honor/Minor courses(The hours distribution can be 3-0-2 or 3-1-0)	4	0	0	4

Professional Elective – I

S. No	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	21EEEEP505A	Special Electrical Machines.	3	0	0	3
2	21EEEEP505B	Electrical Energy conservation & Auditing.	3	0	0	3
3	21EEEEP505C	Digital signal Processing	3	0	0	3

Open Electives offered by EEE department

S.No	Course Code	Subject title	L	T	P	C
1	21XXEEOM0XA	Control system design	3	0	0	3
2	21XXEEOM0XB	Digital Control Systems	3	0	0	3
3	21XXEEOM0XC	Intelligent control & its applications	3	0	0	3
4	21XXEEOM0XD	Digital Signal Processing	3	0	0	3
5	21XXEEOM0XE	Electrical and Hybrid Vehicles	3	0	0	3
6	21XXEEOM0XF	Industrial Electrical Systems	3	0	0	3
7	21XXEEOM0XG	Electrical materials	3	0	0	3
8	21XXEEOM0XH	Optimization techniques	3	0	0	3
9	21XXEEOM0XI	Wind and Solar Energy Systems	3	0	0	3

Course structure for Electrical & Electronics Engineering
Honors (for EEE Students)

III B. Tech I Semester:

S. No	Subject code	Name of the Subject	L	T	P	C
1	21EEEEH511A	Electrical Machine Design	3	1	0	4
2	21EEEEH511B	Utilization of Electrical Energy & Traction	3	1	0	4
3	21EEEEH511C	Solar and Advanced Energy Storage System	3	1	0	4
4	21EEEEH511D	Modern Control Systems	3	1	0	4

Course structure for Electrical & Electronics Engineering
Minors to other Departments

III B. Tech I Semester:

S. No	Subject code	Name of the Subject	L	T	P	C
1	21XXEEM511A	Fundamentals of Electrical Machines	3	1	0	4
2	21XXEEM511B	Fundamentals of Power Electronics	3	1	0	4
3	21XXEEM511C	Electrical Measurements & Instrumentation	3	1	0	4

Professional Core Course:

S. No	Course Category	Course Code	Course Title
1	PC	21EEEET5010	Power Generation, Transmission & Distribution
2	PC	21EEEET5020	Power Electronics
3	PC	21EEEET5030	Control Systems
5	PE	21EEEEP505X	Professional Elective-I
6	PC LAB	21EEEEL5060	Power Systems –I Lab
7	PC LAB	21EEEEL5070	Power Electronics Lab
8	SAC/SC	21EEXXS5080	PDPC/ Aptitude Builder - 1
9	MC	21EEEEN5090	Energy studies

POWER GENERATION, TRANSMISSION & DISTRIBUTION SEMESTER-V			
Subject Code	**21EEEET5010**	**IA Marks**	**30**
Number of Lecture Hours/Week	**3L**	**Exam Marks**	**70**
Total Number of Lecture Hours	**50**	**Exam Hours**	**03**
Credits-03			

Course Objectives:

This course will enable student to :

- Understand the concepts of electrical power generation by hydro, thermal and Nuclear power plants.
- Understand the concepts of electrical design of the overhead lines.
- Understand the concepts of mechanical design of the overhead lines.
- Understand the performance of the cables used in power transmission.
- Understand the basic concepts of distribution system.

Unit 1: Conventional Methods of Power Generation	**Hours-10**
Generation of electrical energy by conventional methods, Principle operation of Hydro Electric Generation: Classification of hydro plant, Selection of site, Plant layout. Principle operation of Thermal Power Generation: Block diagram of the plant. Boilers: working and classification. Principle of energy production by nuclear fission, schematic of nuclear power plant.	
Unit 2: Electrical Design of Overhead lines	**Hours-10**
Transmission line parameters: resistance, inductance and capacitance calculations - single phase and three phase lines, double circuit line, effect of earth on transmission line capacitance. **Performance of transmission lines:** representation of lines, classification of transmission lines, short transmission line, medium (Nominal-T, Nominal-π, End condenser method) length transmission line, long transmission line, evaluation of ABCD parameters, surge impedance and SIL of long lines.	
Unit 3: Mechanical Design of Overhead Lines	**Hours-10**
Sag and Tension calculations with equal and unequal heights of towers–Effect of Wind and Ice on weight of Conductor – Stringing chart and sag template and its applications. Types of Insulators – String efficiency and Methods for improvement - Voltage distribution–Calculation of string efficiency – Capacitance grading and Static Shielding.	
Unit 4: Underground Cables	**Hours-10**
Types of cables, construction, types of insulating materials, calculation of insulation resistance, stress in insulation and power factor of cable - Capacitance of single and 3-Core belted Cables. Grading of cables: capacitance grading and intersheath grading.	
Unit 5: Distribution Systems	**Hours-10**
Introduction to distribution systems - Distribution system losses – Coincidence factor – Contribution factor – loss factor – Relationship between the load factor and loss factor – Numerical Problems – Load Modeling and Characteristics – Classification and characteristics of loads (Residential - commercial - Agricultural and Industrial).Reactive power compensation	

Course outcomes:

On completion of the course student will be able to:

1. Illustrate various components of hydro, thermal and nuclear power generation.
2. Estimate various factors related to electrical design of the overhead lines.
3. Estimate various factors related to mechanical design of the overhead lines.
4. Discuss the types of cables and their capacitance calculations.
5. Discuss the basic definitions and concepts of distribution system.

Text Books:

4. A Text Book on Power System Engineering by M.L.Soni, P.V.Gupta, U.S. Bhatnagar and A. Chakrabarti, DhanpatRai& Co. Pvt. Ltd, 2016.
5. Generation, Distribution and Utilization of Electric Energy by C.L.Wadhawa, New age International (P) Limited, Publishers, 3 rd edition.
6. O. I. Elgerd, "Electric Energy Systems Theory", McGraw Hill Education.

Reference Books:

1. Elements of Electrical Power Station Design by M V Deshpande, PHI, New Delhi.
2. B. M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G. Strbac, " Electric Power Systems", Wiley.

POWER ELECTRONICS SEMESTER-V			
Subject Code	**21EEEET5020**	**IA Marks**	**30**
Number of Lecture Hours/week	**3L**	**Exam Marks**	**70**
Total Number of Lecture Hours	**45**	**Exam Hours**	**03**
Credits – 03			

Course Objectives:

This course will enable student:

1. To study the static and dynamic characteristics of SCR, Power MOSFET and Power IGBT.
2. To understand the operation of single-phase controlled rectifiers.
3. To study the operation of three phase-controlled converters for three pulse, six pulse and bridge configurations.
4. To understand the operation of different types of DC-DC converters and AC-AC Converters.
5. To study the operation of different types of DC-AC converters.

Unit-1: Power Semi-Conductor Devices	
Silicon controlled rectifier (SCR) – Two transistor analogy - Static and Dynamic characteristics – Turn on and Turn off Methods - Triggering Methods (R, RC and UJT) – Snubber circuit design. Static and Dynamic Characteristics of Power MOSFET and Power IGBT.	**Hours– 8**
Unit – 2: Single & Three Phase AC-DC Converters	
Single-phase half-wave controlled rectifiers - R and RL loads with and without freewheeling diode - Single-phase fully controlled mid-point and bridge converter with R load, RL load and RLE load - Effect of source inductance in Single-phase fully controlled bridge rectifier – Expression for output voltages – Single-phase Semi-Converter with R load-RL load and RLE load - Harmonic Analysis, Numerical Problems. Introduction to three phase converters – Three pulse and six pulse converters – Bridge configuration with R and RL loads - average load voltage – Dual converters (both single phase and three phase - Principle of operation only).	**Hours–10**
Unit – 3: DC-DC Converters	
DC-DC Converters - Introduction - Control Strategies, Buck converter, Boost Converter, Buck-Boost converter,	**Hours – 8**
Unit – 4: DC-AC Converters	
Introduction - Single phase and 3-phase bridge inverters with R and RL loads – 3-phase square wave inverters – 120^0 conduction and 180^0 conduction modes of operation – PWM inverters – Quasi-square wave pulse width modulation – Sinusoidal pulse width modulation –Voltage Source Inverter (VSI) – Current Source Inverter (CSI).	**Hours – 12**
Unit – 5: AC-AC Converters	
AC-AC Converters- Introduction - Single phase AC voltage controller with R and RL loads – modes of operation of TRIAC – TRIAC with R and RL loads – Derivation of RMS load voltage, current and input power factor. Cyclo converters (Principle of operation only).	**Hours – 7**

Course outcomes:

On completion of the course student will be able to:

1. Analyze the static and dynamic characteristics of SCR, Power MOSFET and Power IGBT.
2. Explain the operation of single-phase controlled rectifiers.
3. Explain the operation of three phase-controlled converters for three pulse, six pulse and bridge configurations.
4. Analyze the operation of different types of DC-DC and AC-AC converters.
5. Explain the operation of different types of DC-AC converters.

Text Books:

1. Power Electronics: Circuits, Devices and Applications – by M. H. Rashid, Pearson, 4th edition.
2. Power Electronics: Essentials & Applications by L.Umanand, Wiley, Pvt. Limited, India.

Reference Books:

1. Power Electronics – by Vedam Subramanyam, New Age International (P) Limited, Publishers.
2. Power Electronics – by V.R.Murthy , 1st edition OXFORD University Press.
3. Power Electronics – by P.S. Bhimbra, Khanna Publishers.
4. Power Electronics: converters, applications & design -by Nedmohan, Tore M. Undeland, Robbins by Wiley India Pvt. Ltd.

CONTROLSYSTEMS SEMESTER-V			
Subject Code	**21EEEET5030**	**IA Marks**	**30**
Number of Lecture Hours/Week	**3L**	**Exam Marks**	**70**
Total Number of Lecture Hours	**45**	**Exam Hours**	**03**
Credits-03			

COURSE OBJECTIVES:

This course will enable students :

1. To derive mathematical models related and also Transfer function to various physical systems.
2. To analyze the behavior of second order systems and determine error constants
3. To analyze the stability of systems using Frequency response methods
4. To design various compensators to improve the performance of systems
5. To able to determine controllability and Observability and STM of given system.

Unit -1: Mathematical Modeling of Control systems	**Hours-09**
Mathematical models of electrical and mechanical (translational and rotational) systems, Force-Voltage and Force-Current analogies. Transfer function models of linear time invariant systems.Feedback Control: Open Loop and Closed loop systems, Applications Benefits of Feedback. Block diagram algebra. Signal Flow Graph Mason's gain formula.	
Unit -2: Time Response Analysis	**Hours-09**
Standard test signals. Time response of first and second order systems for standard test inputs. Application of initial and final value theorem. Classification of errors and error constants. Design specifications for second order systems based on the time response. Concept of Stability. Routh-Hurwitz Criteria. Relative Stability analysis. Root Locus technique. Construction of Rootloci.	
Unit – 3: Frequency Response Analysis	**Hours-09**
Frequency domain specifications. Relationship between time and frequency response, Bode plots, Polar plots, Nyquist stability criterion. Relative stability using Nyquist criterion.	
Unit – 4: Control System Design	**Hours-09**
Introduction to P,PI,PID controllers, design of Lag , Lead and Lag Lead compensator using Bode Plot approach, Effects of addition of poles and zeros on stability.	
Unit – 5: State Space Analysis	**Hours-09**
Concepts of state variables. State space model. Canonical forms of State Matrix. Solution of state equations, State transition matrix. Eigen values and Stability Analysis. Concept of controllability and observability.	

COURSE OUTCOMES:

On completion of the course student will be able to:

1. Derive transfer function of different physical Systems.
2. Analyze the behavior of second order system with time domain specifications.
3. Compute Stability of LTI system using Bode Plot, Nyquist plot and polar plot.
4. Analyze the different controllers
5. Determine controllability and Observability and STM of given system.

TEXTBOOKS:

1. B.C.Kuo,"AutomaticControlSystem",PrenticeHall..
2. K.Ogata,"ModernControlEngineering",PrenticeHall.
   I.J.NagrathandM.Gopal,"ControlSystemsEngineering",NewAgeInternational.

REFERENCE BOOKS:

1. ControlSystemsbyN.K.Sinha,NewAgeInternational(P)LimitedPublishers,3rdEdition.

2.Controlsystems–byA.Nagoorkani,CBSpublications

3. Problems&solutionsincontrolsystems–byA.K.Jairath.

POWER SYSTEMS LAB

SEMESTER-V

Subject Code	**21EEEEL5050**	**1A-Marks**	**15**
Number of Practice Hours/Week	**3P**	**Exam-Marks**	**35**
Total Number of Practice Hours	**36**	**Exam-Hours**	**03**

Credits- 1.5

COURSE-OBJECTIVES:

This course will enable student to :

1. Understand the concepts of electrical design of the overhead lines.
2. Understand the concepts of mechanical design of the overhead lines.
3. Understand the concepts of Power angle characteristics.
4. Understand the Characteristics solar PV array.
5. Understand the Measurement of earth resistance.

List-of-Experiments-(Any-ten-experiments-must-be-conducted)

1. Transmission line parameter calculations (inductance & capacitance)
2. ABCD parameters of Transmission line.
3. Characteristics of transmission line with open & short circuit termination
4. Power angle characteristics of a salient pole synchronous machine.
5. Study of different types of insulators
6. Voltage distribution across the string insulator
7. Determination of string efficiency using longer cross arm method.
8. Determination of string efficiency using guard ring method.
9. Characteristics solar PV array.
10. Determination of breakdown strength of transformer oil
11. Measurement of earth resistance by earth tester

COURSE-OUTCOMES:

On completion of the course student will be able to:

1. Estimate various factors related to electrical design of the overhead lines
2. Estimate various factors related to mechanical design of the overhead lines.
3. Analyze the Power angle characteristics of a salient pole synchronous machine.
4. Analyze the Characteristics solar PV array.
5. Estimate the earth resistance by earth tester.

POWER ELECTRONICS LAB SEMESTER-V			
Subject-Code-	**21EEEET5060**	**1A-Marks**	**15**
Number-of-Practice--Hours/Week	**3P**	**Exam-Marks**	**35**
Total-Number-of-Practice-Hours	**36**	**Exam-Hours**	**03**
Credits-1.5			

LAB-OBJECTIVES:

1. To study the characteristics of various power electronic devices and analyze firing circuits and commutation circuits of SCR.
2. To analyze the performance of single–phase-controlled rectifiers with resistive and inductive loads.
3. To analyze the performance of three–phase-controlled rectifiers with resistive and inductive loads.
4. To understand the working of Buck, Boost and Buck boost converters.
5. To understand the operation of AC voltage regulator with resistive and inductive loads.

List-of-Experiments-(Any-ten-experiments-must-be-conducted)

1. Study of Characteristics of Thyristor, MOSFET & IGBT.
2. Single Phase Half controlled converter with R and RL load
3. Single Phase fully controlled bridge converter with R and RL loads
4. Three Phase fully controlled converter with RL–load.
5. Single Phase AC Voltage Regulator with R and RL Loads
6. Three Phase AC-AC voltage regulator with R-load.
7. Single phase PWM inverter with sine triangle PWM technique.
8. Single Phase square wave bridge inverter with R and RL Loads
9. Design and development of a firing circuit for Thyristor.
10. Design and development of gate drive circuits for IGBT.
11. Design and verification of voltages gain of Boost converter in Continuous Conduction Mode (CCM) and Discontinuous Conduction Mode (DCM).

LAB-OUTCOMES:

Students will be able to:

1. Explain the characteristics of various power electronic devices and design the gate drive circuits of SCR, IGBT and MOSFET.
2. Analyze the performance of single–phase-controlled rectifiers with resistive and inductive loads.
3. Analyze the performance of three–phase-controlled rectifiers with resistive and inductive loads.
4. Design and control the voltage ripple of Buck converter and Boost converter in CCM and DCM.
5. Explain the operation of AC voltage regulators with resistive and inductive loads.

ENERGY STUDIES SEMESTER-V			
Subject Code	**21EEEEN5090**	**IA Marks**	**30**
Number of Lecture Hours/Week	**3L**	**Exam Marks**	**70**
Total Number of Lecture Hours	**45**	**Exam Hours**	**03**
Credits-04			

Course Objectives:

This course will enable students :

1.To study energy conservation
2. To study Solar, Nuclear, Geothermal, Tide and Wind Energies.
3.To study Role of energy in economic development
4.To study Indian Energy Scenario
5. To study Energy policy issues at global level

Unit -1: Energy Sources Fossil fuels, hydro, solar, tide, wind and bio fuels in India, Nuclear energy through fission and fusion processes.	**Hours – 05**
Unit – 2: Energy Conversion Energy conversion from source to utility, hydro, solar, tide, wind and bio fuels in India, Nuclear energies.	**Hours – 10**
Unit – 3: Global Energy Scenario Role of energy in economic development and social transformation, Overall energy demand, availability and consumption, Depletion of energy resources and its impact on economy, Nonproliferation of nuclear energy. International energy policies of G-8, G-20, OPEC and European union countries.	**Hours – 10**
Unit – 4: Indian Energy Scenario Commercial and noncommercial forms of energy, Utilization pattern in the past, present and also future prediction, Sector wise energy consumption.	**Hours – 10**
Unit – 5: Energy Policy Energy policy issues at global level, national level and state level, Electricity act 2003,Electricity amendment act. Energy pricing and its impact on global	**Hours – 10**

Course outcomes:

On completion of this course, students are able to

1.Understand the energy conservation
2. Understand the Solar, Nuclear,Geothermal, Tide and Wind Energies.
3. Understand the Role of energy in economic development
4. Understand the Indian Energy Scenario
5. Understand the Energy policy issues at global level

Text Books:

1. Jose Goldenberg, Thomas Johanson, and Reddy, A.K.N., Energy for Sustainable World, WileyEastern.
2. Charles E. Brown, World Energy Resources, Springer Publication, New York.
3. Culp, A.W., Principles of Energy Conversion, McGraw Hill New York.

Reference Books:

1. Bukhootsow, B., Energy Policy and Planning, Prentice Hall of India, New Delhi.
2. TEDDY Year Book, The Energy Research Institute (TERI).
3. International Energy Outlook, EIA Annual Publication.

Professional Elective – I

S. No	**Course Code**	**Course Title**
1	21EEEEP505A	Special Electrical Machines.
2	21EEEEP505B	Electrical Energy conservation & Auditing.
3	21EEEEP505C	Digital signal Processing

SPECIAL ELECTRICAL MACHINES SEMESTER-V			
Subject Code	**21EEEEP505A**	**IA Marks**	**30**
Number of Lecture Hours/week	**3L**	**Exam Marks**	**70**
Total Number of Lecture Hours	**45**	**Exam Hours**	**03**
Credits – 03			

Course Objectives:

The objectives of this course is to acquire knowledge on the

1. Properties of magnetic materials and the operation of PMDC motors.
2. Performance and control of stepper motors and their applications.
3. Theory of operation and control of switched reluctance motor.
4. Characteristics and performance of PM BLDC motors.
5. Principle of operation of linear induction motor

Unit-1: Introduction of PMDC motors	**Hours –08**
Introduction-Classification of permanent magnet materials used in electrical machines-minor hysteresis loop and recoil line-Stator frames of conventional dc machines- Permanent-magnet materials and characteristics-B-H loop and demagnetization characteristics.	
Unit – 2: Stepper Motors	**Hours –08**
Classification of stepper motors –Variable Reluctance Motor (VRM) - Construction and principle of hybrid type synchronous stepper motor – Different configuration for switching the phase windings control circuits for stepper motors – Open loop and closed loop control of 2-phase hybrid stepping motor. Construction and principle of operation of VRM – Single stack and multiple stack – Open loop control of 3- phase VR Stepper Motor- Applications	
Unit – 3: Switched Reluctance Motors	**Hours –09**
Construction – Comparison of conventional and switched reluctance motors(SRM) – Design of stator and rotor pole arcs – Torque producing principle and torque expression – Different converter configurations for SRM – Drive and power circuits for SRM – Position sensing of rotor – Applications of SRM	
Unit – 4: Permanent Magnet Brushless DC Motor	**Hours –12**
Types of constructions – Surface mounted and interior type permanent magnet – Principle of operation of BLDC motor. Torque and EMF equations of square permanent magnet brushless motor – Torque speed characteristics – Performance and efficiency- Square wave brushless motors with 120^0 and 180^0 conduction. Torque and EMF equations of sine wave permanent magnet brushless motor – Phasor Diagram – Circle diagram – Torque/speed characteristics – Applications.	
Unit – 5: Linear Induction Motors	**Hours –08**
Construction– principle of operation–Double sided Linear Induction Motors **(**LIM) from rotating type Induction Motor – Schematic of LIM drive for traction – Development of one-sided LIM with back iron- equivalent circuit of LIM.	

Course Outcomes:

The students should be able to:

1. Acquire knowledge on the characteristics and application of PMDC motors.
2. Explore different types, construction and principle of operation of different types of stepper motors and their applications.
3. Explain theory of operation of switched reluctance motor and its control.
4. Aanalyze the performance of PMBLDC motors.
5. Explain the operation of linear induction motor drive for traction purpose.

Text Books:

1. Brushless Permanent magnet and reluctance motor drives, Clarenden press, T.J.E. Miller,Oxford.
2. Special electrical Machines, K.VenkataRatnam, University press, New Delhi.

Reference Books:

1. Special electrical machines, E.G. Janardhanan, PHI learning private limited.

ELECTRICAL ENERGY CONSERVATION AND AUDITING SEMESTER-V			
Subject Code	**21EEEEP505B**	**IA Marks**	**30**
Number of Lecture Hours/week	**3L**	**Exam Marks**	**70**
Total Number of Lecture Hours	**45**	**Exam Hours**	**03**
Credits-03			

Course Objectives:

This course enable student to:

1. To understand energy efficiency, scope, conservation and technologies.
2. To design energy efficient lighting systems.
3. To estimate/calculate power factor of systems and propose suitable compensation techniques and to understand the working of Energy Instruments.
4. To understand energy conservation in HVACsystems.
5. To calculate life cycle costing analysis and return on investment on energy efficient technologies.

Unit-1: Basic Principles of Energy Audit and management Energy audit – Definitions – Concept – Types of audit – Energy index – Cost index – Pie charts –Sankey diagrams – Load profiles – Energy conservation schemes and energy saving potential – Numerical problems – Principles of energy management – Initiating, planning, controlling, promoting, monitoring, reporting – Energy manager – Qualities and functions – Language – Questionnaire – Check list for top management.	**Hours – 08**
Unit – 2: Lighting Modification of existing systems – Replacement of existing systems – Priorities**:** Definition of terms and units – Luminous efficiency – Polar curve – Calculation of illumination level – Illumination of inclined surface to beam – Luminance or brightness – Types of lamps – Types of lighting – Electric lighting fittings (luminaries) – Flood lighting – White light LED and conducting Polymers – Energy conservation measures.	**Hours – 10**
Unit – 3: Power Factor and energy instruments Power factor – Methods of improvement – Location of capacitors – Power factor with non linear loads – Effect of harmonics on Power factor – Numerical problems. Energy Instruments – Watt–hour meter – Data loggers –Thermocouples – Pyrometers – Lux meters – Tong testers – Power analyzer.	**Hours – 10**
Unit – 4: Space Heating and Ventilation Ventilation -Air-Conditioning (HVAC) and Water Heating**:** Introduction, Heating of buildings -Transfer of Heat–Space heating methods -Ventilation and air–conditioning- Insulation-Cooling load -Electric water heating systems-Energy conservation methods.	**Hours – 08**

Unit – 5: Computation of Economic Aspects and Financial Analysis	**Hours – 9**
Understanding energy cost, Economics Analysis – Depreciation Methods – Time value of money – Rate of return – Present worth method – Replacement analysis – Life cycle costing analysis – Energy efficient motors (basic concepts) – Economics of energy efficient motors and systems. Need of investment, appraisal and criteria, Calculation of simple payback period–Return on investment – Net present value – Internal rate of return – numerical examples Applications of life cycle costing analysis – Return on investment –Numerical examples.	

Course outcomes:

On completion of the course student will be able to:

1. Explain energy efficiency, conservation and various technologies
2. Design energy efficient lighting system
3. Calculate power factor of systems and propose suitable compensation techniques and also able to explain the working of Energy Instruments.
4. Explain energy conservation techniques in HVAC Systems
5. Calculate life cycle costing analysis and return on investment on energy efficiency technologies

Text Books:

1. Hand Book of Energy Audit by Sonal Desai- Tata McGrawhill
2. Energyefficient electricmotorsbyJohn .C. Andreas,Marcel DekkerIncLtd–2nd edition.

ReferenceBooks:

1. Energy management by W.R. Murphy & G. Mckay Butter worth,Elsevier publications.
2. Electric Energy Utilization and Conservation by S C Tripathy, Tata McGraw hill publishing company Ltd. NewDelhi.
3. Energy management by Paul o' Callaghan, Mc–Graw Hill Book company–1st edition.

. Energy management hand book by W.C.Turner, John wiley andsons.

5. Energy management and conservation –k v Sharma and pvenkataseshaiah-I K International Publishing Housepvt.ltd.
6. http://www.energymanagertraining.com/download/Gazette_of_IndiaPartIISecI- 37_25-08-2010.pdf

DIGITAL SIGNAL PROCESSING SEMESTER-V			
Subject Code	**21EEEEP505C**	**IA Marks**	**30**
Number of Lecture Hours/week	**3L**	**Exam Marks**	**70**
Total Number of Lecture Hours	**45**	**Exam Hours**	**03**
Credits – 03			

Course Objectives:

This course will enable student to :

1. A good understanding of the fundamentals of discrete-time signals and systems.
2. Familiarity with techniques of analysis of discrete-time signals and the use of Z-transforms.
3. Knowledge of spectral properties of discrete-time systems through the use of Discrete Fourier transform (FFT) of sequences.
4. Skills in the design of digital filters.
5. Understanding of Applications of Digital Signal Processing

Unit-1: Discrete-time signals and systems	
Discrete time signals and systems: Sequences; representation of signals on orthogonal basis; Representation of discrete systems using difference equations, Sampling and reconstruction of signals - aliasing; Sampling theorem and Nyquist rate.	**Hours –08**
Unit – 2: Z-transform	
z-Transform, Region of Convergence, Analysis of Linear Shift Invariant systems using z- transform, Properties of z-transform for causal signals, Interpretation of stability in z-domain, Inverse z-transforms.	**Hours –08**
Unit – 3: Discrete Fourier Transform	
Frequency Domain Analysis, Discrete Fourier Transform (DFT), Properties of DFT, Convolution of signals, Fast Fourier Transform Algorithm, Parseval's Identity, Implementation of Discrete Time Systems.	**Hours –09**
Unit – 4: Design of Digital filters	
Design of FIR Digital filters: Window method, Park-McClellan's method. Design of IIR Digital Filters: Butterworth, Chebyshev and Elliptic Approximations; Low-pass, Band-pass, Band- stop and High-pass filters. Effect of finite register length in FIR filter design. Parametric and non-parametric spectral estimation. Introduction to multi-rate signal processing.	**Hours –12**
Unit – 5: Applications of Digital Signal Processing	
Correlation Functions and Power Spectra, Stationary Processes, Optimal filtering using ARMA Model, Linear Mean-Square Estimation, Wiener Filter.	**Hours –08**

Course outcomes:

On completion of the course student will be able to:

1. Represent signals and systems mathematically discrete-time without aliasing
2. Analyse discrete-time systems using z-transform.
3. Apply the Discrete-Fourier Transform (DFT) and the FFT algorithms.
4. Design digital filters for various applications.
5. Apply digital signal processing for the analysis of real-life signals

Text Books:

1. S.K.Mitra, "Digital Signal Processing: A computer based approach",Mc GrawHill.
2. A.V.Oppenheim and R.W.Schafer, "Discrete Time Signal Processing",Prentice Hall.
3. J.G.Proakis and D.G. Manolakis, "Digital Signal Processing: Principles,Algorithms And Applications", Prentice Hall.
4. L.R. Rabiner and B.Gold, "Theory and Application of Digital Signal Processing" , Prentice Hall.

Reference Books:

1. J. R.Johnson, "Introduction to Digital Signal Processing", PrenticeHall.
2. D.J.DeFatta ,J.G.Lucas and W.S.Hodgkiss," Digital Signal Processing" , JohnWiley & Sons.
3. Andreas Antoniou, **"Digital Signal Processing",** TATA McGraw Hill.
4. Robert J. Schilling, Sandra L. Harris, **"Fundamentals of Digital Signal Processing using Matlab",**Thomson.

Open Electives offered by EEE department

S.No	Course Code	Subject title
1	21XXEEOM0XA	Control system design
2	21XXEEOM0XB	Digital Control Systems
3	21XXEEOM0XC	Intelligent control & its applications
4	21XXEEOM0XD	Digital Signal Processing
5	21XXEEOM0XE	Electrical and Hybrid Vehicles
6	21XXEEOM0XF	Industrial Electrical Systems
7	21XXEEOM0XG	Electrical materials
8	21XXEEOM0XH	Optimization techniques
9	21XXEEOM0XI	Wind and Solar Energy Systems

CONTROL SYSTEM DESIGN			
Subject Code	**21XXEEOM0XA**	**IA Marks**	30
Number of Lecture Hours/week	**3L**	**Exam Marks**	70
Total Number of Lecture Hours	**45**	**Exam Hours**	03
Credits – 03			

Course Objectives:

This course will enable student to :

1. Know the design of compensator for both time and frequency domain specifications.
2. Know the design of various controllers.
3. Understand the concept on feed-forward control.
4. Enhance the knowledge of design using state space
5. Understand the methods of solving Non-linear system of equations.

Unit – 1: Design Specifications	
Introduction to time domain and frequency domain design specification and its physical relevance. Effect of gain on transient and steady state response. Effect of addition of pole on system performance. Effect of addition of zero on system response.	**Hours-10**
Unit – 2: Design of Classical Control System	
Introduction of compensator. Design of Feedback and Feed forward compensators, Feedback compensation. Compensator design in frequency domain to improve steady state and transient response.	**Hours-09**
Unit – 3: Design of PID controllers	
Design of P, PI, PD and PID controllers in time domain and frequency domain for first, second and third order systems.	**Hours-08**
Unit – 4: Control System Design in state space	
Review of state space representation. Concept of controllability & observability, effect of pole zero cancellation on the controllability & observability of the system, pole placement design through state feedback.	**Hours-09**
Unit – 5: Design of control for Non Linear Systems	
Introduction, Methods of solving Non-linear systems of equations. Pseudo-composition, weight function procedure, Technique for extending scalar methods to the multidimensional case in a nontrivial way	**Hours-09**

Course outcomes:

On completion of the course student will be able to:

1. Know the basic design in both time and frequency domain
2. Understand the concepts of PID controllers
3. Enhance the knowledge of design using state space
4. Enumerate the basic concepts of nonlinearities and their performance
5. Understand the concepts of singular points and performance of system

Text Books:

1. N.Nise, “Control system Engineering”, John Wiley.
2. I.J.Nagrath and M.Gopal, “Control system Engineering”, Wiley.
3. M.Gopal, “Digital Control Engineering”, Wiley Eastern.
4. K.Ogata, “Modern Control Engineering”, Prentice Hall.

Reference Books:

1. B. C. Kuo, " Automatic Control system", Prentice Hall.
2. J. J. D'Azzo and C. H. Houpis, " Linear control system analysis and design (conventional and modern)" , McGraw Hill.
3. R. T. Stefani and G. H. Hostetter, "Design of feedback Control Systems", Saunders College Pub.

DIGITAL CONTROL SYSTEMS			
Subject Code	**21XXEEOM0XB**	**IA Marks**	**30**
Number of Lecture Hours/week	**3L**	**Exam Marks**	**70**
Total Number of Lecture Hours	**45**	**Exam Hours**	**03**
Credits – 03			

Course Objectives:

This course will enable student to :

1. Obtain discrete representation of LTI systems.
2. Analyze and find the solutions for discrete-time systems.
3. Design and analyze digital controllers.
4. Design state feedback and output feedback controllers.
5. Analyze the concepts of feedback control and basic concepts of fast output sampling

Unit – 1: Discrete Representation of Continuous Systems	**Hours-10**
Basics of Digital Control Systems. Discrete representation of continuous systems. Sample and hold circuit. Mathematical Modeling of sample and hold circuit. ZOH equivalent.	
Unit – 2: Discrete System Analysis	**Hours-09**
Z-Transform and Inverse Z Transform for analyzing discrete time systems. Pulse Transfer function. Pulse transfer function of closed loop systems. Mapping from s-plane to z plane. Time response of discrete time system.	
Unit – 3: Stability of Discrete Time System	**Hours-08**
Stability analysis by Jury test. Stability analysis using bilinear transformation. Design of digital control system with dead beat response. State space models of discrete systems, State space analysis. Controllability, Reachability, Reconstructability and observability analysis.	
Unit – 4: Design of Digital Control System	**Hours-09**
Design of discrete PID Controller, Design of discrete state feedback controller. Design of Discrete Observer, full order and reduced order for LTI System.	
Unit – 5: Discrete output feedback control	**Hours-09**
Design of discrete output feedback control. Fast output sampling (FOS) and Periodic output feedback controller design for discrete time systems.	

Course outcomes:

On completion of the course student will be able to:

1. Know the basic of discrete representation of LTI systems.
2. Understand stability of open loop and closed loop discrete-time systems.
3. Enhance the knowledge of design and analyze digital controllers.
4. Enumerate the basic design of state feedback and output feedback controllers.
5. Analyze the concepts of feedback control and basic concepts of fast output sampling

Text Books:

1. K.Ogata,"Digital Control Engineering", Prentice Hall,EnglewoodCliffs.
2. B.C.Kuo,"DigitalControlSystem",Holt,RinehartandWinston..

Reference Books:

1. G. F. Franklin, J. D. Powell and M. L. Workman, " Digital Control of Dynamic Systems", Addison-Wesley.
2. M.Gopal,"DigitalControlEngineering",WileyEastern.

INTELLIGENT CONTROL & ITS APPLICATIONS			
Subject Code	**21XXEEOM0XC**	**IA Marks**	**30**
Number of Lecture Hours/week	**3L**	**Exam Marks**	**70**
Total Number of Lecture Hours	**45**	**Exam Hours**	**03**
Credits – 03			

Course Objectives:

This course will enable student to :

1. Understand the basic intelligent controller concept
2. Understand concepts of feed forward neural networks and learning and understanding of feedback neural networks.
3. Understand and analyze the concept of genetic algorithm.
4. Understand the knowledge of fuzzy logic control.
5. Apply the knowledge of fuzzy logic control, genetic algorithm and neural network to the real problems.

Unit-1: Introduction to Intelligent Control	
Introduction and motivation. Approaches to intelligent control. Architecture for intelligent control. Symbolic reasoning system, rule-based systems, the AI approach. Knowledge representation. Expert systems.	**Hours – 08**
Unit – 2: Artificial Neural Networks	**Hours – 12**
Concept of Artificial Neural Networks, its basic mathematical model, McCulloch-Pitts neuron model, simple perceptron, Adaline and Madaline, Feed-forward Multilayer Perceptron. Learning and Training the neural network. Introduction, derivation, algorithm, flowchart, limitation-Error Back propagation, Hopefield, Radial bases function	
Unit – 3: Genetic Algorithm	**Hours – 08**
Basic concept of Genetic algorithm and detail algorithmic steps, adjustment of free parameters. Solution of typical control problems using genetic algorithm. Concept on some other search techniques like tabu search and ant-colony search techniques for solving optimization problems	
Unit – 4: Fuzzy Logic System	**Hours – 08**
Introduction to crisp sets and fuzzy sets, basic fuzzy set operation and approximate reasoning. Introduction to fuzzy logic modeling and control. Fuzzification, inferencing and defuzzification. Fuzzy knowledge and rule bases. Fuzzy modeling and control schemes for nonlinear systems. Fuzzy logic control for nonlinear time-delay system. Implementation of fuzzy logic controller.	
Unit – 5: Applications	**Hours – 09**
Industrial applications to Genetic Algorithm, Neural Network and Fuzzy Logic Control- case studies	

Course outcomes:

On completion of the course student will be :

1. Able to identify knowledge representations applied to artificial intelligence techniques
2. Able to model artificial neuron and identify its use in Perceptron models and back propagation algorithm to multilayer feed forward networks
3. Able to analyze concept of genetic algorithm.
4. Able to analyze fuzzy logic controller using MATLAB.
5. Able to analyze various applications of neural and fuzzy logic systems in electrical Engineering

Text Books:

1. Simon Haykins, Neural Networks: A comprehensive Foundation, Pearson Edition.
2. T.J. Ross, Fuzzy logic with Fuzzy Applications, McGraw Hill Inc.
3. David E Goldberg, Genetic Algorithms. Wesley Publishing Company.
4. John Yen and Reza Langari, Fuzzy logic Intelligence, Control, and Information, PearsonEducation, Indian Edition.
5. Neural Network, Fuzzy Logic and Genetic Algorithm : Synthesis and Applications S. Rajasekaran and G. A. Vijayalakshmi Pai.

Reference Books:

1. M.T. Hagan, H. B. Demuth and M. Beale, Neural Network Design, Indian reprint.
2. Fredric M. Ham and IvicaKostanic, Principles of Neuro computing for science andEngineering, McGraw Hill.
3. N. K. Bose and P. Liang, Neural Network Fundamentals with Graphs, Algorithms, andApplications, Mc, Graw Hill, Inc.
4. Yung C. Shin and ChengyingXu, Intelligent System, Modeling, Optimization and Control,CRC Press.
5. N. K. Sinha and Madan M Gupta, Soft computing & Intelligent Systems, Theory &Applications, Indian Edition, Elsevier.
6. WitoldPedrycz, Fuzzy Control and Fuzzy Systems, Overseas Press, Indian Edition.

DIGITAL SIGNAL PROCESSING			
Subject Code	**21XXEEOM0XD**	**IA Marks**	**30**
Number of Lecture Hours/week	**3L**	**Exam Marks**	**70**
Total Number of Lecture Hours	**45**	**Exam Hours**	**03**
Credits – 03			

Course Objectives:

This course will enable student to :

1. A good understanding of the fundamentals of discrete-time signals and systems.
2. Familiarity with techniques of analysis of discrete-time signals and the use of Z-transforms.
3. Knowledge of spectral properties of discrete-time systems through the use of Discrete Fourier transform (FFT) of sequences.
4. Skills in the design of digital filters.
5. Understanding of Applications of Digital Signal Processing

Unit-1: Discrete-time signals and systems	
Discrete time signals and systems: Sequences; representation of signals on orthogonal basis; Representation of discrete systems using difference equations, Sampling and reconstruction of signals - aliasing; Sampling theorem and Nyquist rate.	**Hours –08**
Unit – 2: Z-transform	**Hours –08**
z-Transform, Region of Convergence, Analysis of Linear Shift Invariant systems using z- transform, Properties of z-transform for causal signals, Interpretation of stability in z-domain, Inverse z-transforms.	
Unit – 3: Discrete Fourier Transform	**Hours –09**
Frequency Domain Analysis, Discrete Fourier Transform (DFT), Properties of DFT, Convolution of signals, Fast Fourier Transform Algorithm, Parseval's Identity, Implementation of Discrete Time Systems.	
Unit – 4: Design of Digital filters	**Hours –12**
Design of FIR Digital filters: Window method, Park-McClellan's method. Design of IIR Digital Filters: Butterworth, Chebyshev and Elliptic Approximations; Low-pass, Band-pass, Band- stop and High-pass filters. Effect of finite register length in FIR filter design.	
Unit – 5: Applications of Digital Signal Processing	
Correlation Functions and Power Spectra, Stationary Processes, Optimalfiltering using ARMA Model, Linear Mean-Square Estimation, Wiener Filter.	**Hours –08**

Course outcomes:

On completion of the course student will be able to:

1. Represent signals and systems mathematically discrete-time without aliasing
2. Analyse discrete-time systems using z-transform.
3. Apply the Discrete-Fourier Transform (DFT) and the FFT algorithms.
4. Design digital filters for various applications.
5. Apply digital signal processing for the analysis of real-life signals

Text Books:

1. S.K.Mitra, "Digital Signal Processing: A computer based approach",Mc Graw Hill.
2. A.V.Oppenheim and R.W.Schafer, "Discrete Time Signal Processing", Prentice Hall.
3. J.G.Proakis and D.G. Manolakis, "Digital Signal Processing: Principles, Algorithms And Applications", Prentice Hall.
4. L.R. Rabiner and B.Gold, "Theory and Application of Digital Signal Processing" , Prentice Hall.

Reference Books:

1. J. R.Johnson, "Introduction to Digital Signal Processing", PrenticeHall,.
2. D.J.DeFatta ,J.G.Lucas and W.S.Hodgkiss," Digital Signal Processing" , John Wiley & Sons.
3. Andreas Antoniou, **"Digital Signal Processing",** TATA McGraw Hill .
4. Robert J. Schilling, Sandra L. Harris, **"Fundamentals of Digital Signal Processing using Matlab",**Thomson.

ELECTRICAL & HYBRID VEHICLES			
Subject Code	**21XXEEOM0XE**	**IA Marks**	**30**
Number of Lecture Hours/Week	**3L**	**Exam Marks**	**70**
Total Number of Lecture Hours	**45**	**Exam Hours**	**03**
Credits-03			

Course Objectives:

This course will enable student to :

1. Explain working of hybrid and electric vehicles, its performance and characteristics.
2. Discuss hybrid vehicle configuration and its components.
3. Explain electric vehicle drive systems.
4. Discuss the properties of energy storage systems.
5. Compare different Energy management strategies

Unit 1: Introduction	
Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics, and mathematical models to describe vehicle performance. Hybrid Electric Vehicles: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles.	**Hours-8**
Unit 2: Hybrid Electric Drive Trains	
Architecture of Hybrid Electric Vehicles (HEV), analysis of drive trains, energy use in conventional vehicles, energy saving potential of hybrid drive trains, various HEV configurations and their operation model. Power flow in HEV: Power flow control in series, parallel, series-parallel hybrid system.	**Hours-10**
Unit 3: Electric Drive Trains	
Architecture of electric drive train, electric vehicle configuration, electric drive trains, EV power source configurations. Single and Multi-Motor drives, In wheel drives, requirements of different electric motors used in EVs, Power-Torque-Speed characteristics, electric propulsion systems.	**Hours-7**
Unit 4: Energy Storage	
Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices.	**Hours-10**
Unit 5: Energy Management Strategies	
Introduction to energy management strategies used in hybrid and electric vehicles, classification, comparison of different energy management strategies, implementation issues of energy management strategies. Functions of control system in HEVs & EVs, Elementary control theory, Electronic control unit, control area network, control variables, classifications of Hybrid electronic control unit, fuzzy logic based control system.	**Hours-10**

Course outcomes:

On completion of the course student will be able to:

1. Illustrate the working of hybrid and electric vehicles, its performance and characteristics.
2. Analyze hybrid vehicle configuration and its components.
3. Discuss electric vehicle drive systems and Illustrate electric propulsion systems.
4. Infer the properties of energy storage systems.
5. Distinguish different energy management strategies.

Text Books:

1. C. Mi, M. A. Masrur and D. W. Gao, "Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives", John Wiley & Sons.
2. S. Onori, L. Serrao and G. Rizzoni, "Hybrid Electric Vehicles: Energy Management Strategies", Springer.

Reference Books:

1. M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design", CRC Press.
2. T. Denton, "Electric and Hybrid Vehicles", Routledge.

INDUSTRIAL ELECTRICAL SYSTEMS			
Subject Code	**21XXEEOM0XF**	**IA Marks**	**30**
Number of Lecture Hours/week	**3L**	**Exam Marks**	**70**
Total Number of Lecture Hours	**45**	**Exam Hours**	**03**
Credits – 03			

Course Objectives:

This course will enable student to :

1. Understand the electrical wiring systems components.
2. Understand requirements for industrial consumers and commercial systems.
3. Understand concepts in Illumination.
4. Understand various components of industrial electrical systems.
5. Analyze and select the proper size of various electrical system components.

Unit-1: Electrical System Components	
LT system wiring components, selection of cables, wires, switches, distribution box, metering system, Tariff structure, protection components- Fuse, MCB, MCCB, ELCB, inverse current characteristics, symbols, single line diagram (SLD) of a wiring system, Contactor, Isolator, Relays, MPCB, Electric shock and Electrical safety practices	**Hours – 10**
Unit – 2: Residential and Commercial Electrical Systems	**Hours – 10**
Types of residential and commercial wiring systems, general rules and guidelines for installation, load calculation and sizing of wire, rating of main switch, distribution board and protection devices, earthing system calculations, requirements of commercial installation, deciding lighting scheme and number of lamps.	
Unit – 3: Illumination Systems	**Hours – 08**
Understanding various terms regarding light, lumen, intensity, candle power, lamp efficiency, specific consumption, glare, space to height ratio, waste light factor, depreciation factor, various illumination schemes, Incandescent lamps and modern luminaries like CFL, LED and their operation, energy saving in illumination systems.	
Unit – 4: Industrial Electrical Systems-I	**Hours – 10**
HT connection, industrial substation, Transformer selection, Industrial loads, motors, starting of motors, SLD, Cable and Switchgear selection, Lightning Protection, Earthing design, Power factor correction – kVAR calculations, type of compensation, Introduction to PCC, MCC panels. Specifications of LT Breakers, MCB and other LT panel components.	
Unit – 5: Industrial Electrical Systems-II	**Hours – 07**
DG Systems, UPS System, Electrical Systems for the elevators, Battery banks, Sizing the DG, UPS and Battery Banks, Selection of UPS and Battery Banks.	

Course outcomes:

On completion of the course student will be able to:

1. Acquire Knowledge on Tariff structure and protection components.
2. Understand various types wiring systems and IE rules.
3. Evaluate the Illumination technology.
4. Understand various types of cables.
5. Acquire Knowledge on UPS systems.

Text Books:

1. S. L. Uppal and G. C. Garg, " Electrical Wiring, Estimating & Costing", Khannapublishers.
2. K. B. Raina, "Electrical Design, Estimating & Costing", New age International.
3. S. Singh and R. D. Singh, "Electrical estimating and costing", DhanpatRai and Co., 1997.

Reference Books:

1. Web site for ISStandards.
2. H. Joshi, " Residential Commercial and Industrial Systems", McGraw Hill Education.

ELECTRICAL MATERIALS			
Subject Code	**21XXEEOM0XG**	**IA Marks**	**30**
Number of Lecture Hours/week	**3L**	**Exam Marks**	**70**
Total Number of Lecture Hours	**45**	**Exam Hours**	**03**
Credits – 03			

Course Objectives:

This course will enable student to :

1. Understand the formation and properties of conducting material.
2. Understand the formation and properties of Semiconductor Materials.
3. Understand the formation and properties of Dielectric Materials.
4. Understand the formation and properties of Magnetic Materials.
5. Understand the formation and properties of Special Purpose Materials.

Unit-1: Conducting Materials:	
Review of metallic conduction on the basis of free electron theory. Fermi-Dirac distribution – variation of conductivity with temperature and composition, materials for electric resistors- general electric properties; material for brushes of electrical machines, lamp filaments, fuses and solder.	**Hours – 10**
Unit – 2: Semiconductor Materials:	**Hours – 08**
Mechanism of conduction in semiconductors, density of carriers in intrinsic semiconductors, the energy gap, types of semiconductors. Hall effect, compound semiconductors, basic ideas of amorphous and organic semiconductors.	
Unit – 3: Dielectric Materials:	**Hours – 10**
Dielectric as Electric Field Medium, leakage currents, dielectric loss, dielectric strength, breakdown voltage, breakdown in solid dielectrics, flashover, liquid dielectrics, electric conductivity in solid, liquid and gaseous dielectrics, Ferromagnetic materials, properties of ferromagnetic materials in static fields, spontaneous, polarization, curie point, anti-ferromagnetic materials, piezoelectric materials, pyro electric materials.	
Unit – 4: Magnetic Materials:	**Hours – 07**
Classification of magnetic materials, spontaneous magnetization in ferromagnetic materials, magnetic Anisotropy, Magnetostriction, diamagnetism, magnetically soft and hard materials, special purpose materials, feebly magnetic materials, Ferrites, cast and cermet permanent magnets, ageing of magnets. Factors effecting permeability and hysteresis	
Unit – 5: Materials for Electrical Applications:	**Hours – 10**
Materials used for Resistors, rheostats, heaters, transmission line structures, stranded conductors, bimetals fuses, soft and hard solders, electric contact materials, electric carbon materials, thermocouple materials. Solid, Liquid and Gaseous insulating materials, Effect of moisture on insulation.	

Course outcomes:

On completion of the course student will be able to:

1. Summarize the properties of conducting materials.
2. Identify materials used in semiconductor applications
3. Define the terms breakdown voltage
4. Classify of magnetic materials.
5. Identify material suitable for different electrical applications.

Text Books:

1. R K Rajput", " A course in Electrical Engineering Materials", Laxmi Publications.
2. "T K Basak", " A course in Electrical Engineering Materials", New Age Science Publications.

Reference Books:

1. TTTI Madras, "Electrical Engineering Materials", McGraw Hill Education.
2. "AdrianusJ.Dekker", Electrical Engineering Materials, PHI Publication.
3. S. P. Seth, P. V. Gupta "A course in Electrical Engineering Materials", Dhanpat Rai & Sons.

OPTIMIZATION TECHNIQUES			
Subject Code	**21XXEEOM0XH**	**IA Marks**	**30**
Number of Lecture Hours/week	**3L**	**Exam Marks**	**70**
Total Number of Lecture Hours	**45**	**Exam Hours**	**03**
Credits -03			

Course Objectives:

This course will enable student to :

1. To define an objective function and constraint functions in terms of design variables, and then state the optimization problem.
2. To state single variable and multi variable optimization problems, without and with constraints.
3. To explain linear programming technique to an optimization problem, define slack and surplus variables, by using Simplex method.
4. To study and explain nonlinear programming techniques, unconstrained or constrained, and define exterior and interior penalty functions for optimization problems.
5. To introduce evolutionary programming techniques.

Unit-1: Introduction and Classical Optimization Techniques:	
Statement of an Optimization problem, design vector, design constraints, constraint surface, objective function, objective function surfaces, classification of Optimization problems.	**Hours – 08**
Unit – 2: Classical Optimization Techniques	**Hours – 08**
Single variable Optimization, multi variable Optimization without constraints, necessary and sufficient conditions for minimum/maximum, multivariable Optimization with equality constraints. Solution by method of Lagrange multipliers, multivariable Optimization with inequality constraints, Kuhn, Tucker conditions.	
Unit – 3: Linear Programming	**Hours – 08**
Standard form of a linear programming problem , geometry of linear programming problems, definitions and theorems, solution of a system of linear simultaneous equations, pivotal reduction of a general system of equations, motivation to the simplex method, simplex algorithm, Duality in Linear Programming, Dual Simplex method.	
Unit – 4: Nonlinear Programming:	**Hours – 08**
Unconstrained cases, One, dimensional minimization methods: Classification, Fibonacci method and Quadratic interpolation method, Univariate method, Powell's method and steepest descent method. Constrained cases**,** Characteristics of a constrained problem, Classification, Basic approach of Penalty Function method; Basic approaches of Interior and Exterior penalty function methods. Introduction to convex Programming Problem.	

Unit – 5: Introduction to Evolutionary Methods:	
Evolutionary programming methods, Introduction to Genetic Algorithms (GA)– Control parameters, Number of generation, population size, selection, reproduction, crossover and mutation, Operator selection criteria , Simple mapping of objective function to fitness function, constraints, Genetic algorithm steps, Stopping criteria –Simple examples.	**Hours – 13**

Course outcomes:

On completion of the course student will be able to:

1. State and formulate the optimization problem, without and with constraints, by using design variables from an engineering design problem.
2. Apply classical optimization techniques to minimize or maximize a multi-variable objective function, without or with constraints, and arrive at an optimal solution.
3. Formulate a mathematical model and apply linear programming technique by using Simplex method. Also extend the concept of dual Simplex method for optimal solutions.
4. Apply gradient and non-gradient methods to nonlinear optimization problems and use interior or exterior penalty functions for the constraints to derive the optimal solutions.
5. Able to apply Genetic algorithms for simple electrical problems.

Text Books:

1. "Engineering optimization: Theory and practice"-by S. S.Rao, New Age International (P) Limited, 3rd edition.
2. Soft Computing with Matlab Programming by N.P.Padhy&S.P.Simson, Oxford University Press .

Reference Books:

1. "Optimization methods in operations Research and Systems Analysis" by K.V.Mital and C.Mohan, New Age International (P) Limited, Publishers, 3rd edition, .
2. Genetic Algorithms in search, optimization, and Machine Learning by David E.Goldberg,ISBN:978-81-7758-829-3, Pearsonby Dorling Kindersley (India) Pvt. Ltd.
3. "Operations Research: An Introduction" by H.A.Taha, PHI pvt. Ltd., 6th edition.
4. Linear Programming by G.Hadley..

WIND AND SOLAR ENERGY SYSTEMS			
Subject Code	**21XXEEOM0XI**	**IA Marks**	**30**
Number of Lecture Hours/Week	**3L**	**Exam Marks**	**70**
Total Number of Lecture Hours	**45**	**Exam Hours**	**03**
Credits-03			

COURSE OBJECTIVES:

This course will enable students :

1. To understand the energy scenario and the consequent growth of the power generation from renewable energy sources.
2. To understand the basic physics of wind and solar power generation.
3. To understand the power electronic interfaces for wind and solar generation.
4. To understand the issues related to the grid-integration of solar and wind energy systems.
5. To understand the basic MPPT techniques of wind and solar power generation.

Unit -1: Physics of Wind Power:	**Hours-9**
History of wind power, Indian and Global statistics, Wind physics, Betz limit, Tip speed ratio, stall and pitch control, Wind speed statistics-probability distributions, Wind speed and power-cumulative distribution functions.	
Unit -2: The Solar Resource	**Hours-10**
Introduction, solar radiation spectra, solar geometry, Earth Sun angles, observer Sun angles, solar day length, Estimation of solar energy availability.	
Unit – 3: Solar Cell Technologies	**Hours-08**
Amorphous, mono crystalline, polycrystalline Solar cells & panels, performance of solar cell, estimation of power obtain from solar power.	
Unit – 4: Solar photovoltaic	**Hours-10**
Solar panels PV systems, components of PV systems, performance of PV systems, concentrating PV systems, PV power plants, V-I characteristics of a PV cell, PV module, array	
Unit – 5: Maximum Power Point Tracking	**Hours-8**
Maximum Power Point Tracking (MPPT) algorithms. Converter Control, design of PV systems, applications of PV systems	

Course Outcomes:

1. Understand the energy scenario and the consequent growth of the power generation from renewable energy sources.
2. Understand the basic physics of wind and solar power generation.
3. Design the power electronics to interface for wind and solar generation.
4. Understand the issues related to the grid-integration of solar and wind energy systems.
5. Design solar system with different types of solar PV panels & MPPT algorithms

TEXT BOOKS:

1. T. Ackermann, "Wind Power in Power Systems", John Wiley and Sons Ltd.
2. Renewable Energy Resources, John Twidell and Tony Weir, Taylor and Francis - second edition.

REFERENCES :

1. H. Siegfried and R. Waddington, "Grid integration of wind energy conversion systems" John Wiley and Sons Ltd.,
2. Renewable Energy- Edited by Godfrey Boyle-oxford university.press,3rd edition..
3. Handbook of renewable technology Ahmed and Zobaa, Ramesh C Bansal, World scientific, Singapore.
4. Renewable Energy Technologies /Ramesh & Kumar /Narosa.
5. Renewable energy technologies – A practical guide for beginners – Chetong Singh Solanki, PHI. Non conventional energy source –B.H.khan- TMH-2nd edition.

Honors (for EEE Students)

III B. Tech I Semester:

S. No	Subject code	Name of the Subject
1	21EEEEH511A	Electrical Machine Design
2	21EEEEH511B	Utilization of Electrical Energy & Traction
3	21EEEEH511C	Solar & Advanced Energy Storage System
4	21EEEEH511D	Modern Control Systems

ELECTRICAL MACHINE DESIGN SEMESTER-V			
Subject Code	**21EEEEH511A**	**IA Marks**	**30**
Number of Lecture Hours/week	**3L**	**Exam Marks**	**70**
Total Number of Lecture Hours	**45**	**Exam Hours**	**03**
Credits – 04			

Course Objectives:

The objectives of this course is to acquire knowledge on the

1. Properties of magnetic materials and the operation of PMDC motors.
2. Performance and control of stepper motors and their applications.
3. Theory of operation and control of switched reluctance motor.
4. Characteristics and performance of PM BLDC motors.
5. Principle of operation of linear induction motor

Unit-1: Fundamental Aspects of Electrical Machine Design	**Hours – 08**
Fundamental Aspects of Electrical Machine Design: Design of Machines, Design Factors, Limitations in design, Modern Trends in design, manufacturing Techniques. **Electrical Engineering Materials:** Desirable properties of Conducting Materials, Comparison of Aluminium and Copper wires. Ferromagnetic Materials: Soft Magnetic materials – Solid Core Materials, Electrical Sheet and Strip, Cold Rolled Grain Oriented Steel. Insulating Materials: Desirable Properties, Temperature Rise and Insulating Materials, Classification of Insulating materials based on Thermal Consideration.	
Unit – 2: Design of DC Machines	**Hours – 08**
Output Equation, Choice of Specific Loadings and Choice of Number of Poles, Main Dimensions of armature, Design of Armature Slot Dimensions, Commutator and Brushes. Estimation of Ampere Turns for the Magnetic Circuit. Dimensions of Yoke, Main Pole and Air Gap. Design of Shunt and Series Field Windings.	
Unit – 3: Design of Transformers	**Hours –12**
Output Equations of Single Phase and Three Phase Transformers, Choice of Specific Loadings, Expression for Volts/Turn, Determination of Main Dimensions of the Core, Estimation of Number of Turns and Conductor Cross Sectional area of Primary and Secondary Windings, No Load Current. Expression for the Leakage Reactance of core type transformer with concentric coils, and calculation of Voltage Regulation. Design of Tank and Cooling (Round and Rectangular) Tubes.	
Unit – 4: Design of Three Phase Induction Motors	**Hours –09**
Output Equation, Choice of Specific Loadings, Main Dimensions of Stator. Design of stator slots and Winding, Choice of Length Air Gap, Estimation of Number of Slots for Squirrel Cage Rotor. Design of Rotor Bars and End Ring. Design of Slip Ring rotor. Estimation of No Load Current and Leakage Reactance.	
Unit – 5: Design of Three Phase Synchronous Machines	**Hours -08**
Output Equation, Choice of Specific Loadings, Short Circuit Ratio, Main Dimensions of Stator. Design of stator slots and Winding. Design of Salient and non- salient Pole Rotors. Magnetic Circuit and Field Winding.	

Course Outcomes:

The students should be able to:

1. Identify and list, limitations and properties of materials used in the electrical machines.
2. Design the field windings and rotor circuits of DC machine
3. Discuss selection of specific loadings and Estimate number of cooling tubes, no load current and leakage reactance of core type transformer.
4. Discuss selection of specific loadings and magnetic circuits of induction motor and design

stator and rotor circuits of a induction motor.

5. Design the field windings of salient pole and non-salient pole alternators for given specifications.

Text Books:

1. A course in Electrical Machine design A. K. Sawhney Dhanpat Rai 6th Edition.

Reference Books:

1. Performance and Design of Alternating Current Machines M.G. Say CBS Publisher 3rd Edition,
2. Design Data Handbook A. Sanmugasundaram Et. al New Age International 1st Edition.

UTILIZATION OF ELECTRICAL ENERGY & TRACTION SEMESTER-V			
Subject Code	**21EEEEH511B**	IA Marks	30
Number of Lecture Hours/week	3L	Exam Marks	70
Total Number of Lecture Hours	45	Exam Hours	03
Credits – 04			

Course Objectives:

This course will enable student to :

1. Study the basic principles of illumination and its measurements and to design the different types lighting systems.
2. Understand the operating principles and characteristics of various motors with respect to speed, temperature and loading conditions.
3. Acquaint with the different types of heating and welding techniques.
4. Understand the basic principles of electric traction including speed–time curves of different traction services
5. Calculation of braking, acceleration and other related parameters.

Unit-1: Illumination	
Choice of motor, type of electric drives, Temperature rise, Types of industrial loads–continuous–Intermittent and variable loads–Load equalization, Introduction to energy efficient motors.	**Hours –10**
Unit – 2: Selection of Motors	**Hours – 08**
Introduction, terms used in illumination–Laws of illumination–Sources of light. Discharge lamps, MV and SV lamps – Comparison between tungsten filament lamps and fluorescent tubes–Basic principles of light control– Types and design of lighting and flood lighting–LED lighting	
Unit – 3: Electric Heating & Electric Welding	**Hours –08**
Advantages and methods of electric heating–Resistance heating, induction heating and dielectric heating. Electric welding–Resistance and arc welding–Electric welding equipment–Comparison between AC and DC Welding	
Unit – 4	**Hours –10**
Electric Traction – I System of electric traction and track electrification– Review of existing electric traction systems in India– Special features of traction motor– Mechanics of train movement–Speed–time curves for different services – Trapezoidal and quadrilateral speed time curves.	
Unit – 5	**Hours –09**
Electric Traction – II Calculations of tractive effort– power –Specific energy consumption for given run–Factors affecting the specific energy consumption. Dead weight, Accelerating weight, adhesive weight and coefficient of adhesion. Requirements of a braking system, Types of braking, Principles of energy efficient motors.	

Course outcomes:

On completion of the course student will be able to:

1. Understand various levels of illuminosity produced by different illuminating sources design different lighting systems by taking inputs and constraints in view.
2. Identify a suitable motor for electric drives and industrial applications
3. Identify most appropriate heating and for suitable applications.
4. Identify most appropriate welding techniques for suitable applications.
5. Determine the speed/time characteristics of different types of traction systems

Text Books:

1. Utilization of Electric Energy – by E. Openshaw Taylor, Orient Longman.
2. Art & Science of Utilization of electrical Energy – by Partab, DhanpatRai&Sons.
3. "Thermal energy storage systems and applications"-by Ibrahim Dincer and Mark A.Rosen. John Wiley and Sons.

Reference Books:

1. Utilization of Electrical Power including Electric drives and Electric traction – by N.V.Suryanarayana, New Age International (P) Limited, Publishers.
2. Generation, Distribution and Utilization of electrical Energy – by C.L. Wadhwa, New Age International(P)Limited,Publishers.

ENERGY STORAGE SYSTEM SEMESTER-V			
Subject Code	**21EEEEH511C**	**IA Marks**	**30**
Number of Lecture Hours/Week	**3L**	**Exam Marks**	**70**
Total Number of Lecture Hours	**45**	**Exam Hours**	**03**
Credits-04			

COURSE OBJECTIVES:

This course will enable students :

1. Solar radiation data, extraterrestrial radiation, radiation on earth's surface
2. Maximum power point techniques in solar PV
3. Need of energy storage and different types of energy storage. thermal, magnetic, electrical and electrochemical energy storage systems
4. Emerging needs for EES pertaining to Renewable energy
5. Types of electrical energy storage systems& design and Applications of Electrical Energy Storage

Unit -1: Fundamentals of Energy Systems	**Hours-7**
Energy conservation principle, Energy scenario (world and India), Solar radiation: Outside earth's atmosphere, Earth surface – Analysis of solar radiation data – Geometry – Radiation on tilted surface, Numerical problems	
Unit -2: Solar Thermal Systems& Solar Photovoltaic Systems	**Hours-10**
Solar Thermal Systems: Liquid flat plate collections: Performance analysis, Transmissivity, Absorptivity, Product collector efficiency factor, Collector heat removal factor, Numerical problems, Introduction to solar air heaters, Concentrating collectors and solar pond. **Solar Photovoltaic Systems:** Balance of systems, I-V & P-V characteristics, System design, Storage sizing, PV system sizing, Maximum power point techniques, Perturb and observe (P&O) technique, Incremental Conductance (INC), Hill climbing technique	
Unit – 3: Introduction To Energy Storage Systems	**Hours-10**
Necessity of energy storage, different types of energy storage, mechanical, chemical, electrical, electrochemical, biological, magnetic, electromagnetic, thermal, comparison of energy storage technologies **Needs for Electrical Energy Storage:** Emerging needs for EES, More renewable energy-less fossil fuel, Smart Grid uses - the roles of electrical energy storage technologies-the roles from the viewpoint of a utility-the roles from the viewpoint of consumers-the roles from the viewpoint of generators of renewable energy	
Unit – 4: Energy Storage Systems:	**Hours-08**
Thermal Energy storage-sensible and latent heat, phase change materials, Energy and energy analysis of thermal energy storage, Electrical Energy storage-super-capacitors, Magnetic Energy storage-Superconducting systems, Mechanical-Pumped hydro, flywheels and pressurized air energy storage, Chemical-Hydrogen production and storage, Principle of direct energy conversion using fuel cells, thermodynamics of fuel cells, Types of fuel cells, Fuel cell performance, Electrochemical Energy Storage-Battery, primary, secondary and flow batteries.	

Unit – 5: **Types, Design and Applications of Electrical Energy Storage systems**	
Types of Electrical Energy Storage systems: Electrical storage systems, Double-layer capacitors (DLC), Superconducting magnetic energy storage (SMES), super charging stations, Thermal storage systems, Standards for EES, Technical comparison of EES technologies. **Design and Applications of Electrical Energy Storage:** Renewable energy storage-Battery sizing and stand-alone applications, stationary (Power Grid application), Small scale application-Portable storage systems and medical devices, Mobile storage Applications- Electric vehicles (EVs), types of EVs, batteries and fuel cells, future technologies, hybrid systems for energy storage	**Hours-10**

COURSE OUTCOMES:

On completion of the course student will be able to:

1. Analyze solar radiation data, extraterrestrial radiation, radiation on earth's surface.
2. develop maximum power point techniques in solar PV
3. know the characteristics of electricity and need for continuous and flexible supply, discuss about the role of electrical energy storage technologies
4. analyze features of EES systems
5. Acquire knowledge on various types of EES systems, apply EES systems to various applications such as smart micro grid, smart home etc.

TEXTBOOKS:

1. 1. Solar Energy: Principles of Thermal Collection and Storage, S. P. Sukhatme and J. K. Nayak, TMH, New Delhi, 3rd Edition
2. Renewable Energy Resources, John Twidell and Tony Weir, Taylor and Francis Electrical and Electronics Engineering 163
3. Energy Science: Principles, Technologies and Impacts, John Andrews and Nick Jelly, Oxford.
4. Energy Storage - Technologies and Applications by Ahmed Faheem Zobaa, InTech.
5. Fundamentals of Energy Storage by J. Jensen and B. Sorenson, Wiley-Interscience, New York
6. Energy Storage: Fundamentals, Materials and Applications, by Huggins R. A., Springer.

REFERENCE BOOKS:

R1. Handbook of renewable technology Ahmed and Zobaa, Ramesh C Bansal,World scientific, Singapore

R2**.** . Renewable Energy Technologies /Ramesh & Kumar /Narosa

R3**:** Renewable energy technologies – A practical guide for beginners –Chetong Singh Solanki, PHI**.**

R4**:** Thermal energy storage: Systems and Applications by Dincer I. and Rosen M. A., Wiley pub.

R5: Energy Storage: Fundamentals, Materials and Applications, by Huggins R. A., Springer.

R6**:** Electric & Hybrid Vehicles by G. Pistoia, Elsevier B. V. iv. Fuel cell Fundamentals by R. O'Hayre, S. Cha, W. Colella and F. B. Prinz, Wiley Pub.

MODERN CONTROL SYSTEMS SEMESTER-V			
Subject Code	**21EEEEH511D**	**IA Marks**	**30**
Number of Lecture Hours/week	**3L**	**Exam Marks**	**70**
Total Number of Lecture Hours	**45**	**Exam Hours**	**03**
Credits – 04			

Course Objectives:

This course will be able student to understand:

1. Review of the state space representation of a control system**:** Formulation of different models from the signal flow graph, diagonalization.
2. To introduce the concept of controllability and observability. Design by pole placement technique.
3. Analysis of a nonlinear system using Describing function approach and Phase plane analysis.
4. The Lypanov's method of stability analysis of a system. Formulation of Euler Laugrange equation for the optimization of typical functional and solutions.
5. Formulation of linear quadratic optimal regulator (LQR) problem by parameter adjustment and solving riccatti equation

Unit-1: State space analysis	**Hours – 08**
Introduction, Concept of State, State Variables and State Model, State Space Representation – Solution of state equation – State transition matrix, – Canonical forms – Controllable canonical form – Observable canonical form.	
Unit – 2: Controllability, observability	**Hours – 12**
Tests for controllability and observability for continuous time systems – Time varying case – Minimum energy control – Time invariant case – Principle of duality – Controllability and observability form Jordan canonical form and other canonical forms – Effect of state feedback on controllability and observability.	
Unit – 3: Describing function analysis & Stability analysis	**Hours – 12**
Introduction to nonlinear systems, Types of nonlinearities, describing functions, Introduction to phase–plane analysis. Stability in the sense of Lyapunov – Lyapunov's stability and Lypanov's instability theorems – Direct method of Lyapunov for the linear and nonlinear continuous time autonomous systems.	
Unit – 4: Calculus of variations	**Hours – 8**
Minimization of functional of single function – Constrained minimization – Minimum principle – Control variable inequality constraints – Control and state variable inequality constraints – Euler lagrangine equation.	

Unit – 5: Optimal control	**Hours – 8**
Various cost functions, Regulatory problems, Linear and Quadratic regulators	

Course outcomes:

On completion of the course student will be able to:

1. Review of the state space representation of a control system**:** Formulation of different models from the signal flow graph, diagonalization.
2. To introduce the concept of controllability and observability. Design by pole placement technique.
3. Analysis of a nonlinear system using Describing function approach and Phase plane analysis.
4. The Lypanov's method of stability analysis of a system. Formulation of Euler Laugrange equation for the optimization of typical functional and solutions.
5. Formulation of linear quadratic optimal regulator (LQR) problem by parameter adjustment and solving riccatti equation

Text Books:

1. Modern Control Engineering – by K. Ogata, Prentice Hall of India, 3rd edition.
2. Automatic Control Systems by B.C. Kuo, Prentice Hall PublicationS. Onori,
3. L. Serrao and G. Rizzoni, " Hybrid Electric Vehicles: Energy Management Strategies" , Springer.

Reference Books:

1. Modern Control System Theory – by M. Gopal, New Age International Publishers, 2nd edition.
2. Control Systems Engineering by I.J. Nagarath and M.Gopal, New Age International (P) Ltd.
3. Digital Control and State Variable Methods – by M. Gopal, Tata McGraw–Hill Companies.
4. Systems and Control by Stainslaw H. Zak , Oxford Press.
5. Optimal control theory: an Introduction by Donald E.Kirk by Dover publications.

Minors to other Departments

III B. Tech I Semester:

S. No	Subject code	Name of the Subject
1	21XXEEM511A	Fundamentals of Electrical Machines
2	21XXEEM511B	Fundamentals of Power Electronics
3	21XXEEM511C	Electrical Measurements & Instrumentation

FUNDAMENTALS OF ELECTRICAL MACHINES

SEMESTER-V

Subject Code	**21XXEEM511A**	**IA Marks**	**30**
Number of Lecture Hours/Week	**3L**	**Exam Marks**	**70**
Total Number of Lecture Hours	**45**	**Exam Hours**	**03**
Credits-04			

COURSE OBJECTIVES:

This course will enable students :

1. The principle of operation and construction of DC generators and DC motors, characteristics of DC generators.
2. Speed control methods, starting and performance characteristics of DC shunt motor
3. Principle of operation, construction of AC machines (transformers, synchronous machinesand 3-phase &1-phase induction motors)
4. Performance characteristics of transformers & 3-phase Induction motors and regulation of transformer and alternators

UNIT – 1: DC Generators	
Principle of operation of DC generator – EMF equation – types of DC machines – OCC & load characteristics of DC generator s.	**Hours-10**
UNIT – 2: DC Motors	
Principle of operation of DC motor - torque equation - speed control methods – losses and efficiency – three point starter - applications – Swinburne's test - brake test - numerical problems.	**Hours-10**
UNIT – 3: Transformers	
Principle of operation and construction of single phase transformer – EMF equation – Losses - OC & SC tests - efficiency and voltage regulation of transformer – Numerical Problems.	**Hours-08**
UNIT-4: Three-Phase Induction Motors	
Principle of operation – construction – revolving magnetic field - types of three-phase induction motors – slip-torque characteristics - maximum, starting and running toques - losses and efficiency - starting methods.	**Hours-07**
UNIT-5: Single Phase Induction Motors	
Principle of operation – construction – revolving magnetic field – starting methods of single-phase induction motors – Equivalent circuit-slip-torque characteristics.	**Hours-10**

COURSE OUTCOMES:

On completion of the course student will be able to:

1. Understand the operation and characteristics of DC generators.
2. Understand the operation and characteristics of DC motors.
3. Understand the operation of single phase transformers.
4. Understand the principle, speed-torque characteristics, performance and starting methods of 3-phase induction motor
5. Understand the operation single phase induction motor.

TEXT BOOKS:

1. Principles of Electrical Machines by V.K. Mehta & Rohit Mehta, S.Chand publications
2. Theory & performance of Electrical Machines by J.B.Guptha, S.K.Kataria & Sons
3. Electrical Machinery by P.S. Bhimbra, Khanna Publishers.

REFERENCE BOOKS:

1. Basic Electrical Engineering by M.S.Naidu & S.Kamakshiah, TMH Publications
2. Fundamentals of Electrical Engineering by Rajendra Prasad, PHI Publications, 2nd edition
3. Basic Electrical Engineering by Nagsarkar, Sukhija, Oxford Publications, 2nd edition

FUNDAMENTALS OF POWER ELECTRONICS SEMESTER-V			
Subject Code	**21XXEEM511B**	**IA Marks**	**30**
Number of Lecture Hours/Week	**3L**	**Exam Marks**	**70**
Total Number of Lecture Hours	**45**	**Exam Hours**	**03**
Credits-04			

COURSE OBJECTIVES:

This course will enable students :

1. To understand the working of power electronic devices.
2. To study the different turn on and turn off methods of SCR.
3. To understand how to controlled the output voltage of controlled rectifiers.
4. To understand the operation of chopper and inverter circuits.
5. To understand the importance of power electronics for industrial applications.

Unit -1: Thyristor Family Devices:	**Hours-10**
V-I Characteristics of SCR, Calculation of latching current (I_L), Holding current (I_H) and anode current of the SCR, V-I characteristics of MOSFET, IGBT GTO, DIAC and TRIAC.	
Unit -2: Turn ON and Turn OFF methods of SCR:	**Hours-10**
Concept of turn ON mechanism of SCR, SCR triggering methods, UJT triggering, protection circuits of SCR from high voltage and high current.	
Unit – 3: Phase Controlled Rectifiers:	**Hours-08**
Phase controlled parameters, single phase half controlled rectifier working and operation for R and RL loads effect of free- wheeling diode, single phase center tapped full wave controlled rectifier working and waveforms with R and RL loads.	
Unit – 4: Choppers and Inverters:	**Hours-07**
Working of chopper circuit and classification of choppers using power MOSFET, Inverters: circuit diagram working of series and parallel inverter.	
Unit – 5: Industrial Applications of power electronic Devices:	**Hours-10**
Light dimmer circuit using DIAC and TRIAC, battery charger using SCR, Temperature control using SCR, Block diagram and concept of UPS, Block diagram and concept of SMPS	

COURSE OUTCOMES:

On completion of the course student will be able to:

1. Analyze when the power electronic devices will come into turn ON condition.
2. Analyze triggering circuit which is suitable to turn ON or turn OFF the SCR.
3. Analyze the operation of type of the converter.
4. Analyze the operation of chopper and inverter circuits.
5. Analyze the different control circuit and its operation.

TEXT BOOKS:

1. M. E. Van Valkenburg, "Network Analysis", Prentice Hall, Third edition.
2. D.Roy Choudhury, "Networks and Systems", New Age International Publications..
3. W. H. Hayt and J. E. Kemmerly, "Engineering Circuit Analysis", McGraw Hill Education.

REFERENCE BOOKS:

1. Thyristorised Power Controllers – by G. K. Dubey, S. R. Doradla, A. Joshi and R. M. K.Sinha, New Age International (P) Limited Publishers.

2. Power Electronics handbook by Muhammad H.Rashid, Elsevier.

3. Power Electronics: converters, applications & design -by Nedmohan, Tore M. Undeland, Robbins by Wiley India Pvt. Ltd.

4. Power Converter Circuits -by William Shepherd, Li zhang, CRC Taylor & Francis Group.

ELECTRICAL MEASUREMENTS AND INSTRUMENTATION SEMESTER-V			
Subject Code	**21XXEEM511C**	**IA Marks**	**30**
Number of Lecture Hours/Week	**3L**	**Exam Marks**	**70**
Total Number of Lecture Hours	**45**	**Exam Hours**	**03**
Credits-04			

Objectives:

This course will enable student to :

1. Understand the PMMC and mi meters and instrument transformers.
2. Understand the working principle & operation of different types of power & energy meters.
3. Understand the physical parameters such as R, L, C and explain the working principle & operation of potentiometers.
4. Understand the performance of various transducers.
5. Understand the use of different digital meters.

Unit-1: Measuring Instruments:	
Classification –Deflecting, control and damping torques – Ammeters and Voltmeters PMMC and Moving iron type instruments, dynamometer type and electrostatic instruments – Expression for the deflecting torque and control torque – Errors and compensations – Extension of range using shunts and series resistance – CT and PT: Ratio and phase angle errors.	**Hours-08**
Unit–2: Measurement of Power and Energy:	
Single phase and Three Phase dynamometer type wattmeter, LPF and UPF, expression for deflecting and control torques – Extension of range of wattmeter using instrument transformers – Measurement of active and reactive powers in balanced and unbalanced systems. Single phase induction type energy meter – driving and braking torques – errors and compensations – testing by phantom loading, Three Phase Energy meter.	**Hours-10**
Unit–3: Measurements of R, L & C Elements	
Method of measuring low, medium and high resistance – sensitivity of Wheat-stone's bridge – Carey Foster's bridge, Kelvin's double bridge for measuring low resistance, measurement of high resistance – loss of charge method. Measurement of inductance- Q-Factor - Maxwell's bridge, Hay's bridge, Anderson's bridge, Owen's bridge. Measurement of capacitance and loss angle. Wien's bridge – Schering Bridge. **Potentiometers** Principle and operation of D.C. Crompton's potentiometer – Standardization – Measurement of unknown resistance – Current – Voltage – AC Potentiometers: polar and coordinate types –Standardization – Applications.	**Hours-12**

Unit–4: Transducers	
Introduction to transducers – Classification of transducers – Advantages ofElectrical transducers – Characteristics and choice of transducers – Principle operation of resistor, inductor and capacitor transducers – LVDT and its applications – Strain gauge and its principle of operation – Guage factor – Thermistors – Thermocouples– Piezoelectric transducers – Photo diodes, Hall effect sensors..	**Hours-07**
Unit–5: Digital Meters	
Digital frequency meter – Digital Voltmeters – Successive approximation DVM - Ramp type DVM and Integrating type DVM – Digital frequency meter - Digital multimeter - Digital tachometer - Digital Energy Meter - Q meter - Power Analyzer. CRO- measurement of phase difference & Frequency using lissajious patterns - Numerical Problems	**Hours-08**

Course outcomes:

On completion of the course student will be able to:

1. Analyze PMMC and mi meters and instrument transformers.
2. Explain the working principle & operation of different types of power & energy meters.
3. Derive the unknown physical parameters such as R, L, C and explain the working principle & operation of potentiometers.
4. Analyze the performance of various transducers.
5. Apply the use of different digital meters.

Text Books:

1. Electrical Measurements and measuring Instruments – by E.W. Goldingand F.C.Widdis, fifth Edition, Wheeler Publishing.
2. Modern Electronic Instrumentation and Measurement Techniques – A.D. Helfrickand W.D. Cooper, PHI, 5th Edition, 2002.
3. Electrical and Electronic Measurements and instrumentation by R. K. Rajput, S. Chand.

Reference Books:

1. Electrical & Electronic Measurement & Instruments by A.K. Sawhney, Dhanpat Rai &Co. Publications.
2. Electrical Measurements – by Buckingham and Price, Prentice –Hall
3. Electrical Measurements by Forest K. Harris. John Wiley andSons
4. Electrical Measurements: Fundamentals, Concepts, Applications – by Reissland, M.U, New Age International (P) Limited,Publishers.

Electrical and Electronic Measurements –by G. K. Banerjee, PHI Learning PrivateLtd., NewDelhi–2012.

Course Structure for III B. Tech II Semester Under the Regulations of SITE-21							
SEMESTER- VI							
S. No	**Course Category**	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	PC	21EEEET6010	Power System Analysis, Operation & Control	3	0	0	3
2	PC	21EEEET6020	Microprocessors & Microcontrollers	3	0	0	3
3	PC	21EEEET6030	Power Semiconductor Controlled Drives.	3	0	0	3
4	PE	21EEEEP604X	Professional Elective-II	3	0	0	3
5	OE	21EEXXO605X	Open Elective -II	2	0	2	3
6	PC	21EEEEL6060	Microprocessors & Microcontrollers Laboratory	0	0	3	1.5
7	PC LAB	21EEEEL6070	Control Systems Lab	0	0	3	1.5
8	PC LAB	21EEEEL6080	Power Systems Analysis Lab	0	0	3	1.5
9	SAC/SC	21EEXXS6090	Soft Skills & Aptitude Builder - 2	0	0	0	2
			TOTAL	**14**	**0**	**11**	**21.5**
10	H/M		Honor/Minor courses(The hours distribution can be 3-0-2 or 3-1-0)	4	0	0	4

Professional Elective-II

S. No	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	21EEEEP604A	Electrical Machine Modeling & Analysis	3	0	0	3
2	21EEEEP604B	Power system Protection.	3	0	0	3
3	21EEEEP604C	Control system design.	3	0	0	3

POWER SYSTEM ANALYSIS, OPERATION &CONTROL

SEMESTER-VI

Subject Code	**21EEEET6010**	**IA- Marks**	**30**
Number of Lecture Hours/week	**3L**	**Exam Marks**	**70**
Total Number of Lecture Hours	**45**	**Exam Hours**	**03**

Credits – 03

Course Objectives:

This course will enable student to :

1. Know the importance of power flow control.
2. Analyze different faults.
3. Understand the concept of stability.
4. Understand real power control and operation.
5. Understand real time control of power systems.

Unit-1	
Power Flow Formation of Y–bus and Z- bus matrix. Necessity of power flow studies, Static Real and Reactive power flow equations at a node. Application of numerical methods for solution of non- linear algebraic equations – Gauss Seidel, Newton- Raphson, Decoupled and fast decoupled methods for the solution of the power flow equations and its comparisons.	**Hours – 10**
Unit – 2	**Hours –08**
Fault Analysis Symmetrical Fault analysis - Short circuit MVA Calculations, Unsymmetrical faults on power system (LG-LL-LLG and LLL)	
Unit – 3	**Hours – 09**
Stability Swing Equations of a synchronous machine connected to an infinite bus. Power angle curve - Synchronizing Power Coefficient. Methods of stability analysis - Euler, Runge-Kutta and Equal Area Criterion. Loss of synchronism in a single machine infinite bus system, sudden increase in mechanical input power, sudden loss of line and three--phase fault. Series compensation of Transmission lines for stability improvement.	
Unit – 4	**Hours – 08**
Operation and Control An overview of power system operation and control, Turbines and Speed- Governors, Frequency dependence of loads, Droop Control and Power Sharing. Automatic Generation and absorption of reactive power by various components of a Power System. Excitation System Control in synchronous generators, Methods of voltage control - Automatic Voltage Regulation.	

Unit – 5	
Power System Economics and Management Power System load variation- System load characteristics, load curves - daily, weekly and annual, load-duration curve, load factor, diversity factor. Reserve requirements: Installed reserves, spinning reserves, cold reserves, hot reserves. Load forecasting, techniques of forecasting. Economic dispatch – Numerical problem lambda-iteration method, Generation Control and integration of economic dispatch control with LFC. unit commitment numerical problems solutions Priority-list methods, forward dynamic programming approach and λ-iteration method.	**Hours – 10**

Course outcomes:

On completion of the course student will be able to:

1. Generalize the power flow analysis using various methods.
2. Find the fault currents for all types faults to provide data for the design of protective devices.
3. Understand the load flow solution of a power system using different methods.
4. Understand real time control of power systems.
5. Compare unit commitment and economic dispatch and their importance.

Question paper pattern:

The question paper will have 10 questions.

1. Each full question carries 14 marks.
2. Each full question will have sub question covering all topics under unit.

The student will have to answer 5 full questions selecting one full question from each unit.

Text Books:

1. J. Grainger and W. D. Stevenson, "Power System Analysis" , McGraw Hill Education, 1994.
2. O.I.Elgerd,"ElectricEnergySystemsTheory",McGrawHillEducation,1995.
3. A.R.BergenandV.Vittal,"PowerSystemAnalysis",PearsonEducationInc.,1999.

Reference Books:

1. D. P. Kothari and I. J. Nagrath, " Modern Power System Analysis" , McGraw Hill Education, 2003.
2. B. M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G. Strbac, "Electric Power Systems", Wiley,2012.

MICROPROCESSORS & MICROCONTROLLERS SEMESTER-VI			
Subject Code	**21EEEET6020**	**IA Marks**	**30**
Number of Lecture Hours/week	**3L**	**Exam Marks**	**70**
Total Number of Lecture Hours	**45**	**Exam Hours**	**03**
Credits-03			

Course Objectives:

This course will enable student to:

1. To understand the organization and architecture of Microprocessor
2. Know the basic principles and operation of various circuit breakers.
3. Explain the protective schemes used for generator and transformers.
4. Explain the protective schemes used for feeders and transmission lines.
5. Evaluate static and microprocessor based relays

Unit 1: Fundamentals of Microprocessors & Microcontrollers	**Hours**
Fundamentals of 8086 Microprocessor Architecture, Functional diagram, Register Organization, Memory Segmentation, Memory addresses, Physical Memory Organization, Difference between Microprocessor and microcontroller, Comparison of 8- bit, 16-bit and 32-bit microcontrollers.	**09**
Unit-2: The 8051 Microcontroller	**08**
Overview of 8051 Microcontroller, Architecture, I/O ports and Interrupts, Memory Organization, Register set, Timers and Counters.	
Unit 3: Instruction set and Programming	**10**
Addressing Modes, Arithmetic instructions, Logical instructions, Data Transfer instructions, Bit manipulation instructions, Branch instructions, Process control Instructions. Simple Assembly language program examples (with and without loops) to use these instructions.	
Unit 4: Memory and I/O interfacing	**08**
I/O And Memory Interface: LCD, Keyboard, External Memory RAM, ROM Interface, ADC, DAC Interface to 8051.	
Unit 5: External Communication Interface & Applications	**10**
Synchronous and Asynchronous Communication. RS232, SPI, I2C. Introduction and interfacing to protocols like Blue-tooth and Zig-bee. LED, LCD and keyboard interfacing. Stepper motor interfacing, DC Motor interfacing, and sensor interfacing.	

Course outcomes:

On completion of the course student will be able to:

1. Illustrate the fundamentals of 8086 microprocessor.
2. Understand the fundamentals of 8051 microcontroller.
3. Explain the instruction set of 8051 microcontroller.
4. Compose the programming of 8051 microcontroller.
5. Examine the memory and I/O interfacing.

Question paper pattern:

The question paper will have 10 questions.

1. Each full question carries 14 marks.
2. Each full question will have sub question covering all topics under unit.

The student will have to answer 5 full questions selecting one full question from each unit.

Text Books:

1. Muhammad Ali Mazidi & Janice Gilli Mazidi, 'The 8051 Micro Controller and Embedded Systems', Pearson Education, Second Edition 2011.
2. Kenneth Ayala, 'The 8051 Microcontroller', Thomson, 3rd Edition 2004
3. Ramesh S. Gaonkar, 'Microprocessor Architecture Programming and Application', Pen ram International (P)ltd., Mumbai, 6th Education, 2013.

Reference Books:

1. Douglas V. Hall, "Micro-processors & Interfacing", Tata McGraw Hill 3rd Edition, 2017.
2. R.S. Kaler - "A Text book of Microprocessors and Micro Controllers" - I.K. International Publishing House Pvt. Ltd.
3. Krishna Kant, "Micro-processors & Micro-controllers", Prentice Hall of India, 2007.
4. Ajit Pal - "Microcontrollers – Principles and Applications" - PHI Learning Pvt Ltd - 2011.

POWER SEMICONDUCTOR CONTROLLED DRIVES SEMESTER-VI			
Subject Code	**21EEEET6030**	**IA Marks**	**30**
Number of Lecture Hours/week	**3L**	**Exam Marks**	**70**
Total Number of Lecture Hours	**45**	**Exam Hours**	**03**
Credits-03			

Course Objectives:

This course will enable student to:

1. To analyze the operation of three phase converter controlled dc motors and four quadrant operation of dc motors using dual converters.
2. To discuss the converter control of dc motors in various quadrants.
3. To understand the concept of speed control of induction motor by using AC voltage controllers and voltage source inverters.
4. To learn the principles of static rotor resistance control and various slip power recovery schemes.
5. To understand the speed control mechanism of synchronous motors

Unit-1	
Fundamentals of Electric Drives Electric drive, Fundamental torque equation, Load torque components ,Nature and classification of load torques ,Steady state stability , Load equalization, Four quadrant operation of drive (hoist control) ,Braking methods**:** Dynamic, Plugging, Regenerative methods.	**Hours –08**
Unit – 2	**Hours – 08**
Controlled Converter Fed DC Motor Drives 1-phase half and fully controlled converter fed separately and self, excited DC motor drive, Output voltage and current waveforms, Speed, torque expressions , Speed, torque characteristics, Principle of operation of dual converters and dual converter fed DC motor drives, Numerical problems.	
Unit – 3	**Hours –10**
DC–DC Converters Fed DC Motor Drives Single quadrant, Two quadrant and four quadrant DC-DC converter fed separately excited and self excited DC motors, Continuous current operation, Output voltage and current waveforms, Speed, torque expressions, Speed- torque characteristics, Four quadrant operation, Closed loop operation (qualitative treatment only).	
Unit – 4	**Hours – 12**
3-phase Induction motor Drives Stator side control of 3,phase Induction motor Drive: Stator voltage control using 3,phase AC voltage regulators, Waveforms, Speed torque characteristics, Variable Voltage Variable Frequency control of induction motor by PWM voltage source inverter, Closed loop v/f control of induction motor drives (qualitative treatment only). Rotor side control of 3,phase Induction motor Drive: Static rotor resistance control, Slip power recovery schemes, Static Scherbius drive, Static Kramer drive, Performance and speed torque characteristics , Advantages–Applications.	
Unit – 5 **Control of Synchronous Motor Drives** Separate control & self, control of synchronous motors, Operation of self, controlled synchronous motors by VSI, Closed Loop control operation ofsynchronous motor drives (qualitative treatment only).Variable frequency control, Pulse width modulation.	**Hours – 07**

Course outcomes:

On completion of the course student will be able to:

1. Explain the fundamentals of electric drive and different electric braking methods.
2. Analyze the operation of three phase converter fed dc motors and four quadrant operations of dc motors using dual converters.
3. Describe the converter control of dc motors in various quadrants of operation
4. Know the concept of speed control of induction motor by using AC voltage controllers and voltage source inverters.
5. Explain the speed control mechanism of synchronous motors

Question paper pattern:

The question paper will have 10 questions.

1. Each full question carries 14 marks.
2. Each full question will have sub question covering all topics under unit.

The student will have to answer 5 full questions selecting one full question from each unit.

Text Books:

1. Fundamentals of Electric Drives – by G K DubeyNarosaPublications
2. Power Semiconductor Drives, by S.B.Dewan, G.R.Slemon, A.Straughen,Wiley, IndiaEdition.

Reference Books:

1. Electric Motors and Drives Fundamentals, Types and Apllications, byAustin Hughes and Bill Drury,Newnes.
2. Thyristor Control of Electric drives – Vedam Subramanyam TataMcGraw HillPublications.
3. Power Electronic Circuits, Devices and applications by M.H.Rashid,PHI
4. Power Electronics handbook by Muhammad H.Rashid,Elsevier.

ELECTRICAL MACHINE MODELLING AND ANALYSIS SEMESTER-VI			
Subject Code	**21EEEEP604A**	**IA-Marks**	**30**
Number of Lecture Hours/Week	**3L**	**Exam-Marks**	**70**
Total Number of Lecture Hours	**45**	**Exam-Hours**	**03**
Credits -03			

Course-Objectives:

The objectives of this course is to acquire knowledge on

1. Unified theory of rotating machines.
2. Concept of phase transformation.
3. Mathematical modeling of machines single phase induction
4. Develop concepts on mathematical modeling of electrical machines.
5. Analyze BLDC Machine and switched reluctance machine based on mathematical modeling of BLDCM and SRM

Unit 1	**Hours**
Basic concepts of modeling: Basic Two-pole Machine representation of Commutator machines, 3-phase synchronous machine with and without damper bars and 3-phase induction machine, Kron's primitive Machine-voltage, current and Torque equations	**10**
Unit 2	
DC machine modeling: Mathematical model of separately excited D.C Motor – Steady State Analysis-Transient State Analysis-Sudden application of Inertia Load-Transfer function of Separately excited D.C Motor- Mathematical model of D.C Series motor, Shunt Motor-Linearization Techniques for small perturbations	**10**
Unit 3	
Reference frame theory & Modeling of single-phase Induction Machines: Linear Transformation-Phase transformation - three phase to two phase transformation (abc to dq0) and two phase to three phase transformation dq0 to abc -Power equivalence- Mathematical modeling of single-phase induction machines.	**10**
Unit 4	
Modeling of three phase Induction Machine: Generalized model in arbitrary reference frame-Electromagnetic Torque-Derivation of commonly used Induction machine models- Stator reference frame model-Rotor reference frame model-Synchronously rotating reference frame model-state space model with flux linkages as variables.	**08**
Unit 5	
Modeling of Synchronous Machine: Synchronous machine inductances–voltage equations in the rotor's dq0 reference frame-electromagnetic torque-current in terms of flux linkages-three phase synchronous machine model. Modeling of Special Machines Modeling of PM Synchronous motor, modeling of BLDC motor and modeling of Switched Reluctance motor.	**07**

Course outcomes:

On completion of the course student will be able to:

1. Discuss about the basic concepts of machine modeling
2. Develop mathematical model of dc motor
3. Acquire knowledge on the abc to dq0 and dq0 to abc transformations to develop mathematical model of single-phase induction machine
4. Design control strategies based on dynamic modeling of 3-ph Induction machines and 3-phase synchronous machine.
5. Model synchronous machine and special electrical machines

Question paper pattern:

The question paper will have 10 questions.

1. Each full question carries 14 marks.
2. Each full question will have sub question covering all topics under unit.

The student will have to answer 5 full questions selecting one full question from each unit.

Text Books:

1. Generalized theory of Electrical Machinery –P.S.Bimbra- Khanna Publishers.
2. Electric Motor Drives - Modeling, Analysis& control -R.Krishnan- Pearson Publications-1st edition -2002.

Reference Books:

1. Analysis of Electrical Machinery and Drive systems – P.C.Krause, OlegWasynczuk, Scott D.Sudhoff – Second Edition-IEEE Press.
2. Dynamic simulation of Electric machinery using Matlab / Simulink –CheeMunOng-PHl.
3. Modern Power Electronics and AC Drives-B.K. Bose - PHI

POWER SYSTEM PROTECTION SEMESTER-VI			
Subject Code	**21EEEEP604B**	**IA Marks**	**30**
Number of Lecture Hours/week	**3L**	**Exam Marks**	**70**
Total Number of Lecture Hours	**45**	**Exam Hours**	**03**
Credits-03			

Course Objectives:

This course will enable student to:

1. Know the classification, operation and application of different types of electromagnetic protective relays.
2. Know the basic principles and operation of various circuit breakers.
3. Explain the protective schemes used for generator and transformers.
4. Explain the protective schemes used for feeders and transmission lines.
5. Evaluate static and microprocessor based relays

Unit-1	**Hours**
Protective Relays: zones of protection, primary and backup protection, essential qualities of protection, classification of protective relays and schemes, current transformers, potential transformers. Introduction to over-current relays, directional relays, distance relays, differential relays.	**10**
Unit-2 **Circuit Breakers:** Introduction, arcing in circuit breakers, arc interruption theories, re-striking and recovery voltage, resistance switching, current chopping, interruption of capacitive current, oil circuit breaker, air blast circuit breakers, SF6 circuit breaker, operating mechanism, selection of circuit breakers, high voltage DC breakers, ratings of circuit breakers, testing of circuit breakers	**08**
Unit-3 **Generator Protection:** External and internal faults, differential protection, biased circulating current protection, self-balance system. Over-current and earth fault protection, protection against failure of excitation. **Transformer protection:** Differential protection, self-balance system of protection, over-current and earth fault protection, Buchholz's relay and its operation.	**10**
Unit-4 **Feeder protection:** Protection of radial feeders, protection of parallel feeders, protection of ring mains, differential pilot protection for feeders, Merz Price voltage balance system, translay system. **Transmission Line Protection:** Definite distance and time distance protection, phase and earth fault protection, carrier current protection	**10**
Unit -5 **Static Relays:** Static over current relays, static directional relay, static differential relay, and static distance relays. **Microprocessor Based Relays:** Over current relays, directional relays, distance relays.	**07**

Course outcomes:

On completion of the course student will be able to:

1. Analyze the working principle and operation of different types of electromagnetic protective relays.
2. Analyze quenching mechanisms used in air, oil, SF6 and vacuum circuit breakers
3. Design protection schemes for generator and transformers.
4. Design protection schemes for feeders and transmission lines.
5. Evaluate static and microprocessor based relays.

Question paper pattern:

The question paper will have 10 questions.

1. Each full question carries 14 marks.
2. Each full question will have sub question covering all topics under unit.

The student will have to answer 5 full questions selecting one full question from each unit.

Text Books:

1. Badri ram and D.N. Vishwakarma, Power System Protection and Switchgear, TMH, 2001.
2. U.A. Bakshi, M. V. Bakshi: Switchgear and Protection, Technical Publications.
3. L. Singh, Digital Protection: Protective relaying from Electromechanical to Microprocessors New Age International.

Reference Books:

1. Fundamentals of Power System Protection by Paithankar and S.R.Bhide.,PHI.
2. Art & Science of Protective Relaying – by C R Mason, Wiley Eastern Ltd.
3. Protection and Switch Gear by BhaveshBhalja, R.P. Maheshwari, NileshG.Chothani, Oxford University Press.

CONTROL SYSTEM DESIGN SEMESTER-VI			
Subject Code	**21EEEEP604C**	**IA Marks**	**30**
Number of Lecture Hours/week	**3L**	**Exam Marks**	**70**
Total Number of Lecture Hours	**45**	**Exam Hours**	**03**
Credits – 03			

Course Objectives:

This course will enable student to

1. Explain the concepts of design problem and various design specifications.
2. Discuss the design of compensator for both time and frequency domain specifications.
3. Explain the design of various controllers.
4. Understand the concept on feed-forward control.
5. Apply the knowledge on state feedback controller design.

Unit-1	**Hours**
Design Specifications : Introduction to design problem and philosophy. Introduction to time domain and frequency domain design specification and its physical relevance. Effect of gain on transient and steady state response. Effect of addition of pole on system performance. Effect of addition of zero on system response.	**08**
Unit-2	**09**
Design of Classical Control System in the time domain and Frequency domain : Introduction to compensator. Design of Feedback and Feed forward compensators, Feedback compensation. Realization of compensators. Compensator design in frequency domain to improve steady state and transient response. Feedback and Feed forward compensator design using Bode diagram.	
Unit-3	**09**
Design of PID controllers : Design of P, PI, PD and PID controllers in time domain and frequency domain for first, second and third order systems. Control loop with auxiliary feedback – Feed forward control.	
Unit-4	**10**
Control System Design in state space : Review of state space representation. Concept of controllability & observability, effect of pole zero cancellation on the controllability & observability of the system, pole placement design through state feedback. Ackerman's Formula for feedback gain design. Design of Observer. Full order, Reduced order observer. Separation Principle.	
Unit-5	**09**
State Feedback Control: Introduction, state feedback controller design with example, Design insights using controllability, Ackermann's pole-placement formula, Reference input tracking with example, Pole-placement example with full Matlab code.	

Course outcomes:

On completion of the course student will be able to:

1. Elaborate the concepts of various designing fundamentals.
2. Apply the basic design in both time and frequency domain
3. Understand the concepts of PID controllers
4. Apply the knowledge of design using state space
5. Discuss the concepts of state feedback controller design.

Question paper pattern:

The question paper will have 10 questions.

1. Each full question carries 14 marks.
2. Each full question will have sub question covering all topics under unit.

The student will have to answer 5 full questions selecting one full question from each unit.

Text Books:

1. N. Nise, "Control system engineering", John Wiley, 2000.
2. I.J. Nagrath and M. Gopal, "Control system engineering", Wiley, 2000.
3. M. Gopal, "Digital Control Engineering", Wiley Eastern, 1988.
4. K. Ogata, "Modern Control Engineering", Prentice Hall, 2010.

Reference Books:

1. B. C. Kuo, "Automatic Control system", Prentice Hall, 1995.
2. J. J. D' Azzo and C. H. Houpis, "Linear control system analysis and design (conventional and modern)", McGraw Hill, 1995.
3. R. T. Stefani and G. H. Hostetter, "Design of feedback Control Systems", Saunders College Pub, 1994.

MICROPROCESSORS & MICROCONTROLLERS LABORATORY SEMESTER-VI			
Subject Code	**21EEEEL6060**	**1A Marks**	**15**
Number of Practice Hours/Week	**3P**	**Exam Marks**	**35**
Total Number of Practice Hours	**36**	**Exam Hours**	**03**
Credits – 1.5			

Course Objectives:

This course will enable student to :

1. Study the Architecture of 8, 16, 32 bit Microprocessors.
2. Learn the Programming skills of Microprocessor & Microcontroller.
3. Learn the design aspects of I/O and Memory Interfacing circuits.
4. Study the Architecture of 8051 microcontroller
5. Learn the design aspects of 8051 for different applications.

List of Experiments (Any 10 experiments must be conducted)

PART-A Microprocessor 8086

1. Arithmetic operation – Multi byte addition and subtraction, multiplication and Division
2. Arithmetic operation - Signed and Unsigned arithmetic operation, ASCII - arithmetic operation.
3. Logic operations- Shift and Rotate- Converting packed BCD to unpacked BCD, BCD to ASCII conversion.
4. By using string operation and instruction prefix: Move block, Reverse string, Sorting,

PART-B Microcontroller 8051

5. Reading and writing on a parallel port using 8051.
6. Timer in different modes using 8051.
7. 8-bit Analog to Digital Converter using 8051
8. 8-bit Digital to Analog Converter using 8051

PART-C 8051 Interfacing

9. Switches and LEDs
10. 7-Segment display (multiplexed)
11. Stepper Motor Interface
12. Traffic Light Control

Course Outcomes:

On completion of the course student will be able to:

1. Develop programs on 8086 Microprocessor.
2. Develop programs for different applications using 8086 & 8051.
3. Design and implement programs on 8051 Micro controller.
4. Interface Micro Controller with other electronic devices.
5. Demonstrate the I/O interfacing

CONTROLSYSTEMS LAB SEMESTER VI			
Subject Code	**21EEEEL6070**	**IA Marks**	**15**
Number of Lecture Hours/week	**3P**	**Exam Marks**	**35**
Total Number of Lecture Hours	**32**	**Exam Hours**	**03**
Credits1.5			

Course Objectives:

This course will enable students:

1. To strengthen the knowledge of Feedback control
2. To inculcate the controller design concepts
3. To introduce the concept of Mathematical Modeling

List of Experiments(Any ten experiments must be conducted)

1. Time response of Second order system and determination of time domain specifications
2. Characteristics of AC servomotor.
3. Characteristics of DC servomotor.
4. Transfer function of DC Motor and DC Generator
5. Effect of P, PD, PI, PID Controller on a second order systems
6. Lagand lead compensation–Magnitude and phaseplot.
7. Temperature controller using PID Controller.
8. Stability analysis (RootLocus,Bode plot ,Nyquist plot) of linear time in variant system.
9. Find the delay time and rise time of PID Controlled DC motor using MATLAB
10. Design the compensators with given gain margine and phase margine.
11. State space model for classical transfer function.

Course(Lab)outcomes:

On completion of the course student will be:

1. Able to derive transfer function of different physical Systems
2. Able to analyze the behavior of second order system with time domain specifications
3. Able to compute Stability of LTI system using Bode Plot Nyquist plot
4. Able to compute Stability of LTI system using Nyquist plot
5. Able to analyze the the different controllers

POWER SYSTEMS ANALYSIS LAB SEMESTER-VI			
Subject Code	**21EEEEL6080**	**IA Marks**	**15**
Number of Practice Hours/week	**3P**	**Exam Marks**	**35**
Total Number of Practice Hours	**36**	**Exam Hours**	**03**
Credits – 03			

Course Objectives:

This course will enable student to :

1. Examine various numerical methods applied to a power system in steady state.
2. Explain stability constraints in a synchronous grid.
3. Demonstrate the methods to control the voltage, frequency and power flow.
4. Explain the monitoring and control of a power system.
5. Discuss the basics of power system economics.

List-of-Experiments-(Any-ten-experiments-must-be-conducted)

1. Formation of Bus Admittance and Impedance Matrices and Solution of Networks.
2. Load Flow Analysis- I : Solution of load flow and related problems using Gauss-Seidel Method.
3. Load Flow Analysis II: Solution of load flow and related problems using Newton Raphson.
4. Load Flow Analysis - II: Solution of load flow and related problems using decoupled and fast decoupled.
5. Fault Analysis of Symmetrical and unsymmetrical faults.
6. Simulation of Swing Equations of a synchronous machine connected a single infinite bus.
7. Analysis of application of Equal Area Criterion in stability studies.
8. Transient and Small Signal Stability Analysis: Single-Machine Infinite Bus System.
9. Transient Stability Analysis of Multi machine Power Systems.
10. Load - Frequency Dynamics of Single- Area and Two-Area Power Systems.
11. System load variation and load characteristics - load curves and load-duration curve.
12. Economic dispatch using lambda-iteration method.
13. Unit commitment: Priority-list schemes and dynamic programming.

Course outcomes:

On completion of the course student will be able to:

1. Examine various numerical methods applied to a power system in steady state.
2. Examine the power system under abnormal conditions
3. Examine stability constraints in a synchronous grid.
4. Demonstrate the methods to control the voltage, frequency and power flow.
5. Illustrate the monitoring and control of a power system.
6. Infer the economic operation of the power system

Course structure for Electrical & Electronics Engineering
Honors (for EEE Students)

III B. Tech II Semester:

S. No	Subject code	Name of the Subject	L	T	P	C
1	21EEEEH611A	Modern Power Electronics	3	1	0	4
2	21EEEEH611B	AC Drives	3	1	0	4
3	21EEEEH611C	Custom Power devices.	3	1	0	4
4	21EEEEH611D	High Voltage Engineering	3	1	0	4

MODERN POWER ELECTRONICS SEMESTER-VI			
Subject Code	**21EEEEH611A**	**IA Marks**	**30**
Number of Lecture Hours/week	**3L**	**Exam Marks**	**70**
Total Number of Lecture Hours	**45**	**Exam Hours**	**03**
Credits – 04			

Course Objectives:

This course will enable student to :

1. Understand the basic concept of power electronics in the field of power control & drives.
2. Understand the concept and methods behind modern power electronic devices.
3. Understand the knowledge behind power semiconductors technologies and their advancement in the field of power conversion.
4. Understand the concept of different level of converters.
5. Understand the concept of modern and advance electric drives.

Unit-1	
Introduction: Review of power semiconductor devices: Thyristor, IGBT, MOSFET, IGCT, GTO and their driver circuits, role of SiC in power semiconductor technology	**Hours – 06**
Unit – 2	**Hours – 12**
AC-DC Converter: Uncontrolled rectifier, semi-controlled rectifiers, fully controlled rectifiers with R, RL and RLE load, effect of source inductance on performance of converter, firing schemes and circuits, **Multipulse Converters:** Multi-pulse converters: 12,18 and 24 pulse converters, phase shifting transformers **Power Factor:** Power factor improvement techniques, PWM rectifiers: equal area PWM, sine PWM, Single Phase and Three phase boost rectifier circuits	
Unit – 3	**Hours – 12**
DC-AC converters: **Voltage Source Inverter:** 120º and 180º conduction modes, **PWM Techniques of Voltage fed Converters:** Selective Harmonic Elimination (SHE), Third harmonic injection, Hysteresis Current Control, Space Vector Pulse Width Modulation. **Current Source Inverter:** Current Source inverters and their role in high power drives: Auto sequential Current Fed inverter, Pulse Width Modulation of CSI	
Unit – 4	**Hours – 08**
Multilevel Inverters: Diode Clamped, Flying Capacitor, Cascaded H-Bridge topology: operation with equal and unequal DC voltages, Carrier modulation schemes of MLI, SVPWM of MLI, Neutral Point Balancing schemes	
Unit – 5	**Hours – 07**
Advance Electrical Drives: **Brushless DC motor:** Sinusoidal and Trapezoidal BLDC motor, Electronic Commutator, Torque production in BLDC motor, Control of Brushless DC drives	

Switched Reluctance Motor:
Elementary Operation and Principle of operation, Modes of operation, Converter circuits for SRM.

Course outcomes:

On completion of the course student will be able to:

1. Know working of concept of power electronics in the field of power control & drives.
2. Analyze concept and methods behind modern power electronic devices.
3. Understand the power semiconductors technologies and their advancement in the field of power conversion.
4. Identify the different areas power conversion and related technology
5. Analyze modern and advance electric drives in day to day life.

Question paper pattern:

1. This section will have 10 questions.
2. Each full question carries 14 marks.
3. Each full question will have sub question covering all topics under unit.

The student will have to answer 5 full questions selecting one full question from each unit.

Text Books:

1. Rashid, M.H., "Power Electronic Circuits Devices and Applications", Prentice Hall of India Pvt. Ltd., New Delhi, 2nd Edition 1999
2. B.K. Bose, "Modern Power Electronics and AC Drives", Prentice Hall of India Pvt. Ltd., New Delhi.
3. Dubey G.K., "Power Semiconductors Controlled Drives", Prentice Hall Eaglewood Cliffs, New Jersey, 2002.

Reference Books:

1. Sen P.C., "Thyristor Dc Drives", John Wiley and sons, New York.
2. Bin Wu., "High power converters and AC Drives", Wiley-IEEE Press.

AC DRIVES SEMESTER-VI			
Subject Code	21EEEEH611B	IA Marks	30
Number of Lecture Hours/week	3L	Exam Marks	70
Total Number of Lecture Hours	45	Exam Hours	03
Credits – 04			

Course Objectives:

The Objectives of this course to

1. Understand the concept of phase transformation
2. Understand the modeling of 3-ϕ induction machines.
3. Explain the modeling of synchronous machines.
4. Explain the stator and rotor control of induction motor drives
5. Understand the self and separate control of synchronous motor drives.

Unit 1: Reference Frame Theory	**Hours**
Reference frame theory: Linear transformation, Phase transformation - 3-ϕ to 2-ϕ transformation (abc to dq0) and 2-ϕ to 3-ϕ transformation (dq0 to abc) - Power equivalence	**08**
Unit 2: Modeling of 3-ϕ Induction Machines	**12**
3-ϕ Induction Machines: Generalized model in arbitrary reference frame - Electromagnetic torque - Stator reference frame model - Rotor reference frame model - Synchronously rotating reference frame model	
Unit 3: Modeling of Synchronous Machines	**08**
Synchronous machine inductances – voltage equations in the rotor's dq0 reference frame electromagnetic torque- current in terms of flux linkages - three synchronous machine model	
Unit 4: Control of Induction Motor Drives	**08**
Stator side control - Stator voltage control using 3-phase AC voltage regulators – Waveforms – Speed torque characteristics – Variable Voltage Variable Frequency control of induction motor by PWM voltage source inverter – Closed loop V/f control of induction motor drives (qualitative treatment only). Rotor side control - Static rotor resistance control – Slip power recovery schemes – Static Scherbius drive – Static Kramer drive – Performance and speed torque characteristics – Advantages – Applications.	
Unit 5: Control of Synchronous Motor Drives	**09**
Separate control & self-control of synchronous motors – Operation of self - controlled synchronous motors by VSI – Closed Loop control operation of synchronous motor drives (qualitative treatment only) – Variable frequency control – Pulse width modulation.	

Course Outcomes:

Students will be able to:

1. Analyze the phase transformation
2. Illustrate the modeling of 3- ϕ induction machines
3. Illustrate the modeling of synchronous machines
4. Explain the v/f control of induction machines
5. Compare the stator and rotor control methods of induction machines

Compare the self and separate control methods of synchronous machines

Question paper pattern:

The question paper will have 10 questions.

1. Each full question carries 14 marks.
2. Each full question will have sub question covering all topics under unit.

The student will have to answer 5 full questions selecting one full question from each unit.

Text Books:

1. Generalized theory of Electrical Machinery –P.S. Bimbra- Khanna Publishers.
2. Bimal K. Bose, "Modern Power Electronics and AC Drives", Pearson Education 2002.
3. N. Mohan, Power Electronics- Converters, Applications and Design, 3rd Ed., John Wiley & Sons, 2003.

Reference Books:

1. Vedam Subramanyam, "Electric Drives – Concepts and Applications", McGraw Hill, Second Edition, 2010.
2. Gobal K. Dubey, "Fundamentals of Electrical Drives", Narosal Publishing House, New Delhi, Second Edition ,2009
3. R.Krishnan, "Electric Motor Drives – Modeling, Analysis and Control", Prentice-Hall of India Pvt. Ltd., New Delhi, 2003.
4. M. Rashid, Power Electronics- Circuits, Devices and Applications, 3rd Ed., Prentice Hall, 2004.
5. Analysis of Electrical Machinery and Drive systems – P.C. Krause, Oleg Wasynczuk, Scott D. Sudhoff – Second Edition-IEEE Press.
6. Modern Power Electronics and AC Drives-B.K. Bose - PHI

CUSTOM POWER DEVICES.			
Subject Code	**21EEEEH611C**	**IA Marks**	**30**
Number of Lecture Hours/week	**3L**	**Exam Marks**	**70**
Total Number of Lecture Hours	**45**	**Exam Hours**	**03**
Credits – 04			

Course Objectives:

This course will enable student to:

1. To learn different types of power quality phenomena.
2. To identify sources for voltage sag, voltage swell, interruptions, transients, long duration over voltages and harmonics in a powersystem.
3. To describe power quality terms and study power qualitystandards.
4. To learn the principle of voltage regulation and power factor improvementmethods.
5. To understand the power quality monitoring concepts and the usage of measuring instruments.

Unit-1	
Introduction Overview of power quality – Concern about the power quality – General classes of power quality and voltage quality problems – Transients – Long–duration voltage variations – Short–duration voltage variations – Voltage unbalance – Waveform distortion – Voltage fluctuation – Power frequency variations.	**Hours -09**
Unit – 2 **Voltage imperfections in power systems** Power quality terms – Voltage sags – Voltage swells and interruptions – Sources of voltage sag, swell and interruptions – Nonlinear loads – IEEE and IEC standards. Source of transient over voltages – Principles of over voltage protection – Devices for over voltage protection – Utility capacitor switching transients.	**Hours - 10**
Unit – 3 **Voltage Regulation and power factor improvement:** Principles of regulating the voltage – Device for voltage regulation – Utility voltage regulator application – Capacitor for voltage regulation – End–user capacitor application – Regulating utility voltage with distributed resources – Flicker – Power factor penalty – Static VAR compensations for powerfactor improvement.	**Hours -10**
Unit – 4 **Harmonic distortion and solutions** Voltage distortion vs. Current distortion – Harmonics vs. Transients – Harmonic indices – Sources of harmonics – Effect of harmonic distortion – Impact of capacitors, transformers, motors and meters – Point of common coupling – Passive and active filtering	**Hours -09**
Unit – 5 **Custom power devices for power quality Improvement**:- Introduction to shunt and series compensators: Principle& Working of DSTATCOM – DSTATCOM in Voltage control mode, current control mode, DVR Structure – Rectifier supported DVR – DC Capacitor supported DVR -Unified power quality conditioner.	**Hours -08**

Course outcomes:

On completion of the course student will be able to:

1. Differentiate between different types of power quality problems.
2. Explain the sources of voltage sag, voltage swell, interruptions, transients, long duration over voltages and harmonics in a power system.
3. Analyze power quality terms and power quality standards.
4. Explain the principle of voltage regulation and power factor improvement methods.
5. Explain the power quality monitoring concepts and the usage of measuring instruments.

Question paper pattern:

The question paper will have 10questions.

1. Each full question carries 14marks.
2. Each full question will have sub question covering all topics underunit.

The student will have to answer 5 full questions selecting one full question from each unit.

Text Books:

1. Electrical Power Systems Quality, Dugan R C, McGranaghan M F, Santoso S,and Beaty H W, Second Edition, McGraw–Hill,
2. Electric power quality problems –M.H.J.Bollen IEEE series-WileyIndia publications,2011.
3. Ghosh, Arindam, and Gerard Ledwich, 'Power quality enhancement using custom power devices' Springer Science & Business Media, 2012

Reference Books:

1. Power Quality Primer, Kennedy B W, First Edition, McGraw–Hill,
2. Understanding Power Quality Problems: Voltage Sags and Interruptions, BollenM HJ, First Edition, IEEE Press
3. Power System Harmonics, Arrillaga J and Watson N R, Second Edition, John Wiley & Sons

High Voltage Engineering SEMESTER-VI			
Subject Code	21EEEEH611D	**IA-Marks**	**30**
Number of Lecture Hours/Week	**3L**	**Exam-Marks**	**70**
Total Number of Lecture Hours	**45**	**Exam-Hours**	**03**
Credits-04			

Course-Objectives:

This course will enable student to:

1. To understand HV breakdown phenomena in gases.

2. To understand the breakdown phenomenon of liquids and solid dielectrics.

3. To acquaint with the generating principle of operation and design of HVDC, AC voltages.

4. To understand the generating principles of Impulse voltages & currents.

5. To understand various techniques for AC, DC and Impulse measurements of high voltages and currents**.**

Unit 1	**Hours**
Break down phenomenon in Gases: Insulating Materials: Types - applications and properties. Gases as insulating media – Collision process – Ionization process – Townsend's criteria of breakdown in gases and its limitations – Streamers Theory of break down – Paschen's law- Paschens curve.	**9**
Unit 2	
Break down phenomenon in Liquids and Solids: Liquid as Insulator – Pure and commercial liquids – Breakdown in pure and commercial liquids. Intrinsic breakdown – Electromechanical breakdown – Thermal breakdown – Breakdown of composite solid dielectrics.	**9**
Unit 3	
Generation of High DC and High AC voltages: Generation of High DC voltages: Voltage Doubler Circuit - Voltage Multiplier Circuit – Vande- Graaff Generator. Generation of High AC voltages: Cascaded Transformers – Resonant Transformers –Tesla Coil	**9**
Unit 4	
Generation of Impulse voltages and Impulse Currents: Generation of Impulse voltages: Specifications of impulse wave – Analysis of RLC circuit only- Marx Circuit. Generation of Impulse currents: Definitions – Circuits for producing Impulse current waves – Wave shape control - Tripping and control of impulse generators.	**10**
Unit 5	
Measurement of High DC & AC Voltages: Resistance potential divider - Generating Voltmeter - Capacitor Voltage Transformer (CVT) -Electrostatic Voltmeters – Sphere Gaps, Standards	**8**

Courseoutcomes:

Oncompletionofthecoursestudentwillbeableto:

1. Recognise the dielectric properties of gaseous materials used in HV equipment.
2. Differentiate the break down phenomenon in liquid and solid dielectric materials.
3. Explain the techniques of generation of high AC and DC voltages
4. Explain the techniques of generation of high Impulse voltages and currents.
5. Explain measurement techniques of high AC - DC - Impulse voltages and currents

Question paper pattern:

The question paper will have 10 questions.

3. Each full question carries 14 marks.
4. Each full question will have sub question covering all topics under unit.

The student will have to answer 5 full questions selecting one full question from each unit.

Text Books:

1. High Voltage Engineering: Fundamentals by E.Kuffel, W.S.Zaengl, J.Kuffel by Elsevier, 2nd Edition.
2. High Voltage Engineering and Technology by Ryan, IET Publishers.

ReferenceBooks:

1. High Voltage Engineering by M.S.Naidu and V. Kamaraju – TMH Publications, 3rd Edition
2. High Voltage Engineering by C.L.Wadhwa, New Age Internationals (P) Limited, 1997.
3. High Voltage Insulation Engineering by RavindraArora, Wolfgang Mosch, New Age International (P)Limited,1995

Minors to other Departments

III B. Tech II Semester:

S. No	Subject code	Name of the Subject	L	T	P	C
1	21XXEEM611A	Fundamentals of Electrical Power Generation & Economic Concepts	3	1	0	4
2	21XXEEM611B	Fundamentals of Renewable Energy Sources	3	1	0	4
3	21XXEEM611C	Fundamentals of Energy Storage Systems	3	1	0	4

FUNDAMENTAL OF ELECTRICAL POWER GENERATION & ECONOMIC CONCEPTS SEMESTER-VI			
Subject Code	21XXEEM611A	**IA-Marks**	**30**
Number of Lecture Hours/Week	**4L**	**Exam-Marks**	**70**
Total Number of Lecture Hours	**46**	**Exam-Hours**	**03**
Credits -04			

Course-Objectives:

This course will enable student to:

1. To understand the principle of operation of different components of a thermal power stations.
2. To understand the principle of operation of different components of a Nuclear power stations.
3. To analyze constructional and operation of different components of an Air and Gas Insulated substations.
4. To study constructional details of different types of cables.
5. To understand different types of load curves and tariffs applicable to consumers.

Unit 1	**Hours**
Thermal Power Stations Selection of site, general layout of a thermal power plant showing paths of coal, steam, water, air, ash and flue gasses, ash handling system, Brief description of components: boilers, super heaters, economizers, electrostatic precipitators, steam turbines: impulse and reaction turbines, condensers, feed water circuit, cooling towers and chimney.	**10**
Unit 2	
Nuclear Power Stations Location of nuclear power plant, working principle, nuclear fission, nuclear fuels, nuclear chain reaction, nuclear reactor components: moderators, control rods, reflectors and coolants, types of nuclear reactors and brief description of PWR, BWR and FBR. Radiation: radiation hazards and shielding, nuclear waste disposal.	**08**
Unit 3	
Substations Classification of substations: **Air Insulated Substations**– indoor & outdoor substations, substations layouts of 33/11 kV showing the location of all the substation equipment.Bus bar arrangements in the sub-stations: simple arrangements like single bus bar, sectionalized single bus bar, double bus bar with one and two circuit breakers, main and transfer bus bar system with relevant diagrams.	**08**
Unit 4	
Gas Insulated Substations (GIS) – advantages of gas insulated substations, different types of gas insulated substations, single line diagram of gas insulated substations, constructional aspects of GIS, installation and maintenance of GIS, comparison of air insulated substations and gas insulated substations.	**10**
Unit 5	
Economic Aspects of Power Generation & Tariff **Economic Aspects** – load curve, load duration and integrated load duration curves, discussion on economic aspects: connected load, maximum demand, demand factor, load factor, diversity factor, power capacity factor and plant use factor, base and peak load plants. **Tariff Methods**– costs of generation and their division into fixed, semi-fixed and running costs, desirable characteristics of a tariff method, tariff methods: simple rate, flat rate, block-rate, two-part, three–part, and power factor tariff methods.	**08**

Course outcomes:

On completion of the course student will be able to:

1. Identify the different components of thermal power plants.
2. Identify the different components of nuclear power plants.
3. Identify the different components of air and gas insulated substations.
4. Identify single core and three core cables with different insulating materials.
5. Analyse the different economic factors of power generation and tariffs.

Question paper pattern:

The question paper will have 10 questions.

5. Each full question carries 14 marks.
6. Each full question will have sub question covering all topics under unit.

The student will have to answer 5 full questions selecting one full question from each unit.

Text Books:

1. A Text Book on Power System Engineering by M.L.Soni, P.V.Gupta, U.S.Bhatnagarand Chakrabarti, DhanpatRai& Co. Pvt. Ltd.

2. Generation, Distribution and Utilization of Electric Energy by C.L.Wadhawa New age International (P) Limited, Publishers.

Reference Books:

1. Electrical Power Distribution Systems by V. Kamaraju, TataMcGraw Hill, New Delhi.
2. Elements of Electrical Power Station Design by M V Deshpande, PHI, New Delhi.

FUNDAMENTALS OF RENEWABLE ENERGY SOURCES

SEMESTER-VI

Subject Code	21XXEEM611B	**IA-Marks**	**30**
Number of Lecture Hours/Week	**4L**	**Exam-Marks**	**70**
Total Number of Lecture Hours	**45**	**Exam-Hours**	**03**

Credits -04

Course-Objectives:

This course will enable student to:

1. To study the solar radiation data, equivalent circuit of PV cell and its I-V & P-V characteristics.
2. To understand the concept of Wind Energy Conversion & its applications.
3. To study the principles of biomass and geothermal energy.
4. To understand the principles of Ocean Thermal Energy Conversion (OTEC), motion of waves andpower associated with it.
5. To study the various chemical energy sources such as fuell cell and hydrogen energy along withtheir operation and equivalent circuit.

Unit 1	**Hours**
Fundamentals of Energy Systems and Solar Energy: Energy conservation principle, Energy scenario (world and India) Solar radiation at the Earth Surface - Equivalent circuit of a Photovoltaic (PV) Cell - I-V & P-V Characteristics - Solar Energy Collectors: Flat plate Collectors, concentrating collectors - Solar Energy storage systems and Applications: Solar Pond - Solar water heating - Solar Green house.	**10**
Unit 2	
Wind Energy: Introduction - basic Principles of Wind Energy Conversion, the nature of Wind - the power in the wind - Wind Energy Conversion - Site selection considerations - basic components of Wind Energy Conversion Systems (WECS) - Classification - Applications.	**08**
Unit 3	
Biomass and Geothermal Energy: **Biomass:** Introduction - Biomass conversion technologies - Photosynthesis, factors affecting Biodigestion - classification of biogas plants - Types of biogas plants - selection of site for a biogas plant **Geothermal Energy**: Introduction, Geothermal Sources – Applications - operational and Environmentalproblems.	**08**
Unit 4	
Energy From oceans, Waves & Tides: **Oceans:** Introduction - Ocean Thermal Electric Conversion (OTEC) – methods - prospects of OTEC inIndia. **Waves:** Introduction - Energy and Power from the waves - Wave Energy conversion devices. **Tides:** Basic principle of Tide Energy -Components of Tidal Energy.	**10**

Unit 5	
Chemical Energy Sources: **Fuel Cells**: Introduction - Fuel Cell Equivalent Circuit - operation of Fuel cell - types of Fuel Cells -Applications. Introduction - Fuel Cell Equivalent Circuit - operation of Fuel cell - types of Fuel Cells -Applications.	**08**

Course outcomes:

On completion of the course student will be able to:

1. Analyze solar radiation data, extra-terrestrial radiation, radiation on earth's surface and solarEnergy Storage.
2. Illustrate the components of wind energy systems.
3. Illustrate the working of biomass, digesters and Geothermal plants.
4. Demonstrate the principle of Energy production from OTEC, Tidal and Waves.
5. Evaluate the concept and working of Fuel cells & MHD power generation.

Question paper pattern:

The question paper will have 10 questions.

7. Each full question carries 14 marks.
8. Each full question will have sub question covering all topics under unit.

The student will have to answer 5 full questions selecting one full question from each unit.

Text Books:

1. G.D.Rai, Non-Conventional Energy Sources, Khanna Publications, 2011.
2. John Twidell & Tony Weir, Renewable Energy Sources, Taylor & Francis, 2013.
3. Renewable Energy Technologies /Ramesh & Kumar /Narosa.
4. Renewable energy technologies – A practical guide for beginners –Chetong Singh Solanki, PHI.

Reference Books:

1. S.P.Sukhatme & J.K.Nayak, Solar Energy-Principles of Thermal Collection and Storage, TMH,2011.
2. John Andrews & Nick Jelly, Energy Science- principles, Technologies and Impacts, Oxford, 2nd edition, 2013.
3. Shoba Nath Singh, Non- Conventional Energy Resources, Pearson Publications, 2015.

ENERGY STORAGE SYSTEMS SEMESTER-VI			
Subject Code	**21XXEEM611C**	**IA-Marks**	**30**
Number of Lecture Hours/Week	**3L**	**Exam-Marks**	**70**
Total Number of Lecture Hours	**45**	**Exam-Hours**	**03**
Credits -03			

Course-Objectives:

This course will enable student to:

1. To study the Overview of energy storage technologies
2. To study the different types of electrical energy storage devices
3. To understand the working of various types of electric vehicle
4. To understand the configurations and applications of hybrid energy storage systems
5. To study the various types of renewable energy systems
6. To apply the use of energy storage systems in MATLAB Simulink

Unit 1	**Hours**
Introduction to energy storage for power systems: Role of energy storage systems, applications. **Overview of energy storage technologies:** Thermal, Mechanical, Chemical, Electrochemical, Electrical. Efficiency of energy storage systems.	**10**
Unit 2	
Electrical energy storage: Batteries, Super capacitors, Superconducting Magnetic Energy Storage (SMES), charging methodologies, SoC, SoH estimation techniques. Hydrogen production and storage, fuel cells.	**10**
Unit 3	
Mobile storage system: electric vehicle, G2V, V2G. **Hybrid Energy storage systems:** configurations and applications.	**05**
Unit 4	
Storage for renewable energy systems: Solar energy, Wind energy, Pumped hydro energy, fuel cells. Energy storage in Micro-grid and Smart grid. Energy Management with storage systems, Battery SCADA, Increase of energy conversion efficiencies by introducing energy storage.	**10**
Unit 5	
MATLAB base Simulink modals: Simulation of energy storage systems and its management, smart park, Electric Vehicle charging facility, HESS in micro-grid and smart grid, microbial fuel cell, hydrogen fuel cell and so on.	**10**

Course outcomes:

On completion of the course student will be able to:

1. Elaborate the concepts of various energy storage technologies
2. Understand the concepts of electrical energy storage devices
3. Discuss the concepts of hybrid energy storage systems and mobile storage system
4. Analyze the operation of renewable energy systems
5. Apply the knowledge of design using MATLAB Simulink

Question paper pattern:

The question paper will have 10 questions.

9. Each full question carries 14 marks.
10. Each full question will have sub question covering all topics under unit.

The student will have to answer 5 full questions selecting one full question from each unit.

Text Books:

1. A.G.Ter-Gazarian, "Energy Storage for Power Systems", Second Edition, The Institution of Engineering and Technology (IET) Publication, UK,
2. " Energy Storage in Power Systems" Wiley Publication, ISBN: 978-1-118-97130-7, Mar
3. A. R. Pendse, "Energy Storage Science and Technology", SBS Publishers & Distributors

Pvt. Ltd., New Delhi

Reference Books:

1. Electric Power Research Institute (USA), "Electricity Energy Storage Technology Options: A White Paper Primer on Applications, Costs, and Benefits" (1020676), December 2010.
2. Paul Denholm, Erik Ela, Brendan Kirby and Michael Milligan, "The Role of Energy Storage with Renewable Electricity Generation", National Renewable Energy Laboratory (NREL) – A National Laboratory of the U.S. Department of Energy – Technical Report NREL/ TP6A2-47187,

TRANSMISSION AND DISTRIBUTION OF ELECTRICAL POWER SEMESTER-VII			
Subject Code	**21EEEEM709A**	**IA-Marks**	**30**
Number of Lecture Hours/Week	**3L**	**Exam-Marks**	**70**
Total Number of Lecture Hours	**45**	**Exam-Hours**	**03**
Credits -03			

Course-Objectives:

This course will enable student to:

1. Understand the concepts of electrical power transmission lines.
2. Understand the electrical design and mechanical design of the overhead lines.
3. Understand the performance of the overhead line insulators.
4. Understand the performance of the cables used in power transmission.
5. Understand the AC Distribution Systems.

Unit 1: Electrical Design of Overhead lines	**hours**
Transmission line parameters: resistance, inductance and capacitance calculations - single phase and three phase lines, double circuit line, effect of earth on transmission line capacitance. **Performance of transmission lines:** representation of lines, classification of transmission lines, short transmission line, medium length transmission line (Nominal-T, Nominal-π, End condenser method), long transmission line, Ferranti Effect in transmission lines	**11**
Unit 2: Mechanical Design of Overhead Lines	
Overhead Line Insulators: Introduction, types of insulators, Potential distribution over a string of suspension insulators, Methods of equalizing the potential, testing of insulators. Sag and Tension calculations with equal and unequal heights of towers- Effect of Wind and Ice on weight of Conductor, Calculation of string efficiency, Capacitance grading and Static Shielding.	**10**
Unit 3: Corona and surge impedance	
Corona: Introduction, disruptive critical voltage, corona loss, Factors affecting corona loss and methods of reducing corona loss, Disadvantages of corona, interference between power and Communication lines, surge impedance and SIL of long lines.	**07**
Unit 4: Underground Cables	
Insulated Cables: Introduction, need for insulation to design of cables, insulating materials for cables, Extra high voltage cables, grading of cables, insulation resistance of a cable, Capacitance of a single core and three core cables, Overhead lines versus underground cables, types of cables.	**09**
Unit 5: Distribution Systems	
AC Distribution: Introduction, AC distribution, Single phase, 3-phase, 3 phase 4 wire system,bus bar arrangement, Selection of site and layout of substation. Distribution system losses – Coincidence factor – Contribution factor – loss factor – Relationship between the load factor and loss factor – Numerical Problems	**08**

Course outcomes:

On completion of the course student will be able to:

6. Illustrate the basic concepts of electrical power transmission lines and Describe various types of electrical design of the overhead.
7. Estimate various factors related to mechanical design of the overhead lines.
8. Distinguish concept of corona and surge impedence.
9. Discuss the types of cables and their capacitance calculations.
10. Illustrate the basic concepts of ac distribution systems.

Question paper pattern:

The question paper will have 10 questions.

11. Each full question carries 14 marks.
12. Each full question will have sub question covering all topics under unit.

The student will have to answer 5 full questions selecting one full question from each unit.

Text Books:

1. C.L. Wadhwa, Generation, Distribution and Utilization of Electrical Energy, 3rd Edition, New Age International, 2015.
2. A Text Book on Power System Engineering by M.L.Soni, P.V.Gupta, U.S.Bhatnagarand A. Chakrabarti, DhanpatRai& Co. Pvt. Ltd, 2016
3. Generation, Distribution and Utilization of Electric Energy by C.L.Wadhawa, New age International (P) Limited, Publishers, 3 rd edition.

Reference Books:

4. C.L. Wadhwa, Electrical Power Systems, 7th Edition, New Age International, 2016.
5. D.P. Kothari and I.J. Nagrath, Power System Engineering-- Tata McGraw-Hill Pub. Co., New Delhi, 3rd Edition, 2019.

Course Structure for IV B. Tech I Semester Under the Regulations of SITE-21							
VII SEMESTER							
S. No	**Course Category**	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	PE	21EEEEP701X	Professional Elective-III	3	0	0	3
2	PE	21EEEEP702X	Professional Elective -IV	3	0	0	3
3	PE	21EEEEP703X	Professional Elective -V	3	0	0	3
4	OE	21EEXXO704X	Open Elective -III	2	0	2	3
5	OE	21EEXXO705X	Open Elective -IV	2	0	2	3
6	H&SS	21EEXXO706X	Elective	3	0	0	3
7	SAC/SC	21EEEES7070	Design of Photovoltaic Systems	1	0	2	2
8	SI	21EEEEI7080	Industrial/Research Internship (1-2 Months) after third year to be evaluated in VII semester	0	0	0	3
TOTAL				**17**	**0**	**6**	**23**
9	H/M		Honor/Minor courses(The hours distribution can be 3-0-2 or 3-1-0)	4	0	0	4

Professional Elective-III

S.No.	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	21EEEEP701A	Switched Mode Power Converters	3	0	0	3
2	21EEEEP701B	Electric & Hybrid Vehicles	3	0	0	3
3	21EEEEP701C	Artificial Intelligence Techniques	3	0	0	3

Professional Elective-IV

S.No.	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	21EEEEP702A	Wind & Solar Energy Systems	3	0	0	3
2	21EEEEP702B	Power Quality	3	0	0	3
3	21EEEEP702C	Discrete Control Systems	3	0	0	3

Professional Elective-V

S.No.	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	21EEEEP703A	FACTS & Fundamentals of HVDC transmission systems.	3	0	0	3
2	21EEEEP703B	Smart Grid	3	0	0	3
3	21EEEEP703C	Optimization Techniques	3	0	0	3

SWITCHED MODE POWER CONVERTERS SEMESTER-VII			
Subject Code:	**21EEEEP701A**	**IA Marks**	**30**
Number of Lecture Hours/week	**3L**	**Exam Marks**	**70**
Total Number of Lecture Hours	**45**	**Exam Hours**	**03**
Credits-03			

Course Objectives:

This course will enable the student:

1. To understand the working, analysis and modeling of different types of converters.
2. To get the knowledge of operation of isolated bridge converters, voltage waveforms and control principles.
3. To know the concept of SMPS, its principle operation and application.
4. To understand about the concept of resonant converters.

Unit-1	
Introduction to DC-DC Converters: Review of Buck, Boost, Buck-Boost topologies, Basic Operation, Waveforms, modes of operation-voltage mode control principles. Push-pull and Forward converter, Basic Operation, Waveforms, modes of operation- Transformer design-voltage mode control principles.	**Hours – 07**
Unit – 2	**Hours – 08**
Isolated Bridge Converters: Half and Full Bridge Converters- Basic Operation, Waveforms, modes of operation-voltage mode control principles. Fly back Converter - Basic Operation, Waveforms, modes of operationvoltage mode control principles.	
Unit – 3	**Hours – 08**
Switch mode power supply-I: Voltage Mode Control of SMPS, Loop gain and Stability Considerations, Shaping the Error Amplifier gain versus frequency characteristics, Error amplifier Transfer function, Transconductance Error amplifiers. Current Mode Control of SMPS, Current Mode Control Advantages, Current Mode versus Voltage Mode Control of SMPS – Current Mode Deficiencies - Slope Compensation.	
Unit – 4	**Hours – 12**
Switch mode power supply-II: Modeling of SMPS, Basic AC modeling Approach, Modeling of non-ideal fly back converter, State Space Averaging, basic state space averaged model, State space averaging of non-ideal buck boost converter, Circuit averaging and averaged switch modeling, Modeling of pulse width modulator.	
Unit – 5	**Hours – 08**
Resonant Converters: Introduction to Resonant Converters, Classification of Resonant Converters, Basic Resonant circuit concepts, load resonant converters, resonant switch converters, zero voltage switching, clamped voltage topologies, resonant DC Link inverters with zero voltage switching, High frequency link integral half cycle converter.	

Course outcomes:

On completion of the course student will be able to:

1. Illustrate the working, analysis, and modeling of different types of converters.
2. Develop the knowledge of operation of isolated bridge converters, voltage waveforms and control principles.
3. Apply the concept of SMPS, its principle operation and application.
4. Demonstrate the concept of resonant converters.

Question paper pattern:

1. This section will have 10 questions.
2. Each full question carries 14 marks.
3. Each full question will have sub question covering all topics under unit.

The student will have to answer 5 full questions selecting one full question from each unit.

Text Books:

1. Ned Mohan, Power Electronics, JohnWiley,3rdedition,2011.
2. Billings K.H., Handbook of Switched Mode Power Supplies, McGraw Hill, 3rd edition, 2010.

Reference Books:

1. Pressman A. I, Switching Power Supply Design, McGraw Hill,3rdedition,2009.
2. Nave M.J, Power Line Filter Design for Switched-Mode Power Supplies, Mark Nave Consultants, 2nd edition, 2010.

ELECTRIC AND HYBRID VEHICLES SEMESTER-VII			
Subject Code	**21EEEEP701B**	**IA Marks**	**30**
Number of Lecture Hours/week	**3L**	**Exam Marks**	**70**
Total Number of Lecture Hours	**45**	**Exam Hours**	**03**
Credits – 03			

Course Objectives:

This course will enable student to :

1. Understand working of hybrid and electric vehicles, its performance and characteristics.
2. Understand hybrid vehicle configuration and its components.
3. Understand the electric vehicle drive systems.
4. Understand the properties of energy storage systems.
5. Understand different Energy management strategies

Unit-1	
Introduction: Hybrid Electric Vehicles: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles. Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics, and mathematical models to describe vehicle performance.	**Hours – 08**
Unit – 2 **Hybrid Electric Drive Trains:** Concept of Hybrid Electric Vehicles (HEV), Analysis of drive trains, Energy use in conventional vehicles, Energy saving potential of hybrid drive trains, Architectures of HEV and their operation model. Power flow Analysis in different types of HEV.	**Hours – 10**
Unit – 3 **Electric Drive Trains:** Electric vehicle configuration, Architecture of electric drive train, Configurations of electric drive trains based on transmission system and power source. Single and Multi-Motor drives, In wheel drives, requirements of different electric motors used in EVs, Power-Torque-Speed characteristics, electric propulsion systems.	**Hours – 08**
Unit – 4 **Energy Storage:** Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices.	**Hours – 10**
Unit – 5 **Energy Management Strategies:** Introduction to energy management strategies used in hybrid and electric vehicles, classification, comparison & implementation issues of different energy management strategies. Functions of control system in HEVs & EVs, Elementary control theory, Electronic control unit, control area network, fuzzy logic based control system.	**Hours – 09**

Course outcomes:

On completion of the course student will be able to:

1. Know working of hybrid and electric vehicles & its performance.
2. Analyze hybrid vehicle configuration and its components.
3. Understand the electric vehicle drive systems.
4. Understand the properties of energy storage systems.
5. Apply different Energy management strategies

Question paper pattern:

4. This section will have 10 questions.
5. Each full question carries 14 marks.
6. Each full question will have sub question covering all topics under unit.

The student will have to answer 5 full questions selecting one full question from each unit.

Text Books:

4. C. Mi, M. A. Masrur and D. W. Gao, " Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives", John Wiley & Sons, 2011.
5. S. Onori, L. Serrao and G. Rizzoni, " Hybrid Electric Vehicles: Energy Management Strategies" , Springer, 2015.

Reference Books:

3. M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design", CRC Press, 2004.
4. T. Denton, "Electric and Hybrid Vehicles", Routledge, 2016.

ARTIFICIAL INTELLIGENCE TECHNIQUES

SEMESTER-VII

Subject Code	21EEEEP701C	**IA Marks**	**30**
Number of Lecture Hours/week	**3L**	**Exam Marks**	**70**
Total Number of Lecture Hours	**45**	**Exam Hours**	**03**

Credits – 03

Course Objectives:

This course will enable student to :

1. Understand the basic intelligent controller concept
2. Understand concepts of feed forward neural networks and learning and understanding of feedback neural networks.
3. Understand and analyze the concept of genetic algorithm.
4. Understand the knowledge of fuzzy logic control.
5. Apply the knowledge of fuzzy logic control, genetic algorithm and neural network to the real problems.

Unit-1	
INTRODUCTION TO INTELLIGENT CONTROL: Introduction and motivation. Approaches to intelligent control. Architecture for intelligent control. Symbolic reasoning system, rule-based systems, the AI approach. Knowledge representation. Expert systems.	**Hours – 08**
Unit – 2 **ARTIFICIAL NEURAL NETWORKS** Concept of Artificial Neural Networks, its basic mathematical model, McCulloch-Pitts neuron model, simple perceptron, Adaline and Madaline, Feed-forward Multilayer Perceptron. Learning and Training the neural network. Introduction, derivation, algorithm, flowchart, limitation-Error Back propagation, Hopefield, Radial bases function	**Hours – 12**
Unit – 3 **GENETIC ALGORITHM** Basic concept of Genetic algorithm and detail algorithmic steps, adjustment of free parameters. Solution of typical control problems using genetic algorithm. Concept on some other search techniques like tabu search and ant-colony search techniques for solving optimization problems	**Hours – 08**
Unit – 4 **FUZZY LOGIC SYSTEM** Introduction to crisp sets and fuzzy sets, basic fuzzy set operation and approximate reasoning. Introduction to fuzzy logic modeling and control. Fuzzification, inferencing and defuzzification. Fuzzy knowledge and rule bases. Fuzzy modeling and control schemes for nonlinear systems. Fuzzy logic control for nonlinear time-delay system. Implementation of fuzzy logic controller.	**Hours – 08**
Unit – 5 **APPLICATIONS** Industrial applications to Genetic Algorithm, Neural Network and Fuzzy Logic Control- case studies	**Hours – 09**

Course outcomes:

On completion of the course student will be :

1. Able to identify knowledge representations applied to artificial intelligence techniques
2. Able to model artificial neuron and identify its use in Perceptron models and back propagation algorithm to multilayer feed forward networks
3. Able to analyze concept of genetic algorithm.
4. Able to analyze fuzzy logic controller using MATLAB.
5. Able to analyze various applications of neural and fuzzy logic systems in electrical Engineering

Question paper pattern:

The question paper will have 10 questions.

1. Each full question carries 14 marks.
2. Each full question will have sub question covering all topics under unit.

The student will have to answer 5 full questions selecting one full question from each unit.

Text Books:

1. Simon Haykins, Neural Networks: A comprehensive Foundation, Pearson Edition, 2003.
2. T.J. Ross, Fuzzy logic with Fuzzy Applications, McGraw Hill Inc, 2011.
3. David E Goldberg, Genetic Algorithms. Wesley Publishing Company,1989
4. John Yen and Reza Langari, Fuzzy logic Intelligence, Control, and Information, Pearson Education, Indian Edition, 2003.
5. Neural Network, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications S. Rajasekaran and G. A. VijayalakshmiPai, Prentice Hall India, 2013

Reference Books:

1. M.T. Hagan, H. B. Demuth and M. Beale, Neural Network Design, Indian reprint, 2008.
2. Fredric M. Ham and IvicaKostanic, Principles of Neuro computing for science and Engineering, McGraw Hill, 2001.
3. N. K. Bose and P. Liang, Neural Network Fundamentals with Graphs, Algorithms, and Applications, Mc, Graw Hill, Inc. 1996.
4. Yung C. Shin and ChengyingXu, Intelligent System, Modeling, Optimization and Control, CRC Press, 2009.
5. N. K. Sinha and Madan M Gupta, Soft computing & Intelligent Systems, Theory &Applications, Indian Edition, Elsevier, 2007.
6. WitoldPedrycz, Fuzzy Control and Fuzzy Systems, Overseas Press, Indian Edition, 2008.

WIND AND SOLAR ENERGY SYSTEMS SEMESTER-VII			
Subject Code:	**21EEEEP702A**	**IA Marks**	**30**
Number of Lecture Hours/week	**3L**	**Exam Marks**	**70**
Total Number of Lecture Hours	**45**	**Exam Hours**	**03**
Credits-03			

Course Objectives:

This course will enable student to understand:

1. The fundamental concepts of power generation and gain enough knowledge about the wind and solar energy sources.
2. The construction, principle of operation of various equipments used in power generation
3. The key aspects in the design and operation of photovoltaic along with solar thermal power energy systems.
4. The various factors affecting the power quality issues in integration of renewable energy resources.

Unit-1	
Fundamentals of Wind Power: History of wind power, Indian and Global statistics, Wind physics, Betz limit, Tip speed ratio, stall and pitch control, Wind speed statistics-probability distributions, Wind speed and power-cumulative distribution functions.	**Hours – 07**
Unit – 2	**Hours – 08**
Wind generator topologies: Review of modern wind turbine technologies, Fixed and Variable speed wind turbines, Induction Generators, Doubly-Fed Induction Generators and their characteristics, Permanent- Magnet Synchronous Generators, Power electronics converters. Generator-Converter configurations, Converter Control.	
Unit – 3	**Hours – 10**
Fundamentals of Solar Power: Introduction, solar radiation spectra, solar geometry, Earth Sun angles, observer Sun angles, solar day length, Estimation of solar energy availability. Technologies-Amorphous, mono crystalline, polycrystalline Solar cells & panels, performance of solar cell, estimation of power obtain from solar power,	
Unit – 4	**Hours – 10**
Solar photovoltaic Systems solar panels PV systems, components of PV systems, performance of PV systems, , concentrating PV systems, PV power plants, V-I characteristics of a PV cell, PV module, array, Power Electronic Converters for Solar Systems, Maximum Power Point Tracking (MPPT) algorithms (Hill climbing method, Fractional Short Circuit Current). Converter Control, design of PV systems, applications of PV systems.	

Unit – 5	
Grid integrated Problems & Mitigation Overview of grid code technical requirements. Fault ride-through for wind farms, real and reactive power regulation, voltage and frequency operating limits, solar PV and wind farm behavior during grid disturbances. Power quality issues. Power system interconnection experiences in the world.	**Hours – 10**

Course outcomes:

On completion of the course student will be able to:

1. Remember the energy scenario and the consequent growth of the power generation from renewable energy sources.
2. Analyze the basic physics of wind and solar power generation.
3. Apply the power electronic interfaces to the wind and solar generation.
4. Define the issues related to the grid-integration of solar and wind energy systems.

Question paper pattern:

1. This section will have 10 questions.
2. Each full question carries 14 marks.
3. Each full question will have sub question covering all topics under unit.

The student will have to answer 5 full questions selecting one full question from each unit.

Text Books:

1. T. Ackermann, " Wind Power in Power Systems" , John Wiley and Sons Ltd., 2005.
2. G. M. Masters, "Renewable and Efficient Electric Power Systems", John Wiley and Sons, 2004.
3. S. P. Sukhatme, " Solar Energy: Principles of Thermal Collection and Storage", McGraw Hill, 1984.

Reference Books:

1. H. Siegfried and R. Waddington, " Grid integration of wind energy conversion systems" John Wiley and Sons Ltd., 2006.
2. G. N. Tiwari and M. K. Ghosal, " Renewable Energy Applications" , Narosa Publications, 2004.
3. J. A. Duffie and W. A. Beckman, " Solar Engineering of Thermal Processes", John Wiley & Sons, 1991.
4. Bin Wu, Yongqiang Lang, NavidZargari, Samir Kouro, "Power Conversion and Control of Wind Energy Systems", John Wiley & Sons

POWER QUALITY SEMESTER-VII			
Subject Code	**21EEEEP702B**	**IA-Marks**	**30**
Number of Lecture Hours/Week	**3L**	**Exam-Marks**	**70**
Total Number of Lecture Hours	**45**	**Exam-Hours**	**03**
Credits - 03			

Course Objectives:

This course will enable student to:

7. Infer different types of power quality phenomena.
8. Understand voltage sags and interruptions.
9. Learn the about Transient over voltage.
10. Distinguish between Harmonics and Transients.
11. Know the power quality monitoring concepts and the usage of measuring instruments.

Unit 1: Terms & Definitions	**Hours**
Terms & Definitions: General Classes of Power Quality Problems, Transients, Long Duration Voltage Variations, Short-Duration Voltage Variations, Voltage Imbalance, Waveform Distortion, Voltage Fluctuations, Power Frequency Variations, Power Quality Terms	**09**
Unit 2: Voltage Sags & Interruptions	
Sources of Sags and Interruptions, Estimating Voltage Sag Performance, Fundamental Principles of Protection, Solutions at the End-User Level, Evaluating the Economics of Different Ride-Through Alternatives, Motor Starting Sags, Utility System Fault-Clearing Issues.	**09**
Unit 3: Transient Over Voltages	
Sources of Transient Over Voltages, Principle 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 Transient Analysis.	**09**
Unit 4: Fundamentals of Harmonics	
Harmonic Distortion, Voltage Versus Current Distortion, Harmonics Versus Transients, Power System Quantities under Non-sinusoidal Conditions, Harmonic Indices, Harmonic Sources from Commercial Loads, Locating Harmonic Sources, System Response Characteristics, Effects of Harmonic Distortion, Inter-harmonics..	**09**
Unit 5: Power Quality Monitoring	
Monitoring Considerations, Historical Perspective of Power Quality Measuring Instruments, Power Quality Measurement Equipments, Assessment of Power Quality Measurement Data, Application of Intelligent Systems, Power Quality Monitoring Standards.	**09**

Course outcomes:

On completion of the course student will be able to:

6. Differentiate between types of power quality problems.
7. Analyze power quality terms and power quality standards.
8. Explain the different tools to analyze the transient analysis.
9. Demonstrate the relationship between Harmonics and Transients.
10. Elobarate the power quality monitoring concepts and the usage of measuring instruments

Question paper pattern:

The question paper will have 10 questions.

1. Each full question carries 14 marks.
2. Each full question will have sub question covering all topics under unit.

The student will have to answer 5 full questions selecting one full question from each unit.

Text Books:

1. Electrical Power Systems Quality, Dugan R C, Mc Granaghan M F, Santoso S, and

Beaty H W, Second Edition, McGraw–Hill, 2012, 3rd edition.
2. Electric power quality problems –M.H.J. Bollen IEEE series-Wiley India publications, 2011.

Reference Books:

1. Power Quality Primer, Kennedy B W, First Edition, McGraw–Hill, 2000.
2. Understanding Power Quality Problems: Voltage Sags and Interruptions, Bollen M HJ, First Edition, IEEE Press; 2000.
3. Power System Harmonics, Arrillaga J and Watson N R, Second Edition, John Wiley & Sons, 2003.
4. Electric Power Quality control Techniques, W. E. Kazibwe and M. H. Sendaula, Van Nostrad Reinhold, New York.
5. Power Quality C. Shankaran, CRC Press, 2001
6. Harmonics and Power Systems – Franciso C.DE LA Rosa–CRC Press (Taylor & Francis)
7. Power Quality in Power systems and Electrical Machines–Ewald F. fuchs, Mohammad A.S. Masoum–Elsevier.

DISCRETE CONTROL SYSTEMS SEMESTER-VII			
Subject Code	**21EEEEP702C**	**IA Marks**	**30**
Number of Lecture Hours/week	**3L**	**Exam Marks**	**70**
Total Number of Lecture Hours	**45**	**Exam Hours**	**03**
Credits – 03			

Course Objectives:

This course will enable student to :

1. Obtain discrete representation of LTI systems.
2. Analyze and find the solutions for discrete-time systems.
3. Design and analyze digital controllers.
4. Design state feedback and output feedback controllers.
5. Analyze the concepts of feedback control
6. Understand the basic concepts of fast output sampling

Unit-1	
Discrete Representation of Continuous Systems Basics of Digital Control Systems. Discrete representation of continuous systems. Sample and hold circuit. Mathematical Modeling of sample and hold circuit. Effects of Sampling and Quantization. Choice of sampling frequency. ZOH equivalent.	**Hours – 08**
Unit – 2	**Hours – 08**
Discrete System Analysis Z-Transform and Inverse Z Transform for analyzing discrete time systems. Pulse Transfer function. Pulse transfer function of closed loop systems. Mapping from s-plane to z plane. Solution of Discrete time systems. Time response of discrete time system.	
Unit – 3	**Hours – 12**
Stability of Discrete Time System Stability analysis by Jury test. Stability analysis using bilinear transformation. Design of digital control system with dead beat response. Practical issues with dead beat response design. **State Space Approach for discrete time systems** State space models of discrete systems, State space analysis. Controllability, reachability, Reconstructability and observability analysis. Effect of pole zero cancellation on the controllability & observability.	
Unit – 4	**Hours – 04**
Design of Digital Control System Design of Discrete PID Controller, Design of discrete state feedback controller. Design of Discrete Observer, full order and reduced order for LTI System.	
Unit – 5	**Hours – 05**
Discrete output feedback control Design of discrete output feedback control. Fast output sampling (FOS) and Periodic output feedback controller design for discrete time systems.	

Course outcomes:

On completion of the course student will be able to:

1. Obtain discrete representation of LTI systems.
2. Analyze stability of open loop and closed loop discrete-time systems.
3. Design and analyze digital controllers.
4. Design state feedback and output feedback controllers.
5. Analyze the concepts of feedback control

Question paper pattern:

1. This section will have 10 questions.
2. Each full question carries 14 marks.
3. Each full question will have sub question covering all topics under unit.

The student will have to answer 5 full questions selecting one full question from each unit.

Text Books:

1. K.Ogata,"Digital Control Engineering", Prentice Hall,EnglewoodCliffs,1995.
2. B.C.Kuo,"DigitalControlSystem",Holt,RinehartandWinston,1980.

Reference Books:

3. G. F. Franklin, J. D. Powell and M. L. Workman, " Digital Control of Dynamic Systems", Addison-Wesley,1998.
4. M.Gopal,"DigitalControlEngineering",WileyEastern,1988.

FACTS & FUNDAMENTALS OF HVDC TRANSMISSION SYSTEMS. SEMESTER-VII			
Subject Code	**21EEEEP703A**	**IA-Marks**	**30**
Number of Lecture Hours/Week	**3L**	**Exam-Marks**	**70**
Total Number of Lecture Hours	**45**	**Exam-Hours**	**03**
Credits -			

Course-Objectives:

The objectives of this course are to acquire knowledge on

1. shunt compensation methods to improve stability and learn method of shunt compensations using static VAR compensators.
2. various methods of compensation using series compensators
3. operation of Unified Power Flow Controller (UPFC)
4. 6-pulse and 12-pulse converter performance.
5. control strategies for HVDC network

Unit 1	**Hours**
Introduction to FACTS: FACTS concepts and general system conditions: Power flow in AC systems, Relative importance of controllable parameters, Basic types of FACTS controllers, shunt and series controllers, Current source and Voltage source converters (qualitative treatment only)	**10**
Unit 2	
Static Shunt Compensators: Objectives of shunt compensation, Methods of controllable VAR generation, Static Var Compensator, its characteristics, TCR, TSC, FC-TCR configurations, STATCOM, basic operating principle, control approaches and characteristics	**12**
Unit 3	
Static Series Compensators: Objectives of series compensator, variable impedance type of series compensators, TCSC, TSSC-operating principles and control schemes, SSSC, Power Angle characteristics, Control range and VAR rating, Capability to provide reactive power compensation, external control **Combined Compensators:** Introduction to Unified Power Flow Controller, Basic operating principles, Conventional control capabilities, independent control of real and reactive power.	**12**
Unit 4	
DC Power Transmission: Evolution of AC and DC transmission systems, Comparison of HVDC and HVAC Transmission systems, Types of DC links, Components of a HVDC system, **Analysis of HVDC Converters:** Pulse number, choice of converter configurations, Analysis of Graetz circuit with and without overlap, voltage waveforms, Analysis of two and three valve conduction mode, Converter Bridge characteristics, Inverter mode of operation, voltage waveforms	**14**
Unit 5	
HVDC Control: Principles of DC link control, Converter Control characteristics, Control hierarchy Constant current Control, CEA Control, firing angle control of valves, starting and stopping of a dc link, Power control	**14**

Course outcomes:

On completion of the course student will be able to:

1. Analyze and select a suitable FACTS controller for a given power flow condition
2. Compare the characteristics of static VAR compensation and STATCOM
3. Compare HVDC and HVAC transmission systems
4. Analyze converter configurations for HVDC and FACTS and evaluate the performance

metrics.

5. Understand controllers for power flow control of dc links

Question paper pattern:

The question paper will have 10 questions.

1. Each full question carries 14 marks.
2. Each full question will have sub question covering all topics under unit.

The student will have to answer 5 full questions selecting one full question from each unit.

Text Books:

1. HVDC Power Transmission Systems –Technology and System Interactions, K.R.Padiyar, New Age International Publishers, 2017,Third edition.
2. Direct Current Transmission, Kimbark, Wiley–Blackwell Publishers, Vol.1, 1971.
3. Understanding FACTS –Concepts and Technology of Flexible AC Transmission Systems, Narain G. Hingorani, Laszlo Gyugyi, Wiley India Pvt Ltd, 2011.

Reference Books:

1. High Voltage Direct Current Transmission, Institution of Engineering and Technology, Jos Arrillaga, 1998,2nd edition.
2. Flexible AC Transmission Systems, Yong Hua Song, Allan T Johns, Institution of Engineering and Technology, 1999.

SMART GRID SEMESTER-VII			
Subject Code	**21EEEEP703B**	**IA Marks**	**30**
Number of Lecture Hours/week	**3L**	**Exam Marks**	**70**
Total Number of Lecture Hours	**45**	**Exam Hours**	**03**
Credits-03			

Course Objectives:

This course will enable student to:

1. Understand concept of smart grid and its advantages over conventional grid.
2. Know smart metering techniques.
3. Learn wide area measurement techniques.
4. Understanding the problems associated with integration of distributed generation & its solution through smart grid.

Unit-1	**Hours**
Introduction to Smart Grid: Evolution of Electric Grid, Concept of Smart Grid, Definitions, Need of Smart Grid, Concept of Robust & Self-Healing Grid, Present development & International policies in Smart Grid.	**08**
Unit-2	
Smart Grid Applications-I: Introduction to Smart Meters, Real Time Prizing, Smart Appliances, Automatic Meter Reading(AMR), Outage Management System(OMS), Plug in Hybrid Electric Vehicles(PHEV),Vehicle to Grid, Smart Sensors, Home & Building Automation, Smart Substations, Substation Automation,Feeder Automation	**08**
Unit-3	
Smart Grid Applications-II: Geographic Information System(GIS), Intelligent Electronic Devices (IED) & their application for monitoring & protection, Smart storage like Battery, SMES, Pumped Hydro, Compressed Air Energy Storage, Wide Area Measurement System (WAMS), Phase Measurement Unit(PMU).	**08**
Unit-4	
Micro Grid Technology: Concept of micro-grid, need & applications of micro-grid, Formation of micro-grid, Issues of interconnection, Protection & control of micro-grid, Plastic & Organic solar cells, Thin film solar cells, Variable speed wind generators, fuel-cells, micro- turbines, Captive power plants, Integration of renewable energy sources.	**10**
Unit-5	
Regulations and Market Models for Smart Grid: Net Metering, Building to Grid B2G, Vehicle to Grid V2G, Solar to Grid, Micro grid Demand Response, Tariff Design, Time of the day pricing (TOD), Time of use pricing (TOU), Consumer privacy and data protection, consumer engagement etc. Costs benefit analysis of smart grid projects.	**11**

Course outcomes:

On completion of the course student will be able to:

1. Discriminate smart grid & conventional grid.
2. Apply smart metering concepts to industrial and commercial installations.
3. Formulate solutions in the areas of smart substations, distributed generation and wide area measurements.
4. Analyze the concept of micro grid and solar cells
5. Estimate smart grid solutions using modern communication technologies.

Question paper pattern:

The question paper will have 10questions.

1. Each full question carries 14marks.
2. Each full question will have sub question covering all topics underunit.

The student will have to answer 5 full questions selecting one full question from each unit.

Text Books:

1. Ali Keyhani, "Design of smart power grid renewable energy systems",Wiley IEEE, 2011.
2. Clark W. Gellings, "The Smart Grid: Enabling Energy Efficiency andDemand Response", CRCPress, 200
3. JanakaEkanayake, Nick Jenkins, KithsiriLiyanage, "Smart Grid: Technologyand Applications",Wiley2012

Reference Books:

1. Stuart Borlas'e, "Smart Grid: Infrastructure, Technology and solutions"CRC Press.
2. A. G. Phadke , "Synchronized Phasor Measurement andtheir Applications", Springer.

OPTIMIZATION TECHNIQUES SEMESTER - VII			
Subject Code	**21EEEEP703C**	**IA Marks**	**30**
Number of Lecture Hours/week	**3L**	**Exam Marks**	**70**
Total Number of Lecture Hours	**45**	**Exam Hours**	**03**
Credits -03			

Course Objectives:

This course will enable student to:

1. Explain the objective and constraint functions in terms of design variables, and then state the optimization problem.
2. Solve single variable and multi variable optimization problems with and without constraints.
3. Explain linear programming technique to an optimization problem, slack and surplus variables, by using Simplex method.
4. Explain nonlinear programming techniques, unconstrained or constrained, and define exterior and interior penalty functions for optimization problems.
5. Discuss evolutionary programming techniques.

Unit 1: Introduction and Classical Optimization Techniques	**Hours**
Statement of an Optimization problem, design vector, design constraints, constraint surface, objective function, objective function surfaces, classification of Optimization problems.	**08**
Unit 2: Classical Optimization Techniques Single variable Optimization, multi variable Optimization without constraints, necessary and sufficient conditions for minimum/maximum, multivariable Optimization with equality constraints. Solution by method of Lagrange multipliers, multivariable Optimization with inequality constraints, Kuhn, Tucker conditions.	**08**
Unit 3: Linear Programming Standard form of a linear programming problem , geometry of linear programming problems, definitions and theorems, solution of a system of linear simultaneous equations, pivotal reduction of a general system of equations, motivation to the simplex method, simplex algorithm, Duality in Linear Programming, Dual Simplex method.	**08**
Unit 4: Nonlinear Programming Unconstrained cases, One, dimensional minimization methods: Classification, Fibonacci method and Quadratic interpolation method, Univariate method, Powell's method and steepest descent method. Constrained cases, Characteristics of a constrained problem, Classification, Basic approach of Penalty Function method; Basic approaches of Interior and Exterior penalty function methods. Introduction to convex Programming Problem.	**08**
Unit 5: Introduction to Evolutionary Methods Evolutionary programming methods, Introduction to Genetic Algorithms (GA)– Control parameters, Number of generation, population size, selection, reproduction, crossover and mutation, Operator selection criteria , Simple mapping of objective function to fitness function, constraints, Genetic algorithm steps, Stopping criteria –Simple examples.	**13**

Course outcomes:

On completion of the course student will be able to:

1. State and formulate the optimization problem, without and with constraints, by using design variables from an engineering design problem.
2. Apply classical optimization techniques to minimize or maximize a multi-variable objective function, without or with constraints, and arrive at an optimal solution.
3. Formulate a mathematical model and apply linear programming technique by using Simplex method. Also extend the concept of dual Simplex method for optimal solutions.
4. Apply gradient and non-gradient methods to nonlinear optimization problems.
5. Apply interior or exterior penalty functions for the constraints to derive the optimal solutions.

Question paper pattern:

The question paper will have 10 questions.

1. Each full question carries 14 marks.
2. Each full question will have sub question covering all topics under unit.

The student will have to answer 5 full questions selecting one full question from each unit.

Text Books:

1. "Engineering optimization: Theory and practice"-by S. S. Rao, New Age International (P) Limited, 3rd edition, 1998.
2. Soft Computing with Matlab Programming by N. P. Padhy & S.P. Simson, Oxford University Press – 2015

Reference Books:

1. "Optimization methods in operations Research and Systems Analysis" by K.V. Mital and C. Mohan, New Age International (P) Limited, Publishers, 3rd edition, 1996.
2. Genetic Algorithms in search, optimization, and Machine Learning by Davi E. Goldberg, ISBN: 978-81-7758-829-3, Pearson by Dorling Kindersley (India) Pvt Ltd.
3. "Operations Research: An Introduction" by H. A. Taha, PHI Pvt. Ltd., 6th edition.
4. Linear Programming by G. Hadley.

Design of Photovoltaic Systems SEMESTER-VII			
Subject Code	**21EEEES7070**	**IA-Marks**	**00**
Number of Lecture Hours/Week	**2L**	**Exam-Marks**	**50**
Total Number of Lecture Hours	**15**	**Exam-Hours**	**02**
Credits -02			

Course Objectives:

This course will enable student to :

1. Understand the fundamentals of Photovoltaic systems.
2. Know various technologies used in the Photovoltaic systems.
3. Know various methods used to improve power track in the Photovoltaic systems.
4. Know the connectivity of battery devices using in PV system.
5. Understand the implementation of PV system to Grid.

All the following topics are to be discussed

1. Basics Characteristics of Photovoltaic (PV) cell
2. Series Interconnections of PV cell
3. Parallel Interconnections of PV cell
4. Energy from sun and Incident energy estimation for different locations
5. Sizing of PV Cell
6. Maximum Power Point Tracking (MPPT) using P&O Algorithms
7. Maximum Power Point Tracking (MPPT) Using IC Algorithms
8. Maximum Power Point Tracking (MPPT) Using Fuzzy Logic Algorithms
9. PV and Battery Interfaces
10. PV and Grid Interfaces

Course Outcomes:

On completion of the course student will be able to:

1. Understand the fundamentals of Photovoltaic systems.
2. Know various technologies used in the Photovoltaic systems.
3. Know various methods used to improve power track in the Photovoltaic systems.
4. Learn the connectivity of battery devices to the PV system.
5. Learn the process of cooling and maintenance of the system.
6. Understand the implementation of PV system to Grid.

Books and references:

1. Chenming, H. and White, R.M., Solar Cells from B to Advanced Systems, McGraw Hill Book Co 1983
2. Ruschenbach, HS, Solar Cell Array Design Hand Varmostrand, Reinhold, NY, 1980
3. Proceedings of IEEE Photovoltaics Specialists Conferences, Solar Energy Journal.

Course structure for Electrical & Electronics Engineering
Honors (for EEE Students)

IV B. Tech I Semester:

S. No	Subject code	Name of the Subject	L	T	P	C
1	21EEEEH709A	EHV AC Transmission	3	1	0	4
2	21EEEEH709B	Line Commutated & Active Rectifiers	3	1	0	4
3	21EEEEH709C	Electrical Distribution Systems	3	1	0	4
4	21EEEEH709D	Power Systems Dynamics & Stability	3	1	0	4

EXTRA HIGH VOLTAGE AC TRANSMISSION SEMESTER-VII			
Subject Code	**21EEEEH709A**	**IA-Marks**	**30**
Number of Lecture Hours/Week	**3L**	**Exam-Marks**	**70**
Total Number of Lecture Hours	**45**	**Exam-Hours**	**03**
Credits-04			

Course-Objectives:

This course will enable student to:

1. To calculate the transmission line parameters.
2. To calculate the field effects on EHV and UHV AC lines.
3. To have knowledge of corona, RI and audible noise in EHV and UHV lines.
4. To have knowledge of voltage control in EHV and UHV transmission systems.
5. To have knowledge of various reactive power compensating systems in EHV lines.

Unit 1	**Hours**
E.H.V. A.C. Transmission Parameters: line trends and preliminary aspects, standard transmission voltages – power handling capacities and line losses – mechanical aspects. Calculation of line resistance and inductance: resistance of conductors, temperature rise of conductor and current carrying capacity. Properties of bundled conductors and geometric mean radius of bundle, inductance of two conductor lines and multi conductor lines, Maxwell's coefficient matrix. Line capacitance calculation. capacitance of two conductor line, and capacitance of multi conductor lines, potential coefficients for bundled conductor lines, sequence inductances and capacitances and diagonalization.	**10**
Unit 2	
Voltage Gradient on conductors: Calculation of electro static field of AC lines - Effect of high electrostatic field on biological organisms and human beings. Surface voltage Gradient on conductors, surface gradient on two conductor bundle and cosine law, maximum surface voltage gradient of bundle with more than 3 sub conductors, Mangolt formula.	**9**
Unit 3	
Corona : Corona in EHV lines – corona loss formulae – attenuation of traveling waves due to corona –Audio noise due to corona, its generation, characteristics and limits, measurement of audio noise.	**8**
Unit 4	
Power Frequency voltage control : Problems at power frequency, generalized constants, No load voltage conditions and charging currents, voltage control using synchronous condenser, cascade connection of components : Shunt and series compensation, sub synchronous resonance in series – capacitor compensated lines	**9**
Unit 5	
Reactive power compensating systems: Introduction, SVC schemes, Harmonics injected into network by TCR, design of filters for suppressing harmonics injected into the system, Introduction to STATCOM.	**9**

Courseoutcomes:

Oncompletionofthecoursestudentwillbeableto:

1. Calculate the transmission line parameters.
2. Calculate the field effects on EHV and UHV AC lines.
3. Determine the corona, RI and audible noise in EHV and UHV lines.
4. Analyze voltage control and compensation problems in EHV and UHV transmission systems.
5. Understand reactive power compensation using SVC and TCR

Question paper pattern:

The question paper will have 10 questions.

13. Each full question carries 14 marks.
14. Each full question will have sub question covering all topics under unit.

The student will have to answer 5 full questions selecting one full question from each unit.

Text Books:

1. Rakesh Das Begamudre, "Extra High Voltage AC Transmission Engineering", Fourth Edition New Age International publishers,
2. EHV Transmission line reference book – Edison Electric Institute

LINE COMMUTATED AND ACTIVE RECTIFIERS SEMESTER-VII			
Subject Code:	**21EEEEH709B**	**IA Marks**	**30**
Number of Lecture Hours/week	**3L**	**Exam Marks**	**70**
Total Number of Lecture Hours	**45**	**Exam Hours**	**03**
Credits – 04			

Course Objectives:

This course will enable student to:

1. Analyze the control rectifier circuits
2. Describe the operation of line commutated rectifiers and multipulse converters
3. Understand the operation of boost converters
4. Illustrate the operation of fly back converters

Unit-1	
Thyristor rectifiers with passive filtering Half-wave thyristor rectifier with RL and RC loads; 1-phase thyristor rectifier with L and LC filter; 3-phase thyristor rectifier with L and LC filter; continuous and discontinuous conduction, input current waveshape	**Hours – 08**
Unit – 2	**Hours – 08**
Multi-Pulse converter Review of transformer phase shifting, generation of 6-phase ac voltage from 3-phase ac, 6- pulse converter and 12-pulse converters with inductive loads, steady state analysis, commutation overlap, notches during commutation.	
Unit – 3	**Hours – 08**
Single-phase ac-dc single-switch boost converter Review of dc-dc boost converter, power circuit of single-switch ac-dc converter, steady state analysis, unity power factor operation, closed-loop control structure.	
Unit – 4	**Hours – 08**
Ac-dc bidirectional boost converter Review of 1-phase inverter and 3-phase inverter, power circuits of 1-phase and 3-phase ac-dc boost converter, steady state analysis, operation at leading, lagging and unity power factors. Rectification and regenerating modes. Phasor diagrams, closed-loop control structure.	
Unit – 5	**Hours – 13**
Isolated single-phase ac-dc flyback converter Dc-DC fly back converter, output voltage as a function of duty ratio and transformer turns ratio. Power circuit of ac-dc flyback converter, steady state analysis, unity power factor operation, closed loop control structure.	

Course outcomes:

On completion of the course student will be able to:

1. Analyze the control rectifier circuits
2. Understand the operation of line commutated rectifiers and multipulse converters
3. Describe the operation of boost converters
4. Illustrate the operation of fly back converters

Question paper pattern:

1. This section will have 10 questions.
2. Each full question carries 14 marks.
3. Each full question will have sub question covering all topics under unit.

The student will have to answer 5 full questions selecting one full question from each unit.

Text Books:

1. L. Umanand, " Power Electronics: Essentials and Applications", Wiley India,2009.
2. G. De, "Principles of Thyristorised Converters", Oxford & IBH Publishing Co, 1988.
3. J.G. Kassakian, M. F. Schlecht and G. C. Verghese, "Principles of Power Electronics", Addison- Wesley, 1991.
4. Abraham I.Press man, "Switching Power Supply Design"

Reference Books:

1. N. Mohan and T. M. Undeland, " Power Electronics: Converters, Applications and Design", John Wiley & Sons, 2007.
2. R. W. Erickson and D. Maksimovic, "Fundamentals of Power Electronics", Springer Science & Business Media, 2001.

ELECTRICAL DISTRIBUTION SYSTEMS SEMESTER-VII			
Subject Code	21EEEEH709C	**IA-Marks**	**30**
Number of Lecture Hours/Week	**3L**	**Exam-Marks**	**70**
Total Number of Lecture Hours	**45**	**Exam-Hours**	**03**
Credits -04			

Course-Objectives:

This course will enable student to:

1. To learn different factors of distribution system.
2. To learn and design aspects of the substations and distribution systems.
3. To learn the concepts of voltage drop and power loss.
4. To learn the distribution system protection and its coordination.
5. To learn the effect of compensation for power factor improvement.
6. To learn the effect of voltage control on distribution system.

Unit 1	**Hours**
General Concepts Introduction to distribution systems, Distribution system losses , Coincidence factor, Contribution factor, loss factor, Relationship between the load factor and loss factor, Numerical Problems, Load Modeling and Characteristics , Classification and characteristics of loads (Residential - commercial -Agricultural and Industrial).	**07**
Unit 2	
Substations Selection for location of substations - Rating of distribution substation, Service area with 'n' primary feeders, K- Factors - Benefits and methods of optimal location of substations. Distribution Feeders Design Considerations of distribution feeders: Radial and loop types of primary feeders, Voltage levels, Feeder loading – Basic design practice of the secondary distribution system.	**10**
Unit 3	
System Analysis Voltage drop and power, loss calculations: Derivation for voltage drop and power loss in lines, Uniformly distributed loads and non-uniformly distributed loads , Three phase balanced primary lines, and Non three phase balanced primary lines	**08**
Unit 4	
Protection Objectives of distribution system protection, Time current characteristics, Protective devices: Principle of operation of fuses, Circuit enclosures, Line sectionalized and circuit breakers, Earth leakage circuit breakers, Protection schemes of parallel & Ring-main feeders. **Coordination of protective devices** General coordination procedure, Various types of co-ordinated operation of protective devices – Residual Current Circuit Breaker.	**10**

Unit 5	
Compensation for Power Factor Improvement Capacitive compensation for power factor control, Different types of power capacitors, shunt and series capacitors, Effect of shunt capacitors (Fixed and switched), Power factor correction, Capacitor allocation, Economic justification, Procedure to determine the best capacitor location. **Voltage Control** Equipment for voltage control, Effect of series capacitors, Effect of AVB/AVR, Line drop Compensation.	**10**

Course outcomes:

On completion of the course student will be able to:

1. Discriminate various factors of distribution system - load modelling and characteristic of loads.
2. Know the concept of design considerations of substation and feeders.
3. Determine the voltage drop and power loss for different types of distribution loads.
4. Analyse the protection and its coordination for distribution systems.
5. Analyse the effect of compensation for p.f improvement and voltage improvement.

Question paper pattern:

The question paper will have 10 questions.

1. Each full question carries 14 marks.
2. Each full question will have sub question covering all topics under unit.

The student will have to answer 5 full questions selecting one full question from each unit.

Text Books:

1. "Electric Power Distribution system - Engineering" – by Turan Gonen - McGraw–hill - 2nd edition - 2008

Reference Books:

1. Electrical Distribution Systems by Dale R.Patrick and Stephen W.Fardo - CRC press - 2 nd edition.
2. 2 Electric Power Distribution – by A.S. Pabla - Tata McGraw–hill Publishing Company - 4 th edition - 1997.
3. Electrical Power Distribution Systems by V.Kamaraju - Right Publishers.

POWER SYSTEMS DYNAMICS AND STABILTY SEMESTER-VII			
Subject Code	**21EEEEH709D**	**IA-Marks**	**30**
Number of Lecture Hours/Week	**3L**	**Exam-Marks**	**70**
Total Number of Lecture Hours	**45**	**Exam-Hours**	**03**
Credits -04			

Course-Objectives:

The objectives of this course is to acquire knowledge on

1. Model of synchronous machines.
2. Stability studies of synchronous machines.
3. Solution method of transient stability.
4. Different effects of stability on power system
5. Effect of different excitation systems.

Unit 1	**Hours**
System Dynamics: Synchronous machine model in state space from computer representation for excitation and governor system, modelling of loads and induction machines**.**	**07**
Unit 2	
steady state stability: Steady state stability limit , Dynamics Stability limit , Dynamic stability analysis State space representation of synchronous machine connected to infinite bus-time response, Stability by Eigen value approach	**10**
Unit 3	
Digital Simulation of Transient Stability: Swing equation machine equations, Representation of loads, Alternate cycle solution method, Direct method of solution, Solution Techniques: Modified Euler method, Runge Kutta method, Concept of multi machine stability	**10**
Unit 4	
Effects on Stability Effect of governor action and excite on power system stability effect of saturation, saliency & automatic voltage regulators on stability.	**08**
Unit 5	
Excitation Systems Rotating Self-excited Exciter with direct acting Rheostatic type voltage regulator , Rotating main and Pilot Exciters with Indirect Acting, Rheostatic Type Voltage Regulator, Rotating Main Exciter, Rotating Amplifier and Static Voltage Regulator, Static excitation scheme, Brushless excitation system	**10**

Course outcomes:

The student should be able to

1. Determine the model of synchronous machines.
2. Know the stability studies of synchronous machines.
3. Get the knowledge of solution methods of transient stability.
4. Analyze the different effects of power system
5. Know the effect of different excitation systems in power systems.

Question paper pattern:

The question paper will have 10 questions.

1. Each full question carries 14 marks.
2. Each full question will have sub question covering all topics under unit.

The student will have to answer 5 full questions selecting one full question from each unit.

Text Books:

1. Power System Stability by Kimbark Vol. I&II, III, Willey.
2. Power System control and stability by Anderson and Fund, IEEE Press.

Reference Books:

1. Power systems stability and control by PRABHA KUNDUR, TMH.
2. Computer Applications to Power Systems–Glenn.W.Stagg & Ahmed. H.El.Abiad, TMH.
3. Computer Applications to Power Systems – M.A.Pai, TMH.
4. Power Systems Analysis & Stability – S.S.Vadhera Khanna Publishers.

Course structure for Electrical & Electronics Engineering
Minors to other Departments

IV B. Tech I Semester:

S. No	Subject code	Name of the Subject	L	T	P	C
1	21XXEEM709A	Fundamentals of Electrical Power Transmission & Distribution	3	1	0	4
2	21XXEEM709B	Fundamentals of Utilization of Electrical Energy	3	1	0	4
3	21XXEEM709C	Fundamentals of Electrical Safety	3	1	0	4

TRANSMISSION AND DISTRIBUTION OF ELECTRICAL POWER SEMESTER-VII			
Subject Code	**21EEEEM709A**	**IA-Marks**	**30**
Number of Lecture Hours/Week	**3L**	**Exam-Marks**	**70**
Total Number of Lecture Hours	**45**	**Exam-Hours**	**03**
Credits -03			

Course-Objectives:

This course will enable student to:

1. Understand the concepts of electrical power transmission lines.
2. Understand the electrical design and mechanical design of the overhead lines.
3. Understand the performance of the overhead line insulators.
4. Understand the performance of the cables used in power transmission.
5. Understand the AC Distribution Systems.

Unit 1: Electrical Design of Overhead lines	**hours**
Transmission line parameters: resistance, inductance and capacitance calculations - single phase and three phase lines, double circuit line, effect of earth on transmission line capacitance. **Performance of transmission lines:** representation of lines, classification of transmission lines, short transmission line, medium length transmission line (Nominal-T, Nominal-π, End condenser method), long transmission line, Ferranti Effect in transmission lines	**11**
Unit 2: Mechanical Design of Overhead Lines	
Overhead Line Insulators: Introduction, types of insulators, Potential distribution over a string of suspension insulators, Methods of equalizing the potential, testing of insulators. Sag and Tension calculations with equal and unequal heights of towers- Effect of Wind and Ice on weight of Conductor, Calculation of string efficiency, Capacitance grading and Static Shielding.	**10**
Unit 3: Corona and surge impedance	
Corona: Introduction, disruptive critical voltage, corona loss, Factors affecting corona loss and methods of reducing corona loss, Disadvantages of corona, interference between power and Communication lines, surge impedance and SIL of long lines.	**07**
Unit 4: Underground Cables	
Insulated Cables: Introduction, need for insulation to design of cables, insulating materials for cables, Extra high voltage cables, grading of cables, insulation resistance of a cable, Capacitance of a single core and three core cables, Overhead lines versus underground cables, types of cables.	**09**
Unit 5: Distribution Systems	
AC Distribution: Introduction, AC distribution, Single phase, 3-phase, 3 phase 4 wire system,bus bar arrangement, Selection of site and layout of substation. Distribution system losses – Coincidence factor – Contribution factor – loss factor – Relationship between the load factor and loss factor – Numerical Problems	**08**

Course outcomes:

On completion of the course student will be able to:

1. Illustrate the basic concepts of electrical power transmission lines and Describe various types of electrical design of the overhead.
2. Estimate various factors related to mechanical design of the overhead lines.
3. Distinguish concept of corona and surge impedence.
4. Discuss the types of cables and their capacitance calculations.
5. Illustrate the basic concepts of ac distribution systems.

Question paper pattern:

The question paper will have 10 questions.

1. Each full question carries 14 marks.
2. Each full question will have sub question covering all topics under unit.

The student will have to answer 5 full questions selecting one full question from each unit.

Text Books:

1. C.L. Wadhwa, Generation, Distribution and Utilization of Electrical Energy, 3rd Edition, New Age International, 2015.
2. A Text Book on Power System Engineering by M.L.Soni, P.V.Gupta, U.S.Bhatnagarand A. Chakrabarti, DhanpatRai& Co. Pvt. Ltd, 2016
3. Generation, Distribution and Utilization of Electric Energy by C.L.Wadhawa, New age International (P) Limited, Publishers, 3 rd edition.

Reference Books:

1. C.L. Wadhwa, Electrical Power Systems, 7th Edition, New Age International, 2016.
2. D.P. Kothari and I.J. Nagrath, Power System Engineering-- Tata McGraw-Hill Pub. Co., New Delhi, 3rd Edition, 2019.

FUNDAMENTALS OF UTILIZATION OF ELECTRICAL ENERGY SEMESTER- VII			
Subject Code	**21XXEEM709B**	IA Marks	30
Number of Lecture Hours/week	3L	Exam Marks	70
Total Number of Lecture Hours	45	Exam Hours	03
Credits – 03			

Course Objectives:

This course will enable student to :

1. Study the basic principles of illumination and its measurements and to design the different types lighting systems.
2. Understand the operating principles and characteristics of various motors with respect to speed, temperature and loading conditions.
3. Acquaint with the different types of heating welding techniques.
4. Acquaint with the different types of welding techniques
5. Calculation of braking, acceleration and other related parameters.

Unit-1	
Illumination Introduction, terms used in illumination–Laws of illumination–Sources of light. Discharge lamps, MV and SV lamps – Comparison between tungsten filament lamps and fluorescent tubes–Basic principles of light control– Types and design of lighting and flood lighting–LED lighting	**Hours –10**
Unit – 2	**Hours – 08**
Selection of Motors Choice of motor, type of electric drives, Temperature rise, Types of industrial loads–continuous–Intermittent and variable loads–Load equalization, Introduction to energy efficient motors.	
Unit – 3	**Hours –08**
Electric Heating Advantages and methods of electric heating–Resistance heating, induction heating and dielectric heating.	
Unit – 4	**Hours –10**
Electric Welding Electric welding–Resistance and arc welding–Electric welding equipment–Comparison between AC and DC Welding	
Unit – 5	**Hours –09**
Electric Traction System of electric traction and track electrification– Review of existing electric traction systems in India– Special features of traction motor–Speed–time curves for different services.	

Course outcomes:

On completion of the course student will be able to:

1. Understand various levels of illuminosity produced by different illuminating sources design different lighting systems by taking inputs and constraints in view.
2. Identify a suitable motor for electric drives and industrial applications
3. Identify most appropriate heating and for suitable applications.
4. Identify most appropriate welding techniques for suitable applications.
5. Determine the speed/time characteristics of different types of traction systems

Text Books:

1. Utilization of Electric Energy – by E. Openshaw Taylor, Orient Longman.
2. Art & Science of Utilization of electrical Energy – by Partab, DhanpatRai&Sons.
3. "Thermal energy storage systems and applications"-by Ibrahim Dincer and Mark A.Rosen. John Wiley and Sons 2002.

Reference Books:

1. Utilization of Electrical Power including Electric drives and Electric traction – by N.V.Suryanarayana, New Age International (P) Limited, Publishers, 1996.
2. Generation, Distribution and Utilization of electrical Energy – by C.L. Wadhwa, New Age International(P)Limited,Publishers,1997.

FUNDAMENTALS OF ELECTRICAL SAFETY SEMESTER-VII			
Subject Code	21XXEEM709C	**IA-Marks**	**30**
Number of Lecture Hours/Week	**3L**	**Exam-Marks**	**70**
Total Number of Lecture Hours	**45**	**Exam-Hours**	**03**
Credits -04			

Course-Objectives:

This course will enable student to:

1. Know about Electrical Safety, effects of Shocks and their Prevention.
2. Summarize the Safety aspects during Installation of Plant and Equipment.
3. Describe the electrical safety in residential, commercial and agricultural installations.
4. Describe the various Electrical Safety in Hazardous Areas, Equipment Earthing and System Neutral Earthing.
5. State the electrical systems safety management and IE rules.

Unit 1	**Hours**
INTRODUCTION TO ELECTRICAL SAFETY, SHOCKS AND THEIR PREVENTION: Primary and secondary electrical shocks, possibilities of getting electrical shock and its severity, medical analysis of electric shocks and its effects, shocks due to flash/ Spark over's, prevention of shocks, safety precautions against contact shocks, flash shocks, burns, residential buildings and shops.	**10**
Unit 2	
SAFETY DURING INSTALLATION OF PLANT AND EQUIPMENT: Introduction, preliminary preparations, preconditions for start of installation work, personal protective equipment for erection personnel, installation of a large oil immersed power transformer, installation of outdoor switchyard equipment, safety during installation of electrical rotating machines, drying out and insulation resistance measurement of rotating machines.	**10**
Unit 3	
ELECTRICAL SAFETY IN COMMERCIAL STALLATIONS: Wiring and fitting – Domestic appliances ,water tap giving shock, shock from wet wall ,fan firing shock, multi-storied building, Temporary installations ,Agricultural pump installation, Do's and Don'ts for safety in the use of domestic electrical appliances.	**10**
Unit 4	
EQUIPMENT EARTHING AND SYSTEM NEUTRAL EARTHING: Introduction, Distinction between system grounding and Equipment Grounding, Equipment Earthing, Functional Requirement of earthing system, description of a earthing system, , neutral grounding(System Grounding), Types of Grounding, Methods of Earthing Generators Neutrals.	**08**
Unit 5	
REVIEW OF IE RULES AND ACTS AND THEIR SIGNIFICANCE: Objective and scope – ground clearances and section clearances, standards on electrical safety, safe limits of current, voltage, Rules regarding first aid and	**07**

firefighting facility. The Electricity Act, 2003, (Part1, 2, 3,4 & 5)	

Course outcomes:

On completion of the course student will be able to:

1. Explain the objectives and precautions of Electrical Safety, effects of Shocks and their Prevention.
2. Summarize the Safety aspects during Installation of Plant and Equipment.
3. Describe the electrical safety in residential, commercial and agricultural installations.
4. Describe the various Electrical Safety in Hazardous Areas, Equipment Earthing and System Neutral Earthing.
5. State the electrical systems IE rules.

Question paper pattern:

The question paper will have 10 questions.

3. Each full question carries 14 marks.
4. Each full question will have sub question covering all topics under unit.

The student will have to answer 5 full questions selecting one full question from each unit.

Text Books:

1. S. Rao, Prof. H.L. Saluja, "Electrical safety, fire safety Engineering and safety management", Khanna Publishers. New Delhi
2. www.apeasternpower.com/downloads/elecact

Reference Books:

1. Pradeep Chaturvedi, "Energy management policy, planning and utilization", Concept Publishing company, New Delhi