# ACADEMIC REGULATIONS
# COURSE STRUCTURE
# AND
# DETAILED SYLLABUS

## ELECTRICAL & ELECTRONICS ENGINEERING

### B.Tech - Four Year Degree Course

(Applicable for the Batches Admitted from 2019 - 2020)

R-19

(Choice Based Credit System)

NEC
NARASARAOPETA
ENGINEERING COLLEGE
(AUTONOMOUS)

Kotappakonda Road, Yellamanda (P),
Narasaraopet - 522 601, Guntur Dist.,
Andhra Pradesh, INDIA.

# Academic Regulations, Course Structure and Syllabus

# (R19 Regulations)

**B.TECH.**
**Electrical and Electronics Engineering**
**(4 Year Program)**
**(Applicable for the Batches admitted from 2019-20)**

NEC
NARASARAOPETA
ENGINEERING COLLEGE
(AUTONOMOUS)

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(AUTONOMOUS)

**Kotappakonda Road, Yellamanda (Post), Narasaraopet – 522601, Guntur District, AP**
**Approved by AICTE, New Delhi and Permanently affiliated to JNTUK, Kakinada, Code: 47,**
**Accredited by NBA and NAAC, RTA Approved Pollution test Centre, ISO 9001: 2008 Certified Institution**
**Phone: 08647-239905** **Website: www.nrtec.in**

## INSTITUTE VISION AND MISSION

**VISION:**
To emerge as a Centre of excellence in technical education with a blend of effective student centric teaching learning practices as well as research for the transformation of lives and community.

**MISSION:**
M1: Provide the best class infrastructure to explore the field of engineering and research.

M2: Build a passionate and a determined team of faculty with student centric teaching, imbibing experiential, innovative skills

M3: Imbibe lifelong learning skills, entrepreneurial skills and ethical values in students for addressing societal problems.

## DEPARTMENT VISION AND MISSION

**VISION:**
To impart student centric education in the field of Electrical Electronics Engineering to transform the individuals into competent engineers with a focus on research and ethics.

**MISSION:**
M1: To provide knowledge based technology and infrastructure to meet the needs of industry and society.

M2: To assimilate innovation and research oriented culture to make successful professionals and entrepreneurs.

M3: To encourage lifelong learning with ethics among the students so as to make them as responsible individuals.

## PROGRAM EDUCATIONAL OBJECTIVES (PEOS)

The graduates will be able to,

PEO 1: Apply the science and engineering knowledge to solve complex problems of electrical and electronics engineering.

PEO 2: Continue their education to become as researchers and entrepreneurs.

PEO 3: Work effectively with high ethical values, as individuals and as team members

PEO 4: Adopt new methodologies as lifelong learners for their career growth.

## PROGRAM SPECIFIC OUTCOMES (PSOs)

Electrical and Electronics Engineering Graduates will be able to,

PSO1: Apply appropriate techniques and modern tools in the field of electrical and electronics engineering.

PSO2: Demonstrate the sustainable development in non-conventional Energy sources.

# ACADEMIC REGULATIONS R-19 FOR B.TECH

**(Applicable for the students of B.Tech admitted from the academic year 2019-20)**

## 1. PREAMBLE

The rapid transformation in every sphere of life is augmenting the need to prepare the present fast-paced generation to adapt to the changing knowledge & skill requirement on a life-long basis, in the fields of science, engineering, technology and humanities to influence society positively. The future looks up to multi-disciplinary, competent leaders who are Information and Communication Technology ready and driven by strong ethical values.

NEC envisions to nurture knowledge, skills, attitude and values of the aspiring youth to enable them to become global citizens and towards that process, the institution has evolved a flexible integrated academic curriculum.

NEC introduced Outcome Based Education (OBE) and Choice Based Credit System (CBCS), which emphasized on honing the skills and knowledge of the graduates.

NEC is ambitious to develop a new academic regulation, curricular framework and syllabi for its UG programmes. This effort is undertaken to address the present challenges in the educational system and also to be ahead of the curve with respect to innovative practices.

## 2. PROGRAMS OFFERED BY THE COLLEGE

Narasaraopeta Engineering College (NEC) offers a 4-year (8 semesters) **Bachelor of Technology** (B.Tech.) degree programme, under Choice Based Credit System (CBCS) for the following branches of Engineering.

| S. No. | Name of the Program | Program Code |
|---|---|---|
| 1. | Civil Engineering (CE) | 01 |
| 2. | Electrical and Electronics Engineering (EEE) | 02 |
| 3. | Mechanical Engineering (ME) | 03 |
| 4. | Electronics and Communication Engineering (ECE) | 04 |
| 5. | Computer Science and Engineering (CSE) | 05 |
| 6. | Information Technology (IT) | 12 |

## 3. ELIGIBILITY FOR ADMISSION

The total seats available as per the approved intake are grouped into two categories viz. category A and Category B with a ratio of 70:30 as per the state government guidelines vide G.O No.52.

The admissions for category A and B seats shall be as per the guidelines of Andhra Pradesh State Council for Higher Education (APSCHE) in consonance with government reservation policy.

a. Under Category A: 70% of the seats are filled through EAMCET counselling.

b. Under Category B: 30% seats are filled based on 10+2 merits in compliance with guidelines of APSCHE

### Admission eligibility - Under Lateral Entry Scheme

Students with diploma qualification have an option of direct admission into 2nd year B. Tech. (Lateral entry scheme). Under this scheme 10% seats of sanctioned intake will be available in each course as supernumerary seats. Admissions to this three-year B Tech later entry Programme will be through ECET. The maximum period to complete B. Tech. under lateral entry scheme is six consecutive academic years from the date of joining.

### Academic Calendar

For all the eight semesters a common academic calendar shall be followed in each semester by having sixteen weeks of instruction, one week for the conduct of practical exams and with three weeks for theory examinations and evaluation. Dates for registration, sessional and end semester examinations shall be notified in the academic calendar of every semester. The schedule for the conduct of all the curricular and co-curricular activities shall be notified in the planner.

## 4. AWARD OF B.TECH. DEGREE

A student will be declared eligible for the award of the B.Tech. degree if he/she fulfils the following academic regulations:

i) Pursue a course of study for not less than four academic years and not more than eight academic years.

ii) Registers for 160 credits and secures all 160 credits.

Students, who fail to fulfil all the academic requirements for the award of the degree within eight academic years from the year of their admission, shall **forfeit** their seat in B.Tech. course and their admission stands cancelled.

**The medium of instruction for the entire undergraduate programme in Engineering and Technology will be in English only.**

## 5. ABOUT PROGRAM RELATED TERMS

i. **Credit:** A unit by which the course work is measured. It determines the number of hours of instructions required per week. One credit is equivalent to one hour of teaching (Lecture/Tutorial) or two hours of practical work/field work per week.

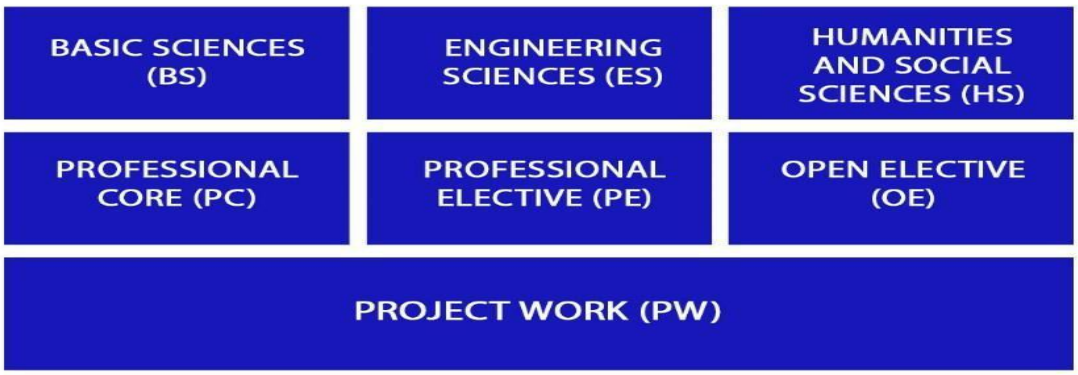
ii. **Academic Year:** Two consecutive (one odd + one even) semesters constitute one academic year.

iii. **Choice Based Credit System (CBCS):** The CBCS provides choice for students to select from the prescribed courses.

iv. Each course is assigned certain number of credits based on following criterion:

| | Semester | |
|---|---|---|
| | Periods / Week | Credits |
| Theory (Lecture/Tutorial) | 02 | 02 |
| | 03 | 03 |
| | 04 | 04 |
| Practical | 02 | 01 |
| | 03 | 1.5 |
| | 04 | 02 |
| Project | 14 | 07 |
| MOOCs | - | 01 |

v. Every B. Tech. Programme will have a curriculum consisting of theory, practical, project courses that shall be included in any of the following categories. The typical curriculum structure for UG degree programmes are based on AICTE and University norms and is given below.



## 5.1 SUBJECT / COURSE CLASSIFICATION

All subjects/ courses offered for the under graduate programme in B.Tech. degree are broadly classified as follows. NEC has followed almost all the guidelines issued by JNTUK/AICTE/UGC

| S.No. | Broad Course Classification | Course Group/Category | Course Description | No. of Credits |
|---|---|---|---|---|
| 1 | FOUNDATION COURSES | BS – Basic Sciences | Includes Mathematics, Physics and Chemistry Subjects | 25 |
| 2 | | ES – Engineering Sciences | Includes fundamental engineering subjects like Engineering Practices, Engineering Graphics, Basics of Electrical / Electronics / Mechanical / Computer Engineering, etc. | 24 |
| 3 | | HS – Humanities and Social Sciences | Includes subjects related to Humanities, Social Sciences and Management Courses like English, Professional Ethics and Human Values, Communication skills and Environmental Science and Engineering | 12 |
| 4 | Core Courses | PC – Professional Core | Includes core subjects related to the parent discipline/ department/ branch of Engineering. | 48 |
| 5 | Electives | PE – Professional Electives | Includes elective subjects related to the parent discipline/ department/ branch of Engineering. | 18 |
| 6 | | OE – Open Electives | Elective subjects which include inter-disciplinary subjects or subjects in an area outside the parent discipline/ department/ branch of Engineering | 18 |
| 7 | Project Work | PR-Project Work | B.Tech. Project or UG Project or UG Major Project | 14 |
| 8 | | Industrial training/ Internship | Industrial training/ Summer Internship | |
| 9 | | Mini- project | Industrial Oriented Mini-project/ Mini-project | |
| 11 | Mandatory Courses (MC) | Mandatory Courses (non-credit) | | 0 |
| 12 | MOOCS | PE | Subjects related to the parent discipline/ department/ branch of Engineering. | 1 |
| | | | Total | 160 |

## 5.2. Induction Program

When new students enter an institution, they come with diverse thoughts, backgrounds and preparations. It is important to help them adjust to the new environment and inculcate in them the ethos of the institution with a sense of larger purpose. Its purpose is to make the students feel comfortable in their new environment, open them up, set a healthy daily routine, create bonding in the batch as well as between faculty and students, develop awareness, sensitivity and understanding of the self, people around them, society at large, and nature.

A two-week induction program for first year B.Tech students is to be held in zero semester. Regular classes will start after the induction program.

The objectives of the program are as follows:

1. Assimilation in the ethos and culture of the institution
2. Exposure to a larger vision of life
3. Bonding among students and teachers
4. Learning a creative skill in arts
5. Regular lifestyle and professional discipline
6. Special assistance for needy students for improving proficiency in English and Mathematics

The above objectives will be achieved through the following activities:

1. Physical activity: Yoga, Mild Exercise, Games and sports etc.
2. Creative arts: Painting, Photography, music, dance etc.
3. Literary activity: General reading, writing summaries, debating, enacting a play etc.
4. Human Values: Discussion/Lectures in small groups of students with a faculty member
5. Lectures by eminent people: From industry, entrepreneurs, public life, social activists, alumni
6. Exposure to department/branch, Innovation, Exploring Engineering.

## 6. DISTRIBUTION AND WEIGHTAGE OF MARKS

The performance of a student in each semester shall be evaluated subject – wise with

a maximum of 100 marks for Theory, 50 marks for Practical Subject / Mini Project and 50 marks for Practical Training / Internship. The Project Work shall be evaluated for 200 marks.

## 6.1. THEORY

For all theory subjects consisting of 5 units in each subject, the assessment shall be for 40 marks through internal evaluation and 60 marks through external end semester examination of 3 hours duration.

## 6. 1.a. INTERNAL EVALUATION

The internal evaluation will be based on two cycle tests conducted in each semester. The 40 internal marks will be awarded as sum of 75% of the best cycle and 25% of the least cycle examinations, where each cycle of examination contains

Descriptive test - 20 Marks

Objective test - 10 Marks

Assignment test - 10 Marks

**Syllabus is framed for 5 Units**. **First descriptive** test question paper contains 3 questions from 50% of the syllabus i.e. 1st, 2nd and half of 3rd unit. **Second descriptive** test in remaining half of 3rd Unit, 4th Unit and 5th Units of each subject in a semester. The student has to answer all the 3 questions (10 marks questions from 1st and 2nd units and 5 marks question from half of the 3rd unit totalling to 25 marks). These 25 marks will be scaled down to 20 marks. The descriptive examination will be conducted in 1½ hour duration.

**Each Objective type** test 1 question paper (Online examination) contains 20 objective Multiple-choice questions for 10 marks covering the syllabus of 1st ,2nd and half of 3rd unit. The Objective Examination (online) will be conducted for a duration of the 20 minutes on the day of descriptive exam. Objective test 2 shall contains 20 Multiple choice questions for 10 marks covering the syllabus from the remaining half of the 3rd unit, 4th and 5th Units.

**Two assignments** will be conducted for each cycle. In first cycle first assignment will be from 1st unit for 10 marks. 5 or 6 questions will be given in the classroom at least one week in advance. Student must answer two questions in classroom which are given at random as per the schedule given by exam cell. Second assignment test for 10 marks of first cycle will be conducted from 2nd unit. 5 or 6 questions will be declared in the class room at least one week in advance. Student has to answer two questions in class room which are given at random as per the schedule given by exam cell.

First cycle assignment marks (10 marks) is calculated from the two assignments (1&2) i.e. 75% of best assignment and 25% of the least assignment.

Similarly, for second cycle assignment test 3 for 10 marks will be conducted from remaining half of the 3rd unit (after first mid syllabus) and half of the 4th unit. 5 or 6 questions will be given in the classroom at least one week in advance. Student must answer two questions in classroom which are given at random as per the schedule given by exam cell.

Assignment test 4 will be from remaining half the fourth unit and half of the 5th unit for 10 marks. 5 or 6 questions will be declared in the classroom at least one week in advance. Student has to answer two questions in class room which are given at random as per the schedule given by exam.

Second cycle assignment marks (10 marks) is calculated from the two assignments (3 &4) i.e. 75% of best assignment and 25% of the least assignment

First cycle (Descriptive, objective and assignment) is conducted for 1st ,2nd and half of 3rd Unit and second cycle is remaining half of 3rd unit, 4th & 5 units of each subject in semester.

Final internal semester marks shall be arrived at by considering the marks secured by the student in both the cycle examinations with 75% weightage given to the best cycle exam and 25% to the other.

**Final internal marks = 75% of best cycle and 25% of the least cycle.**

**=(0.75 x best cycle) + (0.25 x least cycle)**

If the student is absent for any one internal examination, the final internal semester marks shall be arrived at by considering 75% weightage to the marks secured by the student in the appeared examination and zero to the other.

**Final internal marks = 75% of best cycle and 25% of the least cycle.**

**= (0.75 x best cycle) + (0.25 x 0)**

### 6.1.b. EXTERNAL EVALUATION

End semester examinations will be conducted for 60 marks. The Question paper consists of five questions and each question carries 12 marks from all the five units. Each of the question is from one unit and may contain sub-questions. There will be two questions from each unit and student should answer any one of the two questions. The examination duration is 3 hours

## 6.2. PRACTICALS

For practical subjects there shall be continuous evaluation during the semester.

### 6.2.a. INTERNAL EVALUATION

There shall be continuous evaluation during the semester for 20 internal marks.

The internal marks shall be awarded as follows:

i) Day to day performance: Record (4M) +Experiment (4M) + Viva (2M) - 10Marks

ii) Internal Lab Test : 10 Marks

Total =i +ii =10+10 = 20 Marks.

### 6.2.b. EXTERNAL EVALUATION

For practical subjects there shall be an external examination at the end of the semester

for 30 marks in the presence of an external examiner. The examination duration is 3 hours.

### 6.3. DRAWING SUBJECTS

For the subject having design and / or drawing, (such as Engineering Graphics, Engineering Drawing, etc.,) and estimation, the distribution shall be 40 marks for Internal Evaluation and 60 marks for End Examination.

The 40 internal marks will be evaluated as follows:

Internal Tests : 20 marks. (1½ hour duration)

Day – to – day work: 20 marks (evaluation of charts)

In the internal test, 3 questions will be given to the student and he has to answer all the three questions (2 x10 =20 marks from 1st and 2nd units and 5 marks from half of the 3rd unit totalling 25 marks scaled down to 20 marks)

There shall be two internal tests in a semester. The sum of 75% of the best and 25% of the least of two internal tests shall be considered for the award of internal marks.

The syllabus for the subject "**Machine drawing and CAD Lab**" consists of two major portions:

1. Unit 1, 2 –Conventional drawing pattern.
2. Unit 3 and 4 - CAD lab using drafting packages

The distribution of internal and external marks is 40 and 60 marks respectively.

**Internal Evaluation**: Max Marks: 40

The total internal evaluation marks are distributed in the following two components:

1. Day-to-day work : 20 Marks (Evaluation of Charts)
2. Descriptive Test : 20 Marks

**Cycle–I Examination – Conventional drawing pattern**

In Cycle-I examination the 40 marks will be awarded as follows:

Day-to-day evaluation - 20 Marks

Internal Test - 20 Marks

In the Descriptive Test of duration 2 hours, one question for 20 marks will be given to the student.

**Cycle–II Examination – Computer lab pattern using any drafting packages**

for duration of 2 hours.

In Cycle-II examination the 40 marks will be awarded as follows:

Day-to-day evaluation - 20 Marks

Internal Test - 20 Marks

Of two cycle examinations conducted during the semester, sum of 75% of the best and 25% of the least of two cycle examinations shall be considered for the award of internal marks.

**End Examination** (Total Duration: 4 hours, Max, marks: 60) in the presence of external examiner

Conventional drawing pattern (Duration: 2 Hours, Marks: 30)

Computer lab pattern using any drafting packages (Duration: 2 Hours, Max:30)

(Note: Both Conventional drawing pattern and Computer lab pattern using any drafting packages are compulsory and are to be conducted in separate sessions)

## 6.4. MANDATORY NON-CREDIT COURSES

A student is required to take up Non-Credit / Mandatory courses (zero credit), viz. Environmental Science, Constitution of India, Community service, Advanced Communication Skills (ACS), Quantitative Aptitude and Reasoning (QAR), MOOCs (Massive Open Online Courses) etc., as and when the courses are offered. The B.Tech degree shall only be awarded only if a student gets satisfactory grade in each of the mandatory non-credit courses besides acquiring 160 credits.

A student has to repeat the course if he does not get satisfactory grade in each non- credit course for getting the degree awarded.

**Advanced Communication Skills (ACS) & Quantitative Aptitude & Reasoning (QAR) :**

There will be two online internal examinations of 40 marks of each and another 20 marks will be awarded based on day to day evaluation. The student has to secure a minimum of 40 marks out of the above mentioned 100 marks to secure satisfactory report.

**Community Service:**

Community service gives an opportunity to explore the leadership skills, Team work and develop empathy in real world. Students have to spend time in hospitals, temples, at traffic signals, old age homes, orphanage homes at least 24 hours during that semester.

**Old age homes**: The students will go to old age homes and fulfil the special needs and requirements that are unique to senior citizens. They help the old people by taking them to hospitals.

**Hospitals:** in hospitals the students help them to maintain hygiene, help the people who cannot understand the medical terms, give directions to the old people who are unable to read the signs, serve them by distributing food.

**Traffic clearance:** Help the people understand the traffic rules, help the disabled persons,

Children and old people to cross the roads.

**Temple services**: During the festivals the students give the directions to pilgrims, distribute the food and help the old and disabled people to get their darshan in the temple.

## 6.5 PRACTICAL TRAINING / INTERNSHIP

As a part of curriculum in all branches of Engineering, it is mandatory for all students to undergo summer internship Programme at industries (core or allied) / R & D organization to get practical insight of their subject domain during summer break after the $6^{th}$ semester. This internship Programme shall be availed by the students in a duration of minimum 2 weeks or maximum of 4 weeks and the assessment shall be carried out by internal experts.

After the completion of internship, the student shall submit a certificate, a technical report and presentation to the concerned departmental committee constituted by the HOD for evaluation. 50 marks shall be awarded for the submission of certificate, technical report, presentation and Viva-Voce examination.

Students are advised to take up Industrial Internship. In case, the student is unable to obtain the internship, they can opt for Practical Training at College.

**Assessment for Practical Training:**

The practical training gained by student shall be assessed for 50 marks. The time duration for Practical Training shall be 2 to 4 weeks during the inter-semester break. The training shall be evaluated through continuous assessment. After the completion of Practical Training the student shall submit a report and presentation to the Departmental Committee constituted by HOD for evaluation. A total of 50 marks shall be awarded for day to day performance, submission of report, presentation and Viva-Voce examination.

## 6.6. MINI PROJECT

Mini Project shall be evaluated for a total of 50 marks. Out of a total of 50 marks, 20 marks shall be awarded for internal evaluation consisting of day-to-day work, reviews, the assessment of the project report and 30 marks will be awarded for the external evaluation. The external evaluation shall be conducted by the committee. The committee consists of an External Examiner, Head of the Department and Supervisor of the Project. The evaluation of mini project work shall be conducted as and when offered.

Mini Project:

Continuous Assessment (Internal Evaluation): 20 Marks

Distribution

Literature Survey : 04 Marks

Innovativeness of the Project : 04 Marks

Review 1 : 04 Marks

Review 2 : 04 Marks

Marks Final Presentation : 04 Marks

## 6.7. PROJECT WORK

Out of a total of 200 marks for the project work, 80 marks shall be awarded for Internal Evaluation consisting of day-to-day work, reviews, the assessment of the project report and 120 marks are for the external evaluation. The external evaluation shall be conducted by the committee. The committee consists of an External Examiner, Head of the Department and Supervisor of the Project. The evaluation of project work shall be conducted at the end of the IV year II semester.

Continuous Assessment (Internal Evaluation): 80 Marks

Distribution

Innovativeness of the Project : 05 Marks

Literature Survey : 05 Marks

Experimentation / Simulation : 10 Marks

Result Analysis : 05 Marks

Review 1 : 15 Marks

Review II : 20 Marks

Final Presentation : 10 Marks

Project Report : 10 Marks

### 6.8. MOOCS:

Meeting with the global requirements, to inculcate the habit of self-learning and in compliance with AICTE/ UGC guidelines, MOOC (Massive Open Online Course) have been introduced, Student has to complete an on-line course to fulfil the academic requirement of B.Tech course. He/she can start doing the course from II Year I semester and submit the MOOCs certificate before the commencement of the end examinations wherever the MOOCs course is offered. The student shall register on-line Course offered by any reputed organization like NPTEL, SWYAM, JNTUK MOOCS, COURSERA, edX, Udacity, etc., approved by Departmental Committee constituted by HOD. Student has to submit the progress of the MOOC's course (such as assignment submission etc.,) to the mentor or departmental committee. B.Tech. degree shall be awarded only upon submission of MOOC's certificate.

## 7. PASS MARK CRITERIA

A student shall be deemed to have satisfied the pass mark, if he secures not less than 35% of marks in the end examinations and a minimum of 40% of marks in the sum total of the internal evaluation and end examination taken together as detailed below.

On passing a course of a program, the student shall earn the credits as assigned to that course.

| S.No | Category of Subject | Max. Marks | Internal Marks | External Marks | External pass % | External pass mark | Over all pass % | Over all pass mark |
|---|---|---|---|---|---|---|---|---|
| 1 | Theory/ Drawing | 100 | 40 | 60 | 35 | 21 | 40 | 40 |
| 2 | Practical | 50 | 20 | 30 | 35 | 11 | 40 | 20 |
| 3 | Mini Project | 50 | 20 | 30 | 35 | 11 | 40 | 20 |
| 4 | Project work | 200 | 80 | 120 | 35 | 42 | 40 | 80 |
| 5 | Practical Training/ Internship | 50 | 50 | - | - | - | 40 | 20 |
| 6 | MOOCS | Certificate must be submitted before the end semester examinations of that semester in which MOOCS course is offered. | | | | | | |

## 8. PROMOTION POLICY

### 8.1. ATTENDANCE REQUIREMENTS

(1) A student shall be eligible to appear for the end examinations if he acquires a minimum of 75% of attendance in aggregate of all the subjects.

(2) Condonation of shortage of attendance in aggregate up to 10% (65% and above and below 75%) in each semester for genuine medical reasons shall be approved by a committee duly appointed by the college. A fee stipulated by the college shall be

payable towards condonation of shortage of attendance. However, the number of condonations is restricted to **four** for the entire course.

(3) A student who is short of attendance in a semester may seek re-admission into that semester when offered next time within 4 weeks from the date of commencement of class work.

(4) If any candidate fulfils the attendance requirement in the present semester, he shall not be eligible for re-admission into the same semester.

## 8.2. CREDIT REQUIREMENTS

The following academic requirements have to be satisfied in addition to the attendance requirements mentioned above.

(1) A student shall be promoted from I to II year, if he puts up the minimum attendance requirement in I year II semester, irrespective of credits earned.

(2) A student shall be promoted from II year to III year, only if he fulfils the academic requirement of 40% of the credits up to II year II semester from all the examinations, irrespective of whether the candidate takes the examination or not.

(3) A student shall be promoted from III to IV year, only if he fulfils the academic requirements of 40% of the credits up to III year II semester from all the examinations, irrespective of whether the candidate takes the examination or not.

(4) A candidate, who is not promoted either to III year or IV year due to lack of required credits can seek admission into III / IV year in subsequent years after obtaining the required credits as stipulated above.

(5) A student registers for all 160 credits and earns all 160 credits. Marks obtained in the all the courses shall be considered for the calculation of grade points/division.

(6) The registrations in mandatory courses i.e. CI, ES, MOOCS, CS is compulsory and student should get a satisfactory report.

## 8.3. COURSE PATTERN

(1) The entire course of study is of FOUR academic years and each year will have TWO Semesters (Total EIGHT Semesters).

(2) A student is eligible to appear for the end examination in a subject, but absent for it or has failed in the end examinations may appear for that subject in supplementary examinations, when conducted next.

(3) When a student is detained due to lack of credits / shortage of attendance, he may be re-admitted in to the same semester / year in which he has been detained.

**Re-admission Criteria:**

i) A candidate, who is detained in a semester due to lack of attendance has to obtain written permission from the Principal for readmission into the same semester after duly fulfilling the required norms stipulated by the college and by paying the required tuition fee .

ii) A candidate, who is not promoted either to III year or IV year due to lack of required credits can seek admission into III / IV year in subsequent years after obtaining the required credits as stipulated in regulation by paying the required tuition fee.

## 9. METHOD FOR AWARDING OF GRADE POINTS FOR A SUBJECT:

After each subject is evaluated for 100 marks, the marks obtained in each subject will be converted to a corresponding letter grade as given below, depending on the range in which the marks obtained by the student fall.

| Theory/ Drawing / Laboratory / Practical Training / Internship / Mini Project / Project (% of marks in a subject) | Corresponding Grade Points | Letter Grade |
|---|---|---|
| 91 - 100 | 10 | O (Outstanding) |
| 81 - 90 | 9 | A (Excellent) |
| 71 - 80 | 8 | B (Very Good) |
| 61 - 70 | 7 | C (Good) |
| 51 - 60 | 6 | D (Satisfactory) |
| 40 - 50 | 5 | E (Pass) |
| <40 | 0 | F (Fail) |

A student who has obtained an '**F'** grade in any subject shall be deemed to have '**Failed'** and is required to reappear as a 'supplementary student' in the semester end examination, as and when offered. In such cases, internal marks in those subjects will remain the same as those obtained earlier.

To a student who has not appeared for an examination in any subject, '**AB'** grade will be allocated in that subject, and he is deemed to have '**Failed'**. A student will be required to reappear as a 'supplementary student' in the semester end examination, as and when offered next. In this case also, the internal marks in those subjects will remain the same as those obtained earlier. A Student who involved in malpractice during the examination will be marked as MP in that subject grade.

For mandatory courses, "**Satisfactory**" or "**Unsatisfactory**" shall be indicated instead of the letter grade and this will not be counted for the computation of SGPA/CGPA

## 10. CRITERIA FOR AWARD OF GRADES/DIVISION

### 10.1.Calculation of Semester Grade Point Average (SGPA)* for semester

The performance of each student at the end of each semester is indicated in terms of SGPA. The SGPA is calculated by dividing the sum of credit points secured from all subjects registered in a semester by the total no.of credits of that semester.

The SGPA is calculated as given below:

$$\text{SGPA} = \frac{\sum(\text{CR} \times \text{GP})}{\sum \text{CR}} = \frac{\sum(\text{CR} \times \text{GP})}{\sum \text{CR}}$$

WhereCR = Credits of a subject

GP = Grade Points awarded for a subject

*SGPA is calculated for a candidate who passed all the subjects in that semester.

### 10.2. Calculation of Cumulative Grade Point Average (CGPA) for Entire Program:

The CGPA is a measure of the overall cumulative performance of a student in all semesters considered for a registration. CGPA is the ratio of the total credit points secured by a student in all registered courses in all semesters and the total no.of credits in all semesters.

The CGPA is calculated as given below:

$$\text{CGPA} = \frac{\sum(\text{CR} \times \text{GP})}{\sum \text{CR}} = \frac{\sum(\text{CR} \times \text{GP})}{\sum \text{CR}}$$

Where CR= Credits of a subject

GP = Grade Points awarded for a subject

- The SGPA and CGPA shall be rounded off to 2 decimal point and reported in the transcripts.
- Equivalent percentage = (CGPA – 0.75) x 10

CGPA is calculated for a candidate who passed all the subjects of all previous and current semester.

### 10.3 Award of Division:

After satisfying the requirements prescribed for the completion of the program, the student shall be eligible for the award of B.Tech Degree and shall be placed in one of the following classes:

| CGPA | Class | From the CGPA secured from 160 credits |
|---|---|---|
| ≥ 7.75 | First Class with Distinction *(with no subject failures) | |
| ≥ 6.75 | First Class (with subject failures) | |
| ≥ 5.75 & < 6.75 | Second Class | |
| ≥ 4.75 to < 5.75 | Pass Class | |

***First Class with Distinction:** A candidate who qualifies for the award of the Degree having passed all the courses of study of all the eight semesters (six semesters for lateral entry candidates) at the first attempt, within eight consecutive semesters (six consecutive semesters for lateral entry candidates) after the commencement of his /her study and securing a CGPA of 7.75 and above shall be declared to have passed in First Class with Distinction.

### 10.4. CONSOLIDATED GRADE MEMO

A Consolidated Grade Memo containing credits and grades obtained by the candidate will be issued after the completion of the four year B.Tech program.

### 11. REVALUATION

1. Student can submit the application for revaluation, along with the prescribed fee for revaluation of his answer script(s) of theory subject(s) as per the notification issued by the Controller of Examinations.
2. The Controller of Examinations shall arrange for revaluation of such answer script(s).
3. An External evaluator, other than the first evaluator shall revaluate the answer script(s).

### 12. MINIMUM INSTRUCTION DAYS

The minimum instruction days for each semester shall be **90 working days.**

**13**. There shall be **no branch transfer** after the completion of admission process.

### 14. WITHHOLDING OF RESULTS

If the student has not paid the dues, if any, to the college or if any case of indiscipline/malpractice is pending against him, the result of such student will be kept withheld. His degree will be withheld in such cases.

## 15. TRANSITORY REGULATIONS

Discontinued or detained candidates are eligible for readmission as and when next offered.

A candidate, who is detained or discontinued in a semester, on readmission shall be required to do all the subjects in the curriculum prescribed for the batch of students in which the student joins subsequently. However, exemption will be given to those candidates who have already passed such subjects in the earlier semester(s) he was originally admitted into and substitute subjects are offered in place of them as decided by the Board of Studies. However, the decision of the Board of Studies will be final.

**15.1** A student who is following JNTUK curriculum and detained due to shortage of attendance at the end of the first semester of first year shall join the autonomous batch of first year first semester. Such students shall study all the subjects prescribed for the batch in which the student joins and considered on par with regular candidates of Autonomous stream and will be governed by the autonomous regulations.

**15.2** A student who is following JNTUK curriculum, detained due to lack of credits or shortage of attendance at the end of the second semester of first year or at the subsequent semesters shall join with the autonomous batch in the appropriate semester. Such candidates shall be required to pass in all the subjects in the program prescribed by the Board of Studies concerned for that batch of students from that semester onwards to be eligible for the award of degree. However, exemption will be given in the subjects of the semester(s) of the batch which he had passed earlier and substitute subjects will be offered in place of them as decided by the Board of Studies. The student has to clear all his backlog subjects up to previous semester by appearing for the supplementary examinations conducted by JNTUK for the award of degree will be sum of the credits up to previous semester under JNTUK regulations and the credits prescribed for the semester in which a candidate seeks readmission and subsequent semesters under the autonomous stream. The class will be awarded based on the academic performance of a student in the autonomous pattern.

**15.3 Transfer candidates (from non-autonomous college affiliated to JNTUK)**

A student who is following JNTUK curriculum, transferred from other college to this college in second year first semester or subsequent semesters shall join with the autonomous batch in the appropriate semester. Such candidates shall be required to pass in all the subjects in the program prescribed by the Board of Studies concerned for that batch of students from that semester onwards to be eligible for the award of degree. However, exemption will be given in the subjects of the semester(s) of the batch which he had passed earlier and substitute subjects are offered in their place as decided by the Board of Studies. The student has to clear all his backlog subjects up to previous semester by appearing for the supplementary examinations conducted by JNTUK for the award of degree. The total number of credits to be secured for the award of the degree will be the sum of the credits up to previous semester under JNTUK regulations and the credits prescribed for the semester in which a candidate joined after transfer and subsequent semesters under the autonomous stream. The class will be awarded based on the academic performance of a student in the autonomous pattern.

### 15.4 Transfer candidates (from an autonomous college affiliated to JNTUK)

A student who has secured the required credits up to previous semester as per the regulations of other autonomous institutions shall also be permitted to be transferred to this college.

A student who is transferred from the other autonomous colleges to this college in second year first semester or subsequent semesters shall join with the autonomous batch in the appropriate semester. Such candidates shall be required to pass in all the subjects in the program prescribed by the Board of Studies concerned for that batch of students from that semester onwards to be eligible for the award of degree.

However, exemption will be given in the subjects of the semester(s) of the batch which he had passed earlier and substitute subjects are offered in their place as decided by the Board of studies.

The total number of credits to be secured for the award of the degree will be the sum of the credits up to previous semester as per the regulations of the college from which he has transferred and the credits prescribed for the semester in which a candidate joined after transfer and subsequent semesters under the autonomous stream. The class will be awarded based on the academic performance of a student in the autonomous pattern.

## 16. Scope

1. The academic regulations should be read as a whole, for the purpose of any interpretation.
2. In case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Academic Council is final.
3. The college may change or amend the academic regulations, course structure or syllabi at any time, and the changes or amendments made shall be applicable to all students with effect from the date notified by the College Authorities.

## ACADEMIC REGULATIONS (R-19) FOR B. TECH. (LATERAL ENTRY SCHEME)

**(**Effective for the students getting admitted into II year from the

Academic Year 2020- 21 and onwards)

### 1. AWARD OF B. TECH. DEGREE

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

(a) Pursue a course of study for not less than three academic years and not more than six academic years counted from the academic year of admission.

(b) The candidate registers for 120 credits and secures all the 120 credits.

| CGPA | Class | From the CGPA secured from 120 credits from 2nd year to 4th year |
|---|---|---|
| ≥ 7.75 | First Class with Distinction *(with no subject failures) | |
| ≥ 6.75 | First Class (with subject failures) | |
| ≥ 5.75 & < 6.75 | Second Class | |
| ≥ 4.75 to < 5.75 | Pass Class | |

**2.** The attendance regulations of B.Tech (Regular) shall be applicable to B.Tech (LES), whereas the number of condonations are restricted to 3.

### 3. PROMOTION RULE:

(a) Attendance requirement is same as regular course.

(b) A lateral entry student will be promoted from II to III year if he puts up the minimum required attendance in II year II semester irrespective of credits earned.

(c) A student shall be promoted from III to IV year only if he fulfils the academic requirements of 40% of the credits up to III Year II semester from all the examinations, whether the candidate takes the examinations or not.

### 4. TRANSITORY REGULATIONS:

**4.1** A student who is following JNTUK curriculum and detained due to shortage of attendance at the end of the first semester of second year shall join the autonomous batch of second year first semester. Such students shall study all the subjects prescribed for the batch in which the student joins and considered on par with Lateral Entry regular candidates of Autonomous stream and will be governed by the autonomous regulations.

**4.2** A student who is following JNTUK curriculum, detained due to lack of credits or shortage of attendance at the end of the second semester of second year or at the subsequent semesters shall join with the autonomous batch in the appropriate semester. Such candidates shall be required to pass in all the subjects in the program prescribed by the Board of Studies concerned for that batch of students from that semester onwards to be eligible for the award of degree. However, exemption will be given in the subjects of the semester(s) of the batch of them as decided by the Board of Studies.

The student has to clear all his backlog subjects up to previous semester by appearing for the supplementary examinations conducted by JNTUK for the award of degree. The total number of credits to be secured for the award of the degree will be sum of the credits up to previous semester under JNTUK regulations and the credits prescribed for the semester in which a candidate seeks readmission and subsequent semesters under the autonomous stream. The class will be awarded based on the academic performance of a student in the autonomous pattern.

**5**. All the other regulations as applicable for B. Tech. Four- year degree course (Regular) will be applicable for B. Tech. (Lateral Entry Scheme).

## MALPRACTICES RULES

### DISCIPLINARY ACTION FOR / IMPROPER CONDUCT INEXAMINATIONS

- The Principal shall refer the cases of Malpractices in Internal Assessment Test and Semester end examinations to a malpractice prevention committee constituted by him for the purpose. Such committee shall follow the approved levels of punishment. The Principal shall take necessary action against the students based on the recommendations of the committee.

- Any action by the candidate 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:

| | **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 college. |
| 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 practical's and to 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 college 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 college 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 | 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 |

| | | |
|---|---|---|
| | 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<br>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 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. | 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. |
| 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 college 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 | Student of the college expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has |

| | | |
|---|---|---|
| | person not connected with the college indulges in any malpractice or improper conduct mentioned in clause 6to 8. | 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 college for further action to award suitable punishment. | |

**OTHER MATTERS:**

1. Physically challenged candidates who have availed additional examination time and a scribe during their intermediate / EAMCET examinations will be given similar concessions on production of relevant proof / documents.

2. The Principal shall deal in an appropriate manner with any academic problem which is not covered under these rules and regulations, in consultation with the Heads of the departments and subsequently such actions shall be placed before the Academic Council for ratification. Any emergency modification of regulation, approved in the meetings of the Heads of the departments shall be reported to the Academic Council for ratification.

**GENERAL:**

1. The academic council may, from time to time, revise, amend or change the regulations, schemes of examinations and / or syllabi.

2. Where ever the words ‘’he’’ ‘’him’’ ‘’his’’, occur in the regulations, they include ‘’she’’, ’’her’’, ’’hers’’.

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

4. In the case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Principal is final.

# R19 COURSE STRUCTURE

**I B.TECH - I SEMESTER**

| S.No. | Subject Code | Subject | Cat. Code | Internal Marks | External Marks | Total Marks | L | T | P | Credits |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 19BCC1TH01 | Communicative English-I | HS | 40 | 60 | 100 | 2 | - | - | 2 |
| 2 | 19BCC1TH03 | Linear Algebra & Calculus | BS | 40 | 60 | 100 | 3 | - | - | 3 |
| 3 | 19BCC1TH07 | Engineering Chemistry | BS | 40 | 60 | 100 | 3 | - | - | 3 |
| 4 | 19BCC1TH10 | C Programming | ES | 40 | 60 | 100 | 3 | - | - | 3 |
| 5 | 19BEE1TH08 | Basics in Mechanical and Civil Engineering | ES | 40 | 60 | 100 | 3 | - | - | 3 |
| 6 | 19BCC1LB01 | English Communication Skills Lab – I | HS | 20 | 30 | 50 | - | - | 3 | 1.5 |
| 7 | 19BCC1LB05 | Engineering Chemistry Lab | HS | 20 | 30 | 50 | - | - | 3 | 1.5 |
| 8 | 19BCC1LB07 | C Programming Lab | ES | 20 | 30 | 50 | - | - | 3 | 1.5 |
| 9 | 19BEE1LB06 | IT workshop | ES | 20 | 30 | 50 | - | - | 3 | 1.5 |
| 10 | 19BCC1MC02 | Constitution of India(MC) | MC | - | - | - | 3 | - | - | - |
| | | **Total** | | **280** | **420** | **700** | **17** | **0** | **12** | **20** |

**I B.TECH. – II SEMESTER**

| S.No. | Subject Code | Subject | Cat. Code | Internal Marks | External Marks | Total Marks | L | T | P | Credits |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 19BCC2TH01 | Communicative English-II | HS | 40 | 60 | 100 | 2 | - | - | 2 |
| 2 | 19BCC2TH02 | Differential Equations & Vector Calculus | BS | 40 | 60 | 100 | 3 | - | - | 3 |
| 3 | 19BCC2TH07 | Engineering Physics | BS | 40 | 60 | 100 | 3 | - | - | 3 |
| 4 | 19BCC2TH09 | Engineering Graphics | ES | 40 | 60 | 100 | 3 | - | - | 3 |
| 5 | 19BEE2TH13 | Electrical Circuit Analysis-I | PC | 40 | 60 | 100 | 3 | - | - | 3 |
| 6 | 19BEE2TH15 | Power Generation and Economic Aspects | PC | 40 | 60 | 100 | 3 | - | - | 3 |
| 7 | 19BCC2LB06 | Engineering Physics Lab | BS | 20 | 30 | 50 | - | - | 3 | 1.5 |
| 8 | 19BCC2LB08 | Engineering workshop Practice | ES | 20 | 30 | 50 | - | - | 3 | 1.5 |
| 9 | 19BCC2MC02 | Environmental Studies | MC | - | - | - | 3 | - | - | - |
| | | **Total** | | **280** | **420** | **700** | **20** | **0** | **6** | **20** |

**II B.TECH. – I SEMESTER**

| S.No. | Subject Code | Subject | Cat. Code | Internal Marks | External Marks | Total Marks | L | T | P | Credits |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 19BCC3TH01 | Numerical Methods & Transformations | BS | 40 | 60 | 100 | 3 | - | - | 3 |
| 2 | 19BEE3TH02 | Electronic Devices and Circuits | ES | 40 | 60 | 100 | 3 | - | - | 3 |
| 3 | 19BEE3TH03 | Electrical Circuit Analysis - II | PC | 40 | 60 | 100 | 3 | - | - | 3 |
| 4 | 19BEE3TH04 | Electrical Machines-I | PC | 40 | 60 | 100 | 3 | - | - | 3 |
| 5 | 19BEE3TH05 | Electro Magnetic Fields | PC | 40 | 60 | 100 | 3 | - | - | 3 |
| 6 | 19BEE3TH06 | Analog Electronics | PC | 40 | 60 | 100 | 3 | - | - | 3 |
| 7 | 19BEE3LB01 | Electronic Devices and Circuits Lab | ES | 20 | 30 | 50 | - | - | 3 | 1.5 |
| 8 | 19BEE3LB02 | Electrical Circuit Analysis Lab | PC | 20 | 30 | 50 | - | - | 3 | 1.5 |
| 9 | 19BCC3MC02 | Community Service | MC | - | - | - | - | - | - | - |
| | | **Total** | | **280** | **420** | **700** | **18** | **-** | **6** | **21** |

**II B.TECH. – II SEMESTER**

| S.No. | Subject Code | Subject | Cat. Code | Internal Marks | External Marks | Total Marks | L | T | P | Credits |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 19BEE4TH02 | Problem Solving with Python | ES | 40 | 60 | 100 | 3 | - | - | 3 |
| 2 | 19BEE4TH03 | Digital logic and circuits | PC | 40 | 60 | 100 | 3 | - | - | 3 |
| 3 | 19BCC4TH01 | Complex Variables , Probability & Statistics | BS | 40 | 60 | 100 | 3 | - | - | 3 |
| 4 | 19BEE4TH04 | Electrical Machines-II | PC | 40 | 60 | 100 | 3 | - | - | 3 |
| 5 | | **Open Elective-I** | OE | 40 | 60 | 100 | 3 | - | - | 3 |
| 6 | 19BEE4LB02 | Python Lab | ES | 20 | 30 | 50 | - | - | 3 | 1.5 |
| 7 | 19BCC4LB01 | English Communication Skills Lab-II | HS | 20 | 30 | 50 | - | - | 3 | 1.5 |
| 8 | 19BEE4LB03 | Electrical Machines Lab-I | PC | 20 | 30 | 50 | - | - | 3 | 1.5 |
| 9 | 19BEE4LB04 | Analog and Digital Circuits Lab | PC | 20 | 30 | 50 | - | - | 3 | 1.5 |
| 10 | 19BCC4MC02 | Quantitative Aptitude and Reasoning | MC | - | - | - | 3 | - | - | - |
| | | **Total** | | **280** | **420** | **700** | **18** | **-** | **12** | **21** |

**III B.TECH. – I SEMESTER**

| S.No. | Subject Code | Subject | Cat. Code | Internal Marks | External Marks | Total Marks | L | T | P | Credits |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 19BEE5TH01 | Control Systems | PC | 40 | 60 | 100 | 3 | - | - | 3 |
| 2 | 19BEE5TH02 | Power Electronics | PC | 40 | 60 | 100 | 3 | - | - | 3 |
| 3 | 19BEE5TH03 | Electrical Transmission System | PC | 40 | 60 | 100 | 3 | - | - | 3 |
| 4 | 19BEE5TH04 | Electrical Measurements | PC | 40 | 60 | 100 | 3 | - | - | 3 |
| 5 | 19BEE5PE05 | **Professional Elective-I** a. Special Electrical Machines | PE | 40 | 60 | 100 | 3 | - | - | 3 |
| | 19BEE5PE06 | b. Intellectual Property Rights | | | | | | | | |
| | 19BEE5PE07 | c. Signals and System | | | | | | | | |
| | 19BEE5PE08 | d. Electrical Energy Conservation and Auditing | | | | | | | | |
| 6 | | **Open Elective-II** | OE | 40 | 60 | 100 | 3 | - | - | 3 |
| 7 | 19BEE5LB01 | Electrical Machines Lab-II | PC | 20 | 30 | 50 | | - | 3 | 1.5 |
| 8 | 19BEE5LB02 | Power Electronics Lab | PC | 20 | 30 | 50 | | - | 3 | 1.5 |
| 9 | 19BEE5LB03 | Control System & Measurements Lab | PC | 20 | 30 | 50 | | - | 3 | 1.5 |
| 10 | 19BCC5MC01 | Advanced Communication Skills | MC | - | - | - | - | - | 3 | - |
| | | **Total** | | **300** | **450** | **750** | **18** | **-** | **12** | **22.5** |

**III B.TECH. – II SEMESTER**

| S.No. | Subject Code | Subject | Cat. Code | Internal Marks | External Marks | Total Marks | L | T | P | Credits |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 19BEE6TH02 | Microprocessor & Microcontrollers | PC | 40 | 60 | 100 | 3 | - | - | 3 |
| 2 | 19BEE6TH03 | Internet of Things | ES | 40 | 60 | 100 | 2 | 1 | - | 3 |
| 3 | 19BEE6TH04 | Power System Analysis | PC | 40 | 60 | 100 | 3 | - | - | 3 |
| 4 | 19BEE6PE05 | **Professional Elective-II** a. Flexible AC Transmission Systems | PE | 40 | 60 | 100 | 3 | - | - | 3 |
| | 19BEE6PE06 | b. Advanced Power Electronic Converters | | | | | | | | |
| | 19BEE6PE07 | c. Control of Electrical Drives | | | | | | | | |
| | 19BEE6PE08 | d. Electrical Machine Design | | | | | | | | |
| 5 | 19BCC6TH01 | Entrepreneurship and Innovation | HS | 40 | 60 | 100 | 3 | - | - | 2 |
| 6 | | **Open Elective-III** | OE | 40 | 60 | 100 | 3 | - | - | 3 |
| 7 | 19BEE6LB01 | Microprocessors and Microcontrollers Lab | PC | 20 | 30 | 50 | | - | 3 | 1.5 |
| 8 | 19BEE6LB02 | Process Automation Lab (Skill Lab) | PR | 20 | 30 | 50 | | - | 3 | 1 |
| 9 | 19BEE6MP | Mini Project | PR | 50 | - | 50 | - | - | 3 | 1.5 |
| | | **Total** | | **330** | **420** | **750** | **18** | **-** | **9** | **21** |

**IV B.TECH. – I SEMESTER**

| S.No. | Subject Code | Subject | Cat. Code | Internal Marks | External Marks | Total Marks | L | T | P | Credits |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 19BEE7TH01 | Switchgear and Protection | PC | 40 | 60 | 100 | 3 | - | - | 3 |
| 2 | 19BEE7TH02 | Power System Operation and Control | PC | 40 | 60 | 100 | 3 | - | - | 3 |
| 3 | 19BEE7PE04 | **Professional Elective-III** a. HVDC Transmission | PE | 40 | 60 | 100 | 3 | - | - | 3 |
| | 19BEE7PE05 | b. Power System Stability | | | | | | | | |
| | 19BEE7PE06 | c. Digital Control Systems | | | | | | | | |
| | 19BEE7PE07 | d. Electrical and Hybrid Vehicles | | | | | | | | |
| 4 | 19BEE7PE08 | **Professional Elective-IV** a. Power Quality | PE | 40 | 60 | 100 | 3 | - | - | 3 |
| | 19BEE7PE09 | b. Renewable and Distributed Energy Systems | | | | | | | | |
| | 19BEE7PE10 | c. Embedded Systems | | | | | | | | |
| | 19BEE7PE11 | d. Quality Management | | | | | | | | |
| 5 | 19BEE7TH03 | Business Management concepts for Engineers | HS | 40 | 60 | 100 | 3 | - | - | 3 |
| 6 | | **Open Elective-IV** | OE | 40 | 60 | 100 | 3 | - | - | 3 |
| 7 | 19BCC6MOOC | MOOCs | PE | - | - | - | - | - | - | 1 |
| 8 | 19BCC7IPT | Internship/ Practical Training | PR | 50 | - | 50 | - | - | - | 1 |
| 9 | 19BEE7LB01 | Power Systems & Simulation Lab | PC | 20 | 30 | 50 | - | - | 3 | 1.5 |
| | | **Total** | | **360** | **390** | **750** | **18** | **-** | **5** | **21.5** |

**IV B.TECH. – II SEMESTER**

| S.No. | Subject Code | Subject | Cat. Code | Internal Marks | External Marks | Total Marks | L | T | P | Credits |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 19BEE8TH01 | Utilization of Electrical Energy | PC | 40 | 60 | 100 | 3 | - | - | 3 |
| 2 | 19BEE8PE02 | Professional Elective-V a. Electrical Distribution Systems | PE | 40 | 60 | 100 | 3 | - | - | 3 |
| | 19BEE8PE03 | b.Smart Grids | | | | | | | | |
| | 19BEE8PE04 | c. PLC and Automation | | | | | | | | |
| | 19BEE8PE05 | d. Energy Storage Technology | | | | | | | | |
| 3 | 19BEE8PW | Project Work | PR | 80 | 120 | 200 | - | - | - | 7 |
| | | **Total** | | **160** | **240** | **400** | **6** | **-** | **-** | **13** |

## Distribution of Credits

| No. | Year/Sem | HS | BS | ES | PC | PE | OE | PR | TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| 1 | I-I | 5 | 6 | 9 | - | - | - | - | 20 |
| 2 | I-II | 2 | 7.5 | 4.5 | 6 | - | - | - | 20 |
| 3 | II-I | - | 3 | 4.5 | 13.5 | - | - | - | 21 |
| 4 | II-II | 1.5 | 3 | 4.5 | 9 | - | 3 | - | 21 |
| 5 | III-I | - | - | - | 16.5 | 3 | 3 | - | 22.5 |
| 6 | III-II | 2 | - | 3 | 7.5 | 3 | 3 | 2.5 | 21 |
| 7 | IV-I | 3 | - | - | 7.5 | 7 | 3 | 1 | 21.5 |
| 8 | IV-II | - | - | - | 3 | 3 | - | 7 | 13 |
| | **TOTAL(Actual) CREDITS** | **13.5** | **19.5** | **25.5** | **63** | **16** | **12** | **10.5** | **160** |

| S.No. | Course Category | Code | Breakup of Credits (AICTE) | Breakup of Credits (NEC) |
|---|---|---|---|---|
| 1 | Humanities and social science including Management courses | HS | 12 | 13.5 |
| 2 | Basic Science courses | BS | 25 | 19.5 |
| 3 | Engineering science courses | ES | 24 | 25.5 |
| 4 | Professional core Courses | PC | 48 | 63 |
| 5 | Open Elective Courses | OE | 18 | 16 |
| 6 | Professional Elective Courses | PE | 18 | 12 |
| 7 | Internship, seminar, project wok | PR | 15 | 10.5 |
| **Total Credits** | | | **160** | **160** |

# List of open Electives offered by all Departments

## Open Elective-I

| S.No. | Subject Code | Open Elective-I Subject Title | Department Offering the Subject | No.of periods per week | | | No.of Credits |
|---|---|---|---|---|---|---|---|
| | | | | L | T | P | C |
| 1 | 19BCE4OE11 | Public Health Engineering | CE | 3 | 0 | 0 | 3 |
| 2 | 19BCE4OE12 | Geographical Information Systems | CE | 3 | 0 | 0 | 3 |
| 3 | 19BCC4OE03 | Micro Electro Mechanical System | EEE | 3 | 0 | 0 | 3 |
| 4 | 19BCC4OE04 | Energy Audit Conservation and Management | EEE | 3 | 0 | 0 | 3 |
| 5 | 19BME4OE11 | RPT &3D Printing (Other than ME) | ME | 3 | 0 | 0 | 3 |
| 6 | 19BME4OE12 | Operations Research | ME | 3 | 0 | 0 | 3 |
| 7 | 19BME4OE13 | Smart Materials | ME | 3 | 0 | 0 | 3 |
| 8 | 19BME4OE14 | Product Engineering | ME | 3 | 0 | 0 | 3 |
| 9 | 19BCC4OE09 | Principles of Signals, Systems & Communications (Other than ECE) | ECE | 3 | 0 | 0 | 3 |
| 10 | 19BCC4OE09 | Medical Electronics | ECE | 3 | 0 | 0 | 3 |
| 11 | 19BCC4OE10 | DBMS (Other Than CSE) | CSE | 3 | 0 | 0 | 3 |
| 12 | 19BCC4OE11 | Web Development Using Mean Stack Tech | CSE | 3 | 0 | 0 | 3 |
| 13 | 19BCC4OE12 | Front End UI and Frame Work | IT | 3 | 0 | 0 | 3 |
| 14 | 19BCC4OE13 | Front End Web Technologies | IT | 3 | 0 | 0 | 3 |
| 15 | 19BCC4OE14 | Financial Institutions, Markets and Services | MBA | 3 | 0 | 0 | 3 |
| 16 | 19BCC4OE15 | Human Resource Practices | MBA | 3 | 0 | 0 | 3 |

## Open Elective-II

| S.No. | Subject Code | Open Elective-II Subject Title | Department Offering the Subject | No. of periods per week | | | No. of Credits |
|---|---|---|---|---|---|---|---|
| | | | | L | T | P | C |
| 1 | 19BCC5OE01 | Disaster Management | CE | 3 | 0 | 0 | 3 |
| 2 | 19BCC5OE02 | Green Building & Sustainability | CE | 3 | 0 | 0 | 3 |
| 3 | 19BCC5OE03 | Non-Conventional Energy Resources | EEE | 3 | 0 | 0 | 3 |
| 4 | 19BCC5OE04 | Basics in Electrical and Electronics Engineering (Other than EEE) | EEE | 3 | 0 | 0 | 3 |
| 5 | 19BCC5OE05 | Work study | ME | 3 | 0 | 0 | 3 |
| 6 | 19BCC5OE06 | Lean Manufacturing | ME | 3 | 0 | 0 | 3 |
| 7 | 19BCC5OE07 | Condition Monitoring | ME | 3 | 0 | 0 | 3 |
| 8 | 19BCC5OE08 | Mechatronics | ME | 3 | 0 | 0 | 3 |
| 9 | 19BCC5OE09 | Fundamentals of Image Processing (Other than ECE) | ECE | 3 | 0 | 0 | 3 |
| 10 | 19BCC5OE10 | Consumer Electronics | ECE | 3 | 0 | 0 | 3 |
| 11 | 19BCC5OE11 | AI | CSE | 3 | 0 | 0 | 3 |
| 12 | 19BCC5OE12 | Data Structures | CSE | 3 | 0 | 0 | 3 |
| 13 | 19BCC5OE13 | OOPS through JAVA | CSE | 3 | 0 | 0 | 3 |
| 14 | 19BCC5OE14 | Object Oriented Programming through C++ | IT | 3 | 0 | 0 | 3 |
| 15 | 19BCC5OE15 | Cloud Computing | IT | 3 | 0 | 0 | 3 |
| 16 | 19BCC5OE16 | Digital Marketing | MBA | 3 | 0 | 0 | 3 |
| 17 | 19BCC5OE17 | Personal Finance Planning | MBA | 3 | 0 | 0 | 3 |

## Open Elective-III

| S.No. | Subject Code | Open Elective-III Subject Title | Department Offering the Subject | No.of periods per week | | | No.of Credits |
|---|---|---|---|---|---|---|---|
| | | | | L | T | P | C |
| 1 | 19BCC6OE01 | Solid and hazardous waste management | CE | 3 | 0 | 0 | 3 |
| 2 | 19BCC6OE02 | Ground Water Development and Managment | CE | 3 | 0 | 0 | 3 |
| 3 | 19BCC6OE03 | Soft Computing | EEE | 3 | 0 | 0 | 3 |
| 4 | 19BCC6OE04 | Industrial Electronics | EEE | 3 | 0 | 0 | 3 |
| 5 | 19BCC6OE05 | Automotive Vehicles | ME | 3 | 0 | 0 | 3 |
| 6 | 19BCC6OE06 | Nano Technology | ME | 3 | 0 | 0 | 3 |
| 7 | 19BCC6OE07 | Total Quality Management | ME | 3 | 0 | 0 | 3 |
| 8 | 19BCC6OE08 | Basic Manufacturing Processes | ME | 3 | 0 | 0 | 3 |
| 9 | 19BCC6OE09 | Introduction to Embedded Systems (Other than ECE) | ECE | 3 | 0 | 0 | 3 |
| 10 | 19BCC6OE10 | Global Positioning System(GPS) | ECE | 3 | 0 | 0 | 3 |
| 11 | 19BCC6OE11 | OOPS through JAVA | CSE | 3 | 0 | 0 | 3 |
| 12 | 19BCC6OE12 | Cloud Computing | CSE | 3 | 0 | 0 | 3 |
| 13 | 19BCC6OE13 | Block Chain Technologies | CSE | 3 | 0 | 0 | 3 |
| 14 | 19BCC6OE14 | Digital Marketing | IT | 3 | 0 | 0 | 3 |
| 15 | 19BCC6OE15 | DevOps | IT | 3 | 0 | 0 | 3 |
| 16 | 19BCC6OE16 | Performance Management | MBA | 3 | 0 | 0 | 3 |
| 17 | 19BCC6OE17 | Services Marketing | MBA | 3 | 0 | 0 | 3 |

## Open Elective-IV

| S.No. | Subject Code | Open Elective-IV Subject Title | Department Offering the Subject | No.of periods per week | | | No.of Credits |
|---|---|---|---|---|---|---|---|
| | | | | L | T | P | C |
| 1 | 19BCC7OE01 | Water shed management | CE | 3 | 0 | 0 | 3 |
| 2 | 19BCC7OE02 | Modern Construction Material | CE | 3 | 0 | 0 | 3 |
| 3 | 19BCC7OE03 | Control System | EEE | 3 | 0 | 0 | 3 |
| 4 | 19BCC7OE04 | Embedded Control of Electric Drives | EEE | 3 | 0 | 0 | 3 |
| 5 | 19BCC7OE05 | Pneumatics & Hydraulic Automation | ME | 3 | 0 | 0 | 3 |
| 6 | 19BCC7OE06 | Heat Ventilation & Air conditioning | ME | 3 | 0 | 0 | 3 |
| 7 | 19BCC7OE07 | Supply Chain Management | ME | 3 | 0 | 0 | 3 |
| 8 | 19BCC7OE08 | Industrial Robotics | ME | 3 | 0 | 0 | 3 |
| 9 | 19BCC7OE09 | Introduction to Micro Processors & Micro Controllers(Other than ECE) | ECE | 3 | 0 | 0 | 3 |
| 10 | 19BCC7OE10 | Automotive Electronics | ECE | 3 | 0 | 0 | 3 |
| 11 | 19BCC7OE11 | Cyber Security | CSE | 3 | 0 | 0 | 3 |
| 12 | 19BCC7OE12 | Ethical Hacking | CSE | 3 | 0 | 0 | 3 |
| 13 | 19BCC7OE13 | Human Computer Interaction | IT | 3 | 0 | 0 | 3 |
| 14 | 19BCC7OE14 | E-Commerce | IT | 3 | 0 | 0 | 3 |
| 15 | 19BCC7OE15 | Quality Management | MBA | 3 | 0 | 0 | 3 |
| 16 | 19BCC7OE16 | Logistics and Supply Chain Management | MBA | 3 | 0 | 0 | 3 |

**I B.TECH - I SEMESTER**

| S.No. | Subject Code | Subject | Cat. Code | Internal Marks | External Marks | Total Marks | L | T | P | Credits |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 19BCC1TH01 | Communicative English-I | HS | 40 | 60 | 100 | 2 | - | - | 2 |
| 2 | 19BCC1TH03 | Linear Algebra & Calculus | BS | 40 | 60 | 100 | 3 | - | - | 3 |
| 3 | 19BCC1TH07 | Engineering Chemistry | BS | 40 | 60 | 100 | 3 | - | - | 3 |
| 4 | 19BCC1TH10 | C Programming | ES | 40 | 60 | 100 | 3 | - | - | 3 |
| 5 | 19BEE1TH08 | Basics in Mechanical and Civil Engineering | ES | 40 | 60 | 100 | 3 | - | - | 3 |
| 6 | 19BCC1LB01 | English Communication Skills Lab – I | HS | 20 | 30 | 50 | - | - | 3 | 1.5 |
| 7 | 19BCC1LB05 | Engineering Chemistry Lab | HS | 20 | 30 | 50 | - | - | 3 | 1.5 |
| 8 | 19BCC1LB07 | C Programming Lab | ES | 20 | 30 | 50 | - | - | 3 | 1.5 |
| 9 | 19BEE1LB06 | IT workshop | ES | 20 | 30 | 50 | - | - | 3 | 1.5 |
| 10 | 19BCC1MC02 | Constitution of India(MC) | MC | - | - | - | 3 | - | - | - |
| | | **Total** | | **280** | **420** | **700** | **17** | **0** | **12** | **20** |

| I B.TECH I SEMESTER | L | T | P | INTERNAL MARKS | EXTERNAL MARKS | TOTAL MARKS | CREDITS |
|---|---|---|---|---|---|---|---|
| | 2 | 0 | 0 | 40 | 60 | 100 | 2 |
| 19BCC1TH01 | COMMUNICATIVE ENGLISH - I (Common to All Branches) | | | | | | |

**Course Objectives:**

- To equip the students with appropriate oral and written communication skills.
- To inculcate the skills of listening, reading and critical thinking.
- To enhance the students' proficiency in reading skills enabling them meet the academic needs of their course.
- To enable the engineering students develop their basic communication skills in English for academic and social purposes.

**Course outcomes:**

After successful completion of this course, the students will be able to:

**CO 1:** Infer explicit and implicit meaning of a text, recognize key passages; raise questions and summarize it.
**CO 2:** Compose paragraphs, essays as creative writing.
**CO 3:** Build grammatically correct sentences using a variety of sentence structures.
**CO 4:** Enhance word power and usage of lexicons.
**CO 5:** Compile emails, letters, reports, resume and information transfer.

**UNIT-I : Akio Morita**

a) **Speaking**: Introducing self and others.
b) **Reading**: Skimming for main idea, scanning for specific piece of information.
c) **Writing**: Note – making flowed by paragraph writing, effective opening sentences, introducing the topic, key words, main idea, summarize the main idea.
d) **Grammar and Vocabulary**: Content words and function words, verbs, nouns, adjectives and adverbs. Basic sentence structure and simple question form, framing jargon, technical vocabulary (15 words)

**UNIT–II: Dhirubhai Ambani**

a) **Speaking**: Discussions on specific topic
b) **Reading**: Identifying the sequence of ideas and recognizing verbal techniques to link the ideas in a paragraph.
c) **Writing**: Paragraph writing, using key words/phrases and organizing points in a coherent manner.
d) **Grammar and Vocabulary**: Linkers, articles and prepositions.

**UNIT–III : Louis Braille**

e) **Speaking**: Discussions on specific topic
a) **Reading**: Sequencing of ideas and recognizing verbal techniques to link the ideas in a paragraph.
b) **Writing**: Paragraph writing, using key words/phrases and organizing points in a coherent manner.
c) **Grammar and Vocabulary**: Cohesive devices, articles and prepositions

**UNIT-IV : Mallika Srinivasan**

a) **Speaking:** Role plays, asking for and giving information/directions/instructions

b) **Reading**: Understand and interpret graphic elements used in texts.
c) **Writing**: Information transfer.
d) **Grammar and Vocabulary**: Adjectives, adverbs and antonyms.

**UNIT-V : Muhammad Yunus**

a) **Speaking**: Oral presentations
b) **Reading:** Reading for comprehension.
c) **Writing**: Essay writing
d) **Grammar and Vocabulary**: Articles, prepositions, tenses, subject verb agreement and technical jargon (15 words)

**Text Books:**

1. "Modern Trail Blazers", Orient Black Swan Pvt.Ltd.Publisher, 1ST edition. 2013
2. English All Round -I (Communication skills for Under Graduate Learners)– Orient Black Swan Pvt.Ltd.Publisher, 1st edition,2019

**Reference Books:**

1. Raymond Murphy, *Murphy's English Grammar,* Cambridge University Press 2004
2. Meenakshi Raman, Sangeeta Sharma, *Technical Communication: English Skills fo Engineers*, Oxford University Press, 2009
3. Michael Swan, *Practical English Usage,* Oxford University Press, 1996

**Web References:**

1. https://app.grammarly.com/
2. https://www.grammarly.com/blog
3. https://www.englishclub.com/
4. https: www.nonstopenglish.com/
5. https://www.fluentu.com/blog/english/
6. https://www.fluentu.com/blog/english/
7. http://freerice.com soon migrating to https://beta.freerice.com/

| I B.TECH I-SEMESTER | L | T | P | INTERNAL MARKS | EXTERNAL MARKS | TOTAL MARKS | CREDITS |
|---|---|---|---|---|---|---|---|
| | 3 | 0 | 0 | 40 | 60 | 100 | 3 |
| 19BCC1TH03 | LINEAR ALGEBRA & CALCULUS (Common to All Branches) | | | | | | |

**Course objectives:**

- Understanding basic concepts of linear algebra (systems of linear equations, matrix calculus).
- To become proficiency in solving computational problems of linear algebra.
- To acquire knowledge on mean value theorems in calculus.
- Familiarization about the techniques in calculus and multivariate analysis.

**Course outcomes:**

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

**CO 1:** Solve the system of linear equations.

**CO 2:** Analyze the applications of matrices in various fields and obtain Eigen values and Eigen vectors.

**CO 3:** Relate the results of mean value theorems in calculus to Engineering problems.

**CO 4:** Apply the functions of several variables to evaluate the rates of change with respect to time and space variables in engineering.

**CO 5:** Compute the area and volume by interlinking them to appropriate double and triple integrals.

**UNIT-I: Linear Systems of Equations**

Rank of a matrix - Echelon form, Normal form, Solution of linear systems, Direct Methods, Gauss elimination, Gauss Jordon and Gauss Seidal Methods. Solutions of linear simultaneous equations: LU decomposition.

**Application:** Finding the current in a electrical circuit

**UNIT – II: Eigenvalues and Eigenvectors**

Eigenvalues, Eigenvectors, Properties, Cayley - Hamilton Theorem, Quadratic forms, Reduction of quadratic form to canonical form, Rank, Positive definite, negative definite, semi definite, index, signature.

**Application:** Finding powers and inverse of a square matrix using Cayley Hamilton's Theorem.

**UNIT – III: Mean Value Theorems**

Review on limits and continuity, Mean Value theorems (without proofs): Rolle's theorem, Lagrange's theorem, Cauchy's theorem, Taylor's (Generalized mean value) theorem, increasing and decreasing functions, Maxima and minima of function of single variable.

**UNIT- IV: Partial Differention**

Function of two or more variables, Partial derivatives, Total derivatives, change of variables, Jacobian - functional dependence, Taylor's theorem for Two variables. Maxima and Minima of functions of two variables, Lagrange's method of undetermined multipliers.

**UNIT-V: Application of Integration and Multiple Integrals:**
Applications of Integration to Lengths, Volumes and Surface areas of revolution in Cartesian and Polar Coordinates. Multiple Integrals- double and triple integrals, Change of Variables, Change of order of Integration.

**Text Book**:

1. Dr. B.S. Grewal, "Higher Engineering Mathematics", 43rd Edition, Khanna Publishers, 2012.

**References:**

1. N.P. Bali, Bhavanari Satyanarayana, Indrani Promod Kelkar, "Engineering Mathematics", University Science Press, (An Imprint of Lakshmi Publications Pvt., Ltd) New Delhi, 2012.
2. Kreyszig E, "Advanced Engineering Mathematics", 8th Edition, John Wiley, Singapore, 2001.
3. Greenberg M D, "Advanced Engineering Mathematics", 2nd Edition, Pearson Education, Singapore, Indian Print, 2003.
4. Peter V. O'Neil, "Advanced Engineering Mathematics", 7th Edition, Cengage Learning, 2011.
5. Bhavanari Satyanarayana, Pradeep Kumar T.V. & Srinivasulu D, "Linear Algebra and Vector Calculus", Studera Press, New Delhi, 2017.

| I B.TECH I & II SEMESTERS | L | T | P | INTERNAL MARKS | EXTERNAL MARKS | TOTAL MARKS | CREDITS |
|---|---|---|---|---|---|---|---|
| | 3 | 0 | 0 | 40 | 60 | 100 | 3 |
| 19BCC1TH07 | ENGINEERING CHEMISTRY (COMMON TO ALL BRANCHES) | | | | | | |

**Course objectives:**

- To analyze water for its various parameters and its significance in industrial and domestic allocations.
- To acquire the knowledge on types of polymers, fuels and their applications.
- To provide information on exciting advanced materials available in engineering.
- To apply the electrochemical principles, understand the fundamentals of corrosion and development of different techniques in corrosion control.
- To learn the importance of engineering materials used in daily life and industry.

**Course outcomes:**

After successful completion of this course, the students will be able to:

**CO 1:** Analyze the suitable method of water treatment depending on the quality treatment.
**CO 2:** Compare different types of polymers, fuels and their importance.
**CO 3:** Utilize the advanced materials as engineering materials and apply them in domestic and industrial life.
**CO 4:** Distinguish electrical energy sources and importance of corrosion science.
**CO 5:** Identify different types of engineering materials and applications in engineering.

**UNIT-I: Water Chemistry**

**Characteristics of water:** Sources, Impurities–Hardness & its units–Industrial water characteristics– Softening of water by external treatment methods (Lime soda process, Zeolite and Ion exchange process)–Numerical problems on lime soda process–Desalination of brackish water (Reverse osmosis and Electrodialysis).

**Water analysis techniques:** Alkalinity–hardness (Complexo-metric)–Break point chlorination–Free chlorine–DO–BOD and COD.

**UNIT-II: Polymers and Fuel Chemistry**

**Polymers:** Introduction to polymers–Chain growth (free radical, ionic)–Step growth polymerization–Coordination polymerization–Copolymerization with specific examples–Thermoplastics and thermosets–Plastic moulding methods (Compression & Injection moulding)–Rubbers–Natural rubber–Processing–Vulcanization.

**Fuels-**Types of fuels–Calorific value–Numerical problems based on calorific value–Analysis of coal–Liquid fuels–Refining of petroleum–Cracking of heavy oil–Knocking and anti knocking agents–Octane and cetane values.

**UNIT-III: Chemistry of Advanced Materials**

**Nano materials:** Introduction–Sol-gel method & Chemical reduction method of preparation – Characterization by BET method and TEM methods–Carbon nano tubes and fullerenes: Types–Preparation–Properties and Applications.

**Liquid crystals:** Introduction–Types–Applications.

**Composite materials:** Introduction–Definition–Types–Applications–Cermets.

**UNIT-IV: Electrochemistry and Corrosion**

**Electrochemistry:** Galvanic cells–Single electrode potential–Reference electrodes–Electrochemical series–Batteries (primary, secondary and fuel cells)–Applications of secondary batteries in E-vehicles.
**Corrosion:** Causes and effects of corrosion–Theories of corrosion (chemical and electrochemical corrosion)–Factors effecting corrosion–Corrosion control methods–Cathode protection–Sacrificial anodic, Impressed current methods–Surface coatings–Methods of application on metals (Hot dipping, Galvanizing, Tinning, Cladding, Electroplating, Electroless plating)–Organic surface coatings–Paints–Constituents and their functions–Pigment Volume Concentration.

**UNIT-V: Chemistry of Engineering Materials**
**Lubricants:** Introduction–Mechanism of lubrication–Classification of lubricants–Properties and testing of lubricating oils.
**Cement & Refractories:** Manufacture–Setting and hardening of cement–Failures of cement–Slag cement–Refractory: Introduction–Classification and properties of refractories.

**Text Books:**
1. Shikha Agarwal, "**Engineering Chemistry**", ISBN 1107476410, 2nd Edition, Cambridge University Press, New Delhi, (2019).
2. O.G. Palana, "Engineering Chemistry", ISBN 0070146101, Tata McGraw Hill Education Private Limited, New Delhi, (2009).
3. B. Rama Devi, Ch. Venkata Ramana Reddy, Prashantharath, "Text Book of Engineering Chemistry", ISBN 9789353500511, Cenage Learning India Pvt. Ltd, (2016).

**Reference Books:**
1. P.C. Jain and M. Jain "**Engineering Chemistry**", ISBN 8187433175, 15/e, Dhanpat Rai & Sons, Delhi, (2015).
2. B.S Murthy and P. Shankar, "A Text Book of NanoScience and NanoTechnology", University Press (2013).
3. K. Sesha Maheshwaramma and Mridula Chugh, "Engineering Chemistry", Pearson India Edn services, (2016).
4. S.S. Dara, "A Textbook of Engineering Chemistry", ISBN 8121932645, S.Chand Publisher, (2010)

**Web References:**
1. URL: https://www.youtube.com/watch?v=CWOJW4357Bg
2. URL: https://www.youtube.com/watch?v=H1Y1oxQ5eUA&t=627s
3. URL: https://www.youtube.com/watch?v=1xWBPZnEJk8
4. URL: https://www.youtube.com/watch?v=p9yPXdT0k48&t=225s
5. URL: https://www.youtube.com/watch?v=xb_xndPe4n0&t=390s

**E-Books:**
1. "**Engineering Chemistry**" (NPTEL Web-book), by B.L. Tembe, Kamaluddin and M.S. Krishnan.

| I B.TECH I-SEMESTER | L | T | P | INTERNAL MARKS | EXTERNAL MARKS | TOTAL MARKS | CREDITS |
|---|---|---|---|---|---|---|---|
| | 2 | 1 | - | 40 | 60 | 100 | 3 |
| 19BCC1TH10 | C PROGRAMMING | | | | | | |

**Course Objective:**

- To know the basic problem solving process using Flow Charts and algorithms.
- To understand the basic concepts of control structures in C.
- To learn concepts of arrays, functions, pointers and Dynamic memory allocation in C.
- To use the concepts of structures, unions, files and command line arguments in C.

**Course Outcomes:**

After completion of this course, the students would be able to

**CO1**: Develop algorithms and flow charts for simple problems.
**CO2**: Utilize suitable control structures for developing code in C.
**CO3**: Make use of functions and arrays in developing modular programs.
**CO4**: Make use of structures and pointers to write well-structured programs.
**CO5**: Make use of file Operations in C programming for a given application.

**UNIT I:**

**Introduction to Algorithms and Programming Languages**:
Algorithm – Key features of Algorithms – Some more Algorithms – Flow Charts – Pseudo code – Programming Languages – Generation of Programming Languages – Structured Programming Language **Introduction to C:** Introduction – Structure of C Program – Writing the first C Program -Compiling and Executing C Programs - Using Comments – Keywords – Identifiers – Basic Data Types in C – Variables – Constants – I/O Statements in C - Operators in C -Programming Examples – Type Conversion and Type Casting.

**UNIT II**

**Decision Control and Looping Statements:** Introduction to Decision Control Statements – Conditional Branching Statements – Iterative Statements – Nested Loops – Break and Continue Statement – Goto Statement.
**Functions**: Introduction – using functions – Function declaration/ prototype – Function Definition – function call – return statement – Passing parameters – Scope of variables – Storage Classes – Recursive functions – Recursion vs Iteration.

**UNIT III**

**Arrays**: Introduction – Declaration of Arrays – Accessing elements of the Array - Storing Values in Array – Calculating the length of the Array - Operations on Array - Two Dimensional Arrays –Operations on Two Dimensional Arrays.
**Strings:** Introduction – Reading Strings – Writing Strings – String Manipulation functions - Array of Strings.

**UNIT IV**

**Pointers:** Introduction to Pointers – declaring Pointer Variables – Pointer Expressions and Pointer Arithmetic – Null Pointers – Passing Arguments to Functions using Pointer, Dynamic Memory Allocation.

**Structure, Union, and Enumerated Data Types:** Introduction – Nested Structures –Arrays of Structures – Structures and Functions – Self-referential Structures – Union –Enumerated Data Types.

**UNIT V**

**Files:** Introduction to Files – Using Files in C – Reading Data from Files – Writing Data To Files – Detecting the End-of-file – Error Handling during File Operations – Accepting Command Line Arguments – Functions for Selecting a Record Randomly - Remove () – Renaming a File – Creating a Temporary File

**Text Books:**

1. Reema Thareja**, "**Programming in C**"**, First edition, OXFORD University Press 2018.

**Reference Books:**

1. REEMA THAREJA, "Introduction to C programming" OXFORD UNIVERSITY PRESS
2. Rachhpal Singh, "Programming in C", kalyani publishers
3. E Balagurusamy, "computing fundamentals & c programming", isbn 978-0-07- 066909-3, Tata McGraw-Hill, Second Reprint, 2008,
4. Ashok N Kamthane, "Programming with ANSI and Turbo C", Pearson Edition Publications, 2002.
5. Dennis Richie and Brian Kernighan, "The C programming Language", 2nd edition.

**Web References:**

1. http://cprogramminglanguage.net/
2. http://lectures-c.blogspot.com/
3. http://www.coronadoenterprises.com/tutorials/c/c_intro.htm
4. http://vfu.bg/en/e-Learning/Computer-Basics--computer_basics2.pdf

| I B.TECH I SEMESTER | L | T | P | INTERNAL MARKS | EXTERNAL MARKS | TOTAL MARKS | CREDITS |
|---|---|---|---|---|---|---|---|
| | 4 | 0 | 0 | 40 | 60 | 100 | 3 |
| 19BEE1TH08 | BASICS IN MECHANICAL AND CIVIL ENGINEERING | | | | | | |

**Course Objectives:**
- To impart the overview of Civil Engineering and its measuring techniques.
- To familiarize the materials used in Civil Engineering.
- To provide required knowledge on joining, forming, welding & power transmissions.
- To provide an available energy sources.

**Course Outcomes:**
After successful completion of this course, the students will be able to:
**CO 1:** Illustrate the basics and elements of civil engineering.
**CO 2:** Explain the role of traditional and modern infrastructure engineering its planning and execution, its impact on the socio-economic development of the nation.
**CO 3:** Examine the joining, welding, forming techniques for different applications.
**CO 4:** Classify available energy sources.

**UNIT-I: Introduction to Civil Engineering**
Civil Engineering contributions to the welfare of Society-Specialized sub disciplines in Civil Engineering – Structural, Construction, Geotechnical, Environmental, Transportation and Water Resources Engineering- Classification of structures, buildings, towers, chimneys, bridges, water tanks, roads, railways.
**urveying:** Objects-classification-principles-measurements of distances-angles-leveling-determination of areas-contours-examples.

**UNIT-II: Building Materials**
Stones – Classification of stones, Bricks – Composition & Classification and Cement - Basic ingredients, manufacturing process, grades of cement; Aggregates – fine aggregates, coarse aggregates, Timber, steel – structural steel, steel as a reinforcement

**UNIT-III: Joining and Forming Processes: Types of joining:**
Arc welding, Resistance welding, Gas welding, Brazing and Soldering, Metal forming**:** Forging, Rolling, Extrusion operations, working principle.

**UNIT-IV: Power Transmission:**
Different types of power transmission, power transmission by belts, ropes, Power Transmission by chain. Gear: Classification of gears, applications.

**UNIT-V: Energy Sources:**
Renewable and non-renewable energy resources, renewable energy forms and conversions, internal combustion engines**:** classification – working principle - engine components. Four stroke and two stroke petrol and diesel engines, comparison Performance parameters: IP, BP, FP, ME

**Text Books:**

1. Elements of Civil Engineering and Engineering Mechanics, R. V. Ravikar, PHI Learning Pvt. Ltd
2. Basic Civil Engineering, M S Palanichamy, Tata McGraw-Hill
3. Civil Engineering: Through Objective Type Questions, Gupta S.S., CBS Publishers and Distributors
4. Mechanical Engineering Science K R Gopala Krishna, Subhas publications
5. Elements of Mechanical Engineering, M.L. Mathur, F.S.Metha & R.P.Tiwari; Jain Brothers Publications, 2009

**References Books:**

1. Fundamentals of Civil Engineering: An Introduction to the ASCE Body of Knowledge By Richard H. McCuen, Edna Z. Ezzell, Melanie K. Wong, CRC Press
2. Civil Engineer's Handbook of Professional Practice, Karen Hansen, Kent Zenobia
3. John Wiley and Sons (ASCE Press)
4. Production Technology by P.N.Rao by I & II McGraw-Hill publications

| I B.TECH I SEMESTER | L | T | P | INTERNAL MARKS | EXTERNAL MARKS | TOTAL MARKS | CREDITS |
|---|---|---|---|---|---|---|---|
| | - | - | 3 | 20 | 30 | 50 | 1.5 |
| 19BCC1LB01 | ENGLISH COMMUNICATION SKILLS LAB-I (Common to All Branches) | | | | | | |

**Course Objectives:**

- To build confidence in the students to communicate effectively in English.
- To strengthen the oral communication skills to enable them to interact with the people in various social situations.
- To enable the learners improve pronunciation through emphasis on word accent, intonation and rhythm

**Course Outcomes:**

After successful completion of this course, the students will be able to:

**CO 1:** Develop various conversations skills /discourses using formal and informal expressions.

**CO 2:** Apply phonological knowledge to speak English with good pronunciation, overcoming mother tongue influence.

**CO 3:** Identify and comprehend several accents of English Language by listening to audio clips.

**CO 4:** Utilize basic communication skills in JAMS and Role plays.

**UNIT– I**

a. Greeting, Introducing and Taking leave
b. Pure Vowels
c. Listening - TEDx Talks ( https://www.ted.com/talks/ashweetha_shetty_how-education-helped-me-rewrite-my-life?language-en#t-623369)
d. Self-Introduction

**UNIT–II**

a. Giving information and Asking for information
b. Diphthongs
c. Listening -TEDx Talks(https://www.youtube.com/watch?v=Dk20-E0yx_s)
d. Role Play

**UNIT–III**

a. Inviting, Accepting and Declining Invitations
b. Consonants
c. Listening - TEDx Talks (https://www.youtube.com/watch?v=IgAnj6r1O48)
d. JAM

**UNIT-IV**

a. Commands, Instructions and Requests
b. Accent and Rhythm
c. Listening -TEDx Talks(https://youtu.be/SKvMxZ284AA)
d. Tables Turned

**UNIT-V**

a. Suggestions and Opinions
b. Intonation
c. Listening -TEDx Talks(https://youtu.be/ov6pEGXRYZo)
d. Impromptu

**Text Books:**

1. "Strengthen Your Communication Skills", Maruthi Publications, 2013.

**Reference Books:**

1. Meenakshi Raman, Sangeeta Sharma, Technical Communication: Principles and Practice, Oxford University Press, 2015
2. J.D.O Conner, Better English Pronunciation, Cambridge University Press 1980.
3. T.Balasubramanian, "A Text Book of English Phonetics for Indian Students", Macmillan,1981
4. Penny ur Grammar Practice Activities, Cambridge University Press, 2010.
5. Mark Hancock, Pronunciation in Use, Oxford University Press 2007.

| I B.TECH I SEMESTER | L | T | P | INTERNAL MARKS | EXTERNAL MARKS | TOTAL MARKS | CREDITS |
|---|---|---|---|---|---|---|---|
| | - | - | 3 | 20 | 30 | 50 | 1.5 |
| 19BCC1LB05 | ENGINEERING CHEMISTRY LAB (COMMON TO ALL BRANCHES) | | | | | | |

**Course Objectives:**

- To provide the students with a solid foundation in chemistry laboratory required to solve the engineering problems.
- To expose the students in practical aspects of the theoretical concepts.
- To train the students on how to handle the instruments.

**Course Outcomes:**

After successful completion of this course, the students will be able to:

**CO 1:** Develop and perform analytical chemistry techniques to address the water related problems (hardness, alkalinity, Chlorine, DO).

**CO 2:** Explain the functioning of different analytical instruments.

**CO 3:** Compare viscosity and surface tension of different oils.

**CO 4:** Measure molecular/system properties such as strength of solutions, conductance of solutions and acid number of lubricating oils, etc

**List of Experiments**

Introduction to chemistry laboratory–Molarity, Normality, Primary, Secondary standard solutions, Volumetric titrations, Quantitative analysis, Qualitative analysis etc.

1. Estimation of NaOH using standard HCl solution
2. Determination of hardness of water sample by EDTA method
3. Determination of alkalinity of water sample
4. Determination of Dissolved Oxygen content of water sample by Winkler's method
5. Determination of Dissolved Chlorine by Mohr's method
6. Estimation of $Fe^{+2}$ by using $KMnO_4$
7. Preparation of phenol formaldehyde resin/Urea formaldehyde
8. Conductometric titration between strong acid and strong base
9. Determination of viscosity of a liquid by Ostwald's viscometer
10. Determination of surface tension of a liquid by Stalagnometer
11. Determination of moisture content present in given coal sample
12. Determination of acid value of an oil

**Virtual Labs:**

1. Soil Analysis- Determination of pH of soil
2. Water analysis - Determination of Physical parameters

**Text Books:**

1. N.K Bhasin and Sudha Rani "Laboratory Manual on Engineering Chemistry" 3/e, Dhanpat Rai Publishing Company (2007).
2. Mendham J, Denney RC, Barnes JD, Thosmas M and Sivasankar B "Vogel's Quantitative Chemical Analysis" 6/e, Pearson publishers (2000).
3. Sudharani, "Lab manual on Engineering Chemistry" Dhanpat Rai Publications, Co., New Delhi. (2009).

**Web Reference:**

URL: https://vlab.amrita.edu

| I B.TECH I SEMESTER | L | T | P | INTERNAL MARKS | EXTERNAL MARKS | TOTAL MARKS | CREDITS |
|---|---|---|---|---|---|---|---|
| | - | - | 3 | 20 | 30 | 50 | 1.5 |
| 19BCC1LB07 | C PROGRAMMING LAB | | | | | | |

**Course Objective:**

- The purpose of this course is to introduce to students to the field of language. The students will be able to enhance their analyzing and problem solving skills and use the same for writing programs in C.

**Course Outcomes:**

After completion of this C Programming Lab, students should be able to:

**CO 1:** Study, analyze and understand logical structure of computer programming and different constructs to develop programs in C Language.

**CO 2:** Compare and contrast various data types and operator precedence.

**CO 3:** Analyse the use of conditional and looping statements to solve problems associated with conditions and repetitions.

**CO 4:** Analyse simple data structures, use of pointers & dynamic memory allocation techniques.

**CO 5:** Make use of functions and file I/O operations in developing C Programs.

**Exercise l**

Construct Flowcharts for the following through Raptor:

i) Develop a calculator to convert time, distance, area, volume and temperature from one unit to another.

ii) Calculate simple and compound interest for various parameters specified by the user.

iii) Calculate the average of n numbers.

**Exercise 2**

a) Write a C Program to calculate the area of triangle using the formula Area $=(s*(s-a)*(s-b)*(s-c))^{1/2}$ where s= (a+b+c)/2.

b) Write a C Program to find the largest of three numbers using ternary operator.

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

**Exercise 3**

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

b) Write a C program, which takes two integer operands and one operator form the user, performs the operation and then prints the result. (Consider the operators +,-,*, /, % and use Switch Statement)

**Exercise 4**

a) Write a C program to find the sum of individual digits of a positive integer and find the reverse of the given number.

b) Draw a flow chart using Raptor and write a C program to generate all the prime numbers between 1 and n, where n is a value supplied by the user.

**Exercise 5**

a) Draw a flow chart using Raptor and write a C Program to print the multiplication table of a given number n up to a given value, where n is entered by the user.

b) Write a C Program to enter a decimal number, and calculate and display the binary equivalent of that number.

c) Write a C Program to check whether the given number is Armstrong number or not.

**Exercise 6**

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

b) Write a C program to input two m x n matrices, check the compatibility and perform addition and multiplication of them.

**Exercise 7**

a) Draw a flow chart using Raptor and write a C Program to find both the largest and smallest number of an array of integers

b) Write a C Program to find transpose of a matrix.

**Exercise 8**

Draw a flow chart using Raptor and write C programs that use both recursive and non-recursive

Functions for the following

i) To find the factorial of a given integer.

ii) To find the GCD (greatest common divisor) of two given integers.

**Exercise 9**

a) Draw a flow chart using Raptor and write a C Program for the following To find Fibonacci sequence

b) Write C programs illustrating call by value and call by reference concepts.

**Exercise 10**

Write C Programs for the following string operations without using the built in functions - to concatenate two strings

a) To append a string to another string

b) To compare two strings

**Exercise 11**

Write C Programs for the following string operations without using the built in functions

a) To find whether a given string is palindrome or not

**Exercise 12**

Write a C program that uses functions to perform the following operations:

i. To insert a sub-string in to given main string from a given position.

ii. To delete n Characters from a given position in a given string.

iii. To replace a character of string either from beginning or ending or at a specified location

**Exercise 13**

a) Write a C Program to Implement Taylor series method

b) Write a C Program to Implement Euler's method

c) Write a C Program to Implement Runge Kutta method

**Exercise 14**

a) Draw a flow chart using Raptor and write a C program to implement a linear search.

b) Draw a flow chart using Raptor and write a C program to implement binary search

c) Write a C program to implement sorting of an array of elements.

**Exercise 15**

a) Write C Program to reverse a string using pointers

b) Write a C Program to compare two arrays using pointers

c) Write a C program to swap two numbers using pointers

**Exercise 16**

Examples which explores the use of structures, union and other user defined variables

**Exercise 17**

a) Write a C program which copies one file to another.
b) Write a C program to count the number of characters and number of lines in a file.
c) Write a C Program to merge two files into a third file. The names of the files must be entered using command line arguments.

**Exercise 18**

Virtual Lab: http://cse02-iiith.vlabs.ac.in/ /
Any three programs must be submitted with result from the above link.

*** At the end of the semester the student has to submit a Mini-Project on Computer Programming. The list of Mini-Projects is available in the department.**

**Text Books:**

1. Reema Thareja, "Programming in C", OXFORD.
2. The C programming Language by Dennis Richie and Brian Kernighan 2nd ed.

**Reference Books:**

1. Dr.E.Balaguruswamy, "Programming in ANSI C", Tata McGraw-Hill Education.
2. Hanly, "Problem Solving and Program Design in C", Koffman, 7th ed, PEARSON.
3. Forouzan, Gilberg, Prasad,"C Programming, A Problem Solving Approach", CENGAGE.
4. Programming in C, Second Edition by Ashok N.Kamthane, Pearson.

| I B.TECH I SEMESTER | L | T | P | INTERNAL MARKS | EXTERNAL MARKS | TOTAL MARKS | CREDITS |
|---|---|---|---|---|---|---|---|
| | - | - | 3 | 20 | 30 | 50 | 1.5 |
| 19BEE1LB06 | IT WORKSHOP | | | | | | |

**Course Objectives:**

- Enabling the student to understand basic hardware and software tools through practical exposure.

**Course Outcome:**

After completion of this course, the student should be able to

**CO 1:** Demonstrate the need of PC hardware components, applications and softwares.
**CO 2:** Explain the knowledge of networks, internet and World Wide Web, Search engines, Netiquette.
**CO 3:** Experiment with the installation and use of different software like Windows XP, Linux.
**CO 4:** Identify and fix the defective PC and software related issues.
**CO 5:** Make use of various options in Microsoft word, Excel and Power point.

**PC Hardware:**

Identification of basic peripherals, assembling a PC, installation of system software like MS Windows, device drivers. Trouble shooting Hardware and Software some tips and tricks.

**PC Hardware**

**Task 1: Identification of the peripherals of a computer.** To prepare a report containing the block diagram of the CPU along with the configuration of each peripheral and its functions. Description of various I/O Devices.
**Task 2: (Optional):** A Practice on disassembling the components of a PC and assembling them to back to working condition.
**Task 3:** Examples of Operating Systems- DOS, MS Windows, Installation of MS windows on a PC
**Task 4:** Introduction to Memory and Storage Devices, I/O Port, Device Drivers, Assemblers, Compilers, Interpreters, Linkers, Loaders.
**Task 5: Hardware Troubleshooting (Demonstration):** Identification of a problem and fixing a defective PC (improper assembly or defective peripherals).
**Software Troubleshooting (Demonstration):** Identification of problem and fixing the PC for any software issues.

**Internet & World Wide Web:**

Different ways of hooking the PC on to the internet from home and workplace and effectively usage of the internet, web browsers, email, newsgroups and discussion forums. Awareness of cyber hygiene (protecting the personal computer from getting infected with the viruses), worms and other cyber-attacks.
**Task 6:** Demonstrating Importance of Networking, Transmission Media, Networking Devices-Gateway, Routers, Hub, Bridge, NIC, Bluetooth technology, Wireless Technology, Modem, DSL, and Dialup Connection.
**Orientation & Connectivity Boot Camp and Web Browsing:** Students are trained to configure the network settings to connect to the Internet. They are trained to demonstrate the same through web browsing (including all tool bar options) and email access.

**Task 7: Search Engines & Netiquette:**
Students are enabled to use search engines for simple search, academic search and any other context based search (Bing, Google etc).Students are acquainted to the principles of micro-blogging, wiki, collaboration using social networks, participating in online technology forums.
**Task 8: Cyber Hygiene (Demonstration) :** Awareness of various threats on the internet. Importance of Security patch updates and Anti-Virus solution Ethical Hacking, Firewalls, Multi-factors authentication techniques including Smart card Biometrics and also practiced
**Productivity tools:** Crafting professional word documents; excel spread sheets, power point presentations and personal websites using the Microsoft suite of office tools.

**WORD**
**Task 9: MS Word Orientation:** Accessing, overview of toolbars, saving files, Using help and resources, rulers, formatting, Drop Cap, Applying Text effects, Using Character Spacing, OLE in Word, using templates, Borders and Colors, Inserting Header and Footer, Using Date and Time option, security features in word, converting documents while saving.
**Task 10 : Creating Project :** Abstract Features to be covered:-Formatting Styles, Inserting Table, Bullets and Numbering, Changing Text Direction, Cell alignment, footnote, Hyperlink, Symbols, Spell Check, Track Changes, Images from files and clipart, Drawing toolbar and Word Art, Formatting Images, Textboxes and Paragraphs.

**EXCEL**
**Task 11:** Using spread sheet features of EXCEL including the macros, formulae, pivot tables, graphical representations.
**Creating Scheduler -** Features to be covered:-Gridlines, Format Cells, Summation, auto fill, Formatting Text.
**LOOKUP/VLOOKUP**
**Task 12: Performance Analysis:** Features to be covered:-Split cells, freeze panes, group and outline, Sorting, Boolean and Logical operators, Conditional Formatting.

**POWER POINT**
**Task 13:** Students will be working on basic power point utilities and tools which help them create basic power point presentation. Topic covered during this week includes:- PPT Orientation, Slide Layouts, Inserting Text, Word Art, Formatting Text, Bullets and Numbering, Auto Shapes, Lines and Arrows, Hyperlinks, Inserting –Images, Clip Art, Tables and Charts in PowerPoint.
**Task 14:** Focusing on the power and potential of Microsoft power point Helps them learn best practices in designing and preparing power point presentation. Topic covered during this week includes:- Master Layouts (slide, template and notes), Types of views (basic, presentation, slide slotter, notes etc), Inserting – Background , textures, Design Templates, Hidden slides, OLE in PPT.

**Text Books:**
**Faculty to consolidate the workshop manuals using the following references.**
2. Anita Goel , Computer Fundamentals, Pearson
3. Scott. Mueller QUE , Scott Mueller's Upgrading and Repairing PCs, 18/e, Pearson, 2008
**Reference Books:**
1. Dr.N.B.Venkateswarlu, Essential Computer and IT Fundamentals for Engineering and Science Students.
2. G.Praveen Babu, MV Narayana,"Information Technology Workshop", BS Publications, 3e
3. Vikas Gupta, "Comdex Information Technology", Dreamtech.

| I B.TECH I SEMESTER | L | T | P | INTERNAL MARKS | EXTERNAL MARKS | TOTAL MARKS | CREDITS |
|---|---|---|---|---|---|---|---|
| | 3 | 0 | 0 | - | - | - | - |
| 19BCC1MC02 | CONSTITUTION OF INDIA | | | | | | |

**COURSE OBJECTIVES:**

- To train students in understanding the basic structure of Indian Constitution
- To aware the students about the role of constitution in a democratic society
- To prepare students to live better and happily with other fellow beings through the application of Fundamental Rights in their lives.
- To know about the powers of Union Government and State Government

**COURSE OUTCOMES:**

**CO 1:** Examine salient features of Indian Constitution and live accordingly in society & interpret the meaning of Fundamental Rights of State Policy

**CO 2:** Discover various aspects of Union Government legislation and live up to the expectations of the rules.

**CO 3:** Critically examine State Government legislation and improve your living standards by following the rules strictly

**CO 4:** Examine powers and functions of local bodies such as Municipalities and Panchayats and, take advantage of available resources for better living

**CO 5:** Analyze the powers and functions of Election Commission and The Union Public Service Commission and decide upon it for safe and secured life.

**UNIT-I: Introduction to Indian Constitution & Fundamental Rights**

Meaning of the term Indian Constitution –Preamble- Constituent Assembly- Salient Features of Indian Constitution. Fundamental Rights - Fundamental Duties -The Directive Principles of State Policy.

**UNIT-II: Union Government**

Union Government -Union Legislature (Parliament) -Lok Sabha and Rajya Sabha (with Powers and Functions) -Union Executive -President of India (with Powers and Functions) -Prime Minister of India (with Powers and Functions) -Union Judiciary (Supreme Court) -Jurisdiction of the Supreme Court

**UNIT-III: State Government**

State Government -State Legislature (Legislative Assembly / Vidhan Sabha, Legislative Council / Vidhan Parishad) -Powers and Functions of the State Legislature -State Executive-Governor of the State (with Powers and Functions) -The Chief Minister of the State (with Powers and Functions) -State Judiciary (High Courts)

**UNIT-IV: Local Self Governance**

Powers and functions of Municipalities, Panchyats, ZP's and Co – Operative Societies

**UNIT-V: Sovereign Bodies**

Election Commission of India (with Powers and Functions) -The Union Public Service Commission (with Powers and Functions)

**Text Books:**

1. Introduction to constitution of India, Durga Das Basu, Lexis Nexis Publications
2. Constitution of India by PRFESSIONAL BOOK PUBLISHERS
3. The Constitution of India by Arun K Tiru vengadam, Blooms bury publishers.
4. The constitution of India by PM Bakshi, Universal law publishing co
5. The Constitution of India by S.R. Bhansali, Universal law publishing co

**I B.TECH. – II SEMESTER**

| S.No. | Subject Code | Subject | Cat. Code | Internal Marks | External Marks | Total Marks | L | T | P | Credits |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 19BCC2TH01 | Communicative English-II | HS | 40 | 60 | 100 | 2 | - | - | 2 |
| 2 | 19BCC2TH02 | Differential Equations & Vector Calculus | BS | 40 | 60 | 100 | 3 | - | - | 3 |
| 3 | 19BCC2TH07 | Engineering Physics | BS | 40 | 60 | 100 | 3 | - | - | 3 |
| 4 | 19BCC2TH09 | Engineering Graphics | ES | 40 | 60 | 100 | 3 | - | - | 3 |
| 5 | 19BEE2TH13 | Electrical Circuit Analysis-I | PC | 40 | 60 | 100 | 3 | - | - | 3 |
| 6 | 19BEE2TH15 | Power Generation and Economic Aspects | PC | 40 | 60 | 100 | 3 | - | - | 3 |
| 7 | 19BCC2LB06 | Engineering Physics Lab | BS | 20 | 30 | 50 | - | - | 3 | 1.5 |
| 8 | 19BCC2LB08 | Engineering workshop Practice | ES | 20 | 30 | 50 | - | - | 3 | 1.5 |
| 9 | 19BCC2MC02 | Environmental Studies | MC | - | - | - | 3 | - | - | - |
| | | **Total** | | **280** | **420** | **700** | **20** | **0** | **6** | **20** |

| I B.TECH II SEMESTER | L | T | P | INTERNAL MARKS | EXTERNAL MARKS | TOTAL MARKS | CREDITS |
|---|---|---|---|---|---|---|---|
| | 2 | 0 | 0 | 40 | 60 | 100 | 2 |
| 19BCC2TH01 | COMMUNICATIVE ENGLISH - II (Common to All Branches) | | | | | | |

**Course Objectives:**

- To enable the engineering students develop their basic communication skills in English for academic and social purposes.
- To equip the students with appropriate oral and written communication skills.
- To enhance the skills of listening, reading and critical thinking.

**Course Outcomes:**

After successful completion of this course, the students will be able to:

**CO 1:** Infer explicit and implicit meaning of a text, recognize key passages; raise question and summarize it.
**CO 2:** Compose paragraphs, essays as creative writing.
**CO 3:** Build grammatically correct sentences using a variety of sentence structures.
**CO 4:** Enhance word power and usage of lexicons.
**CO 5:** Compile emails, letters, reports, resume and information transfer.

**UNIT– I**

a. **Reading**: Rahul Bajaj
b. **Communication Skills** -Role and significance of communication, Features of Human Communication-
c. **Writing:** Emails and Letters
d. **Vocabulary**: Homonyms, Homophone and Homographs.

**UNIT–II**

a. **Reading:** Ratan Tata
b. **Communication Skills** -Process of Communication & types of Communication, barriers to communication
c. **Writing:** General Essay
d. **Vocabulary:** Words often confused, Suffixes & Prefixes

**UNIT–III**

a. **Reading:** Sabeer Bhatia
b. **Communication Skills** -Importance of Listening for effective communication, Interpersonal communication-
c. **Writing:** Note making
d. **Vocabulary:** Synonyms and Antonyms (100)

**UNIT-IV**

a) **Reading:** Steve Jobs
b) **Communication Skills** -Persuasion techniques
c) **Writing:** Resume
d) **Vocabulary:** One word substitutes (100)

**UNIT-V**

a. **Reading:** Sudha Murthy
b. **Communication Skills -**Telephone and Cell phone etiquette-
c. **Writing:** Report writing; types, format, style, sample reports
d. **Vocabulary:** Frequently used Idioms (100)

**Text Books:**

1. **"**Modern Trail Blazers" , Orient Black Swan Pvt.Ltd.Publisher, 1ST edition. 2013
2. E Suresh Kumar," Engineering English", Orient Black Swan Pvt. Ltd. Publishers.

**Reference Books:**

1. Raman, Meenakshi and Sangeetha Sharma, "Technical Communication: Principles and Practice", Oxford University Press, New Delhi. 2015.
2. Rutherford, Andrea. J Basic Communication Skills for Technology. Pearson, New Delhi. 2001
3. Raymong Murphy, "Murphy's English Grammar", Cambridge University Press 2004.
4. Sanjay Kumar, Pushpa Latha, "Language and Communication Skills for Engineerers", Oxford University Press, 2018.

| I B.TECH-II-SEMESTER | L | T | P | INTERNAL MARKS | EXTERNAL MARKS | TOTAL MARKS | CREDITS |
|---|---|---|---|---|---|---|---|
| | 3 | 0 | 0 | 40 | 60 | 100 | 3 |
| 19BCC2TH02 | DIFFERENTIAL EQUATIONS AND VECTOR CALCULUS (Common to Civil, EEE, ME and ECE) | | | | | | |

**Course Objectives:**

- To formulate and solve first order ordinary differential equations.
- To solve second order differential equations of various kinds.
- To find the solution of first order linear and non-linear partial differential equations.
- The skills derived from the course will help the student from a necessary base to develop analytic and design concepts.

**Course Outcomes:**

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

**CO 1:** Apply first order ordinary differential equations to real life situations.
**CO 2:** Identify and apply suitable methods in solving the higher order differential equations.
**CO 3:** Solve the partial differentiation equations.
**CO 4:** Interpret the physical meaning of different operators as gradient, curl and divergence.
**CO 5:** Estimate the work done against a field, circulation and flux using vector calculus.

**UNIT I: Differential Equations of First Order and First Degree: (10 hours)**

Linear-Bernoulli's-Exact equations and equations reducible to exact form.
**Applications:** Newton's Law of cooling, Law of natural growth and decay, Orthogonal trajectories, Electrical circuits.

**UNIT-II: Linear Differential Equations of Higher Order:**

Finding the complementary functions, Inverse operator, Rules for finding the particular integrals, Method of variation of parameters. Cauchy's and Legendre's linear equations, simultaneous linear equations with constant coefficients.
Application: L-C-R Circuit problems.

**UNIT-III: First Order Partial Differential Equations:**

Formation of partial differential equation by elimination of arbitrary constants and arbitrary functions, solutions of first order linear (Lagrange's) equations.

**UNIT- IV: Vector Differentiation:**

Scalar and vector point functions, vector operator del, del applies to scalar point functions-Gradient, del applied to vector point functions-Divergence and Curl, vector identities.

**UNIT- V: Vector Integration:**

Line integral-circulation-work done, surface integral-flux, Green's theorem in the plane (without proof), Stoke's theorem (without proof), volume integral, Divergence theorem (without proof).

**Text Book**:

1. Dr. B.S. Grewal, "Higher Engineering Mathematics", 43rd Edition, Khanna Publishers, 2012.

2. Bhavanari Satyanarayana, Pradeep Kumar T.V. & Srinivasulu D, "Linear Algebra and Vector Calculus", Studera Press, New Delhi, 2017.

**References Books:**

1. Kreyszig E, "Advanced Engineering Mathematics", 8th Edition, John Wiley, Singapore, 2001.
2. Greenberg M D, "Advanced Engineering Mathematics", 2nd Edition, Pearson Education, Singapore, Indian Print, 2003.
3. Peter V. O'Neil, "Advanced Engineering Mathematics", 7th Edition, Cengage Learning, 2011.
4. N.P. Bali, Bhavanari Satyanarayana, Indrani Promod Kelkar, "Engineering Mathematics", University Science Press, (An Imprint of Lakshmi Publications Pvt., Ltd) New Delhi, 2012.

| I B.TECH II SEMESTER | L | T | P | INTERNAL MARKS | EXTERNAL MARKS | TOTAL MARKS | CREDITS |
|---|---|---|---|---|---|---|---|
| | 3 | 0 | 0 | 40 | 60 | 100 | 3 |
| 19BCC2TH07 | ENGINEERING PHYSICS (Common to All branches) | | | | | | |

**Course Objectives:**

- To impart knowledge in basic concepts of wave optics, fiber optics, properties of solid crystal materials and magnetic materials, acoustics, superconductors.
- To familiarize the applications of materials relevant to engineering field.

**Course Outcomes:**

After successful completion of this course, the students will be able to:

**CO 1:** Find the experimental evidence of wave nature of light and interference in thin films, Diffraction grating and Polarisation in various fields.
**CO 2:** Analyse various types of lasers & optical fibers.
**CO 3:** Explain the crystal structures and XRD techniques.
**CO 4:** Develop the strategies to apply the concepts of magnetism in engineering field.
**CO 5:** Examine the various applications of semiconductors in engineering field.

**UNIT-I**

**Interference & Diffraction:** Introduction -Interference in thin films by reflection – Newton's rings, introduction to diffraction – difference between Fresnel's and Fraunhofer diffraction - Fraunhofer diffraction at single slit (qualitative) - Diffraction grating.

**Polarization:** Introduction – Types of Polarization – Double refraction – Nicol's prism- Quarter wave plate and Half Wave plate

**UNIT–II**

**Lasers:** Introduction – Characteristics of lasers – Spontaneous and Stimulated emission of radiation – Population inversion – Ruby laser – Helium Neon laser-Applications.

**Fiber Optics**: Introduction- Principle of optical fiber - Acceptance angle – cone - Numerical Aperture-Applications.

**UNIT–III**

**Crystallography** : Introduction – Space lattice – Basis – Unit Cell – Lattice parameters – Bravais lattices – Crystal systems – Structures and packing fractions of SC,BCC and FCC.

**X-Ray Diffraction**: Directions and planes in crystals – Miller indices – Separation between successive (h k l) planes – Bragg's law.

**UNIT-IV**

**Electromagnetic Fields:** Gauss and stokes theorems (qualitative) – Fundamental laws of electromagnetism – Maxwell's Electromagnetic Equations.

**Magnetic materials:** Magnetic Susceptibility- Magnetic permeability –Classification of Magnetic materials – Dia, Para, Ferro – Soft and Hard magnetic materials - Applications

**UNIT-V**

**Quantum Mechanics**: Introduction –de-Broglie's concept of Matter waves – Physical significance of wave function - Schrodinger Time Independent wave equations – Particle in a one dimensional potential box.

**Semiconductor Physics:** Origin of energy band formation in solids- classification of materials into conductors, semiconductors and insulators, Intrinsic and Extrinsic semiconductor- Hall Effect.

**Text Books:**

1. A.J. Dekker, "Solid state Physics", ISBN 10: 0333918339 / ISBN 13: 9780333918333, Mc Millan India Ltd, First edition, 2000.
2. M.N. Avadhanulu & P.G. Kshirasagar, "A text book of Engineering Physics", ISBN 81-219-0817-5, S. Chand publications, First Edition, 2011.
3. P. K. Palanisamy, "Engineering Physics", ISBN: 9788183714464, Scitech Publishers, 4th Edition, 2014
4. M.R. Srinivasan, "Engineering Physics", ISBN978-81-224-3636-5, New Age international publishers, 2nd Edition,2014

**Reference Books:**

1. Charles Kittle, "Introduction to solid state physics" ISBN: 9788126578436, Willey India Pvt.Ltd, 5TH edition, 2012.
2. M.Arumugam, "Applied Physics", ISBN: 81-89638-01-7, Anuradha Agencies, 4th edition, 2013.
3. D.K.Bhattacharya, "Engineering Physics", ISBN: 0198065426, 9780198065425, Oxford University press, 2nd edition, 2010.
4. Sanjay D Jain and Girish G Sahasrabudhe "Engineering Physics", University Press ISBN: 8173716781,1st edition, 2010.
5. B.K.Pandey & S. Chaturvedi "Engineering Physics" ISBN: 8131517616, Cengage Learning, 1st edition, 2012.

**Web References:**

1. http://link.springer.com/physics
2. http://www.thphys.physics.ox.ac.uk
3. http://www.sciencedirect.com/science
4. http://www.e-booksdirectory.com

**E-Books:**

1. http://www.peaceone.net/basic/Feynman
2. http://physicsdatabase.com/free-physics-books
3. http://www.damtp.cam.ac.uk/user/tong/statphys/sp.pdf
4. http://www.freebookcentre.net/Physics/Solid-State-Physics-Books.html

| I B.TECH II SEMESTER | L | T | P | INTERNAL MARKS | EXTERNAL MARKS | TOTAL MARKS | CREDITS |
|---|---|---|---|---|---|---|---|
| | 1 | 0 | 4 | 40 | 60 | 100 | 3 |
| 19BCC2TH09 | ENGINEERING GRAPHICS (COMMON TO CSE & ECE & EEE & IT) | | | | | | |

**Cource Objectives:**

- The students to use drawing instruments and to draw polygons, engineering Curves & engineering scales.
- The students use to make orthographic projections, projections of points, simple lines & projections of the lines inclined to both the lines.
- The students use to draw the projections of the plane inclined to both the plane.
- The students use to draw the projections of solids & development of surfaces.
- The students use to draw conversion of isometric views to orthographic views vice versa and to learn basic drawing commands in auto cad.

**Course Outcomes:**

After successful completion of this course, the students will be able to:

**CO 1:** Construct the geometrical shapes of regular polygons, Engineering Curves.

**CO 2:** Develop the orthographic projections, projections of points, and lines inclined to both the planes.

**CO 3:** Construct the projection of planes inclined to both the planes.

**CO 4:** Develop the projection of regular solids and surfaces.

**CO 5:** Interpret the conversion of isometric views to orthographic views vice versa.

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**UNIT-I**

**The Basic Concepts In Engineering Drawing:** Introduction to engineering drawing instruments, lettering and dimensioning practice. Geometrical constructions- Constructing regular polygons by general methods.

**Curves Used In Engineering Practice:** Introduction to **conic** sections, construction of ellipse, parabola, hyperbola by eccentricity method. Construction of ellipse by - Arcs of circles Method, Concentric Circles Method and Oblong Method, & parallelogram methods.

**UNIT–II**

**Orthographic Projections-** Introduction to type of projections, first angle and third angle projections.

**Projection Of Points**: Principles of orthographic projection – Convention – First angle projections, projections of points.

**Projections Of Straight Lines:**

Projections of straight lines parallel to both the planes, parallel to one plane and inclined to the other plane. Lines inclined to both the planes - Projections of straight lines inclined to both the planes- determination of true lengths, angle of inclination and traces.

**UNIT–III**

**Projections Of Planes**: Regular planes perpendicular/parallel to one plane and inclined to the other reference plane; inclined to both the reference planes.

**UNIT-IV**

**Projections of Solids:** Introduction to projections of solids, types of solids: prisms, pyramids, cones and cylinders –simple positions and the axis inclined to one of the plane.

**UNIT-V**

**Isometric and Orthographic Projections**: Introduction of isometric views, isometric projections & orthographic projections. Conversion of isometric views to orthographic views and orthographic views to isometric views.

**Introduction To AUTO CAD:** Practice on draw, edit & modify commands using auto CAD.

**Text Books:**

1. Engineering Drawing by N.D. Butt, Chariot Publications.
2. Engineering Drawing by K.L.Narayana & P. Kannaiah, Scitech Publishers.
3. Engineering Drawing & Graphics by K.Venu gopal, New age international Publishers.

**Reference Books:**

1. Engineering Graphics for Degree by K.C. John, PHI Publishers.
2. Engineering Drawing by Basant Agarwal & CM. Agarwal, Tata McGraw Hill Publishers.

**Web References:**

1. https://nptel.ac.in/courses/112103019/17

**E-Books:**

1. https://www.pdfdrive.com/textbook-of-engineering-drawing-e28918244.html

| I B. TECH II SEMESTER | L | T | P | INTERNAL MARKS | EXTERNAL MARKS | TOTAL MARKS | CREDITS |
|---|---|---|---|---|---|---|---|
| | 3 | 0 | 0 | 40 | 60 | 100 | 3 |
| 19BEE2TH13 | ELECTRICAL CIRCUIT ANALYSIS - I | | | | | | |

**Course Objectives:**

- To introduce fundamental laws, basic electrical elements, sources and their characteristics.
- To learn the concept of phase and phase relationship of basic electrical elements.
- To impart the basic knowledge about the Resonance and coupled circuits
- To compute electrical parameters like current, voltage and power using network theorems for AC and DC circuits.

**Course Outcomes:**

After successful completion of this course, the students will be able to:

**CO 1:** Acquire knowledge about basic electrical circuits.

**CO 2:** Gain knowledge about phase and phase relationship of basic electrical elements and circuits.

**CO 3:** Apply the network topology to electrical circuits.

**CO 4:** Design of tank circuit for given frequency and analyse the coupled circuits in series and parallel.

**CO 5:** Apply the network theorems to compute various parameters of electric network.

**UNIT-I: Introduction to Electrical Circuits**

Passive components and their V-I relations. Sources (dependent and independent), Ohm's Law-Kirchhoff's laws, Network reduction techniques (series, parallel, series - parallel, star- to-delta and delta-to-star transformation). Source transformation technique, nodal analysis, mesh analysis, super node and super mesh analysis for D.C. excitations.

**UNIT-II: Single Phase A.C. Circuits**

Periodic waveforms (determination of rms, average value and form factor). Concept of phase and phase difference. Complex and polar forms of representations, steady state analysis of R, L and C circuits with sinusoidal excitation, Power Factor and its significance, Real, Reactive power and apparent Power.

**UNIT-III: Network Topology**

Definitions of Graph and Tree. Basic cut set and tie set matrices for planar networks. Loop and nodal methods of analysis of networks with dependent and independent voltage and current sources. Duality and Dual networks.

**UNIT-IV Resonance and Coupled Circuits**

Series and parallel resonance - Q factor and bandwidth - Resonant frequency of a tank circuit - Coupled circuits - Self and mutual inductances - Coefficient of Coupling - Analysis of coupled circuits - Dot rule for coupled circuits - Equivalent circuit of coupled circuits - Coupled circuits in Series and Parallel.

**UNIT-V: Network Theorems (DC & AC Excitations)**

Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum Power Transfer theorem, Reciprocity theorem, Millman's theorem, Tellegen's theorem and compensation theorem.

**Text Books:**

1. William H. Hayt, Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuit Analysis", TMH, 8th Edition, 2012
2. Chakrabarti A, "Circuits Theory (Analysis and synthesis), Dhanpath Rai & Sons, New Delhi, 1999.

**Reference Books:**

1. M.E. Vanvalkenburg, "Network Analysis", PHI, 3rd Edition, 2006.
2. A Sudhakar and Shyam Mohan SP, "Circuits and Networks: Analysis and Synthesis", TMH, 5th Edition, 2015.

**Web References:**

1. http://www.egate.ws/
2. http://cosmolearning.org/courses/circuit-theory/
3. http://www.nptelvideos.in/2012/11/circuit-theory.html
4. http://pbtstudies.blogspot.in/

**E-Books:**

1. http://elearning.vtu.ac.in/P9/notes/06ES34/Unit1-KCV.pdf

| I B.TECH II SEMESTER | L | T | P | INTERNAL MARKS | EXTERNAL MARKS | TOTAL MARKS | CREDITS |
|---|---|---|---|---|---|---|---|
| | 3 | 0 | 0 | 40 | 60 | 100 | 3 |
| 19BEE2TH15 | POWER GENERATION & ECONOMIC ASPECTS | | | | | | |

**COURSE OBJECTIVES**

- To introduce the operation of Hydel, Thermal and Nuclear power plants
- To make the students to understand the significance and power generation using non-conventional energy.
- To impart the knowledge of economic aspects and study different types of load curves.

**COURSE OUTCOMES:-**

After successful completion of this course the students will be able to

**CO 1:** Explain the working of different kinds of Turbines & concept of Hydro Power Generation

**CO 2:** Identify the different components of thermal power plants

**CO 3:** Explain the layout, construction and working of the components inside nuclear power plants

**CO 4:** Classify the significance of non-conventional energy resources, power generation using solar, wind, tidal, geo thermal and fuel cells.

**CO 5:** Analyse the significance of various factors for economic analysis of power generation

**UNIT-I: Hydel Power Station**

Classification of Hydro turbines: Working principle-Efficiency calculation and Design principles for Pelton Wheel-Francis and Kaplan turbines-Selection of site-block diagram approach of hydroelectric power plant and Classification of pumped storage power plants.

**UNIT-II: Thermal Power Station**

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.

**UNIT-III: Nuclear Power Station**

Basics of Nuclear Engineering-Layout and subsystems of Nuclear Power Plants-Working of Nuclear Reactors: Boiling Water Reactor (BWR),-Pressurized Water Reactor (PWR)-Canada Deuterium- Uranium reactor (CANDU)-Breeder-Gas Cooled and Liquid Metal Cooled Reactors-Safety measures for Nuclear Power plants.

**UNIT-IV: Power from Renewable Energy**

Solar Energy: Basics of solar energy - solar constant - extra-terrestrial radiation - types of conversion systems - solar thermal power plants -solar pond - solar cell.

Wind Energy: Principles of wind power - types - wind turbine operation, types of wind generators, Tidal energy-Geo thermal Energy - Fuel cells

**UNIT-V: Economic Aspects of Power Generation**

Load curve-load duration and integrated load duration curves-connected load-maximum demand-demand factor-load factor-diversity factor-plant capacity factor-utilization factor-plant use factors- Numerical Problems.

**Text Books:**

1. R.K.Bansal -Fluid Mechanics & Hydraulic Machinery, Lakshmi Publications.
2. M.L.Soni,P.V.Gupta, U.S.Bhatnagarand A. Chakrabarti -A Text Book on Power System Engineering, DhanpatRai& Co. Pvt. Ltd.
3. V.K.Mehta & Rohith Mehta Principles of power systems , S.Chand Publications.

**Reference Books:**

1. V. Kamaraju- Electrical Power Distribution Systems, Tata Mc Graw Hill, New Delhi.
2. M V Deshpande -Elements of Electrical Power Station Design , PHI, New Delhi.
3. M. N. Bandyopadhyay,-Electrical power systems theory and practice -PHI.

**Web References:**

1. URL:https://www.youtube.com/watch?v=uy9lZCdkQIM&list=PLD4ED2FAF3C155625 & index=1

**E-Books:**

1. https://easyengineering.net/principles-of-power-system-by-mehta/
2. https://www.engineeringbookspdf.com/principles-of-power-systems-v-k-mehta/

| I B.TECH I/II SEMESTER | L | T | P | INTERNAL MARKS | EXTERNAL MARKS | TOTAL MARKS | CREDITS |
|---|---|---|---|---|---|---|---|
| | 0 | 0 | 3 | 20 | 30 | 50 | 1.5 |
| 19BCC2LB06 | ENGINEERING PHYSICS LAB (Common to All branches) | | | | | | |

**Course Objectives:**

- To impart physical measurement skills and make the students understand coherence between theoretical and practical knowledge.

**Course Outcomes:**

After successful completion of this course, the students will be able to:

**CO 1:** Explain the principle of physics and interpret them in engineering field and compares the results with theoretical calculations.

**CO 2:** Utilise modern engineering physics techniques and tools in real time applications in engineering studies.

**CO 3:** Identify the characteristics and the behaviour of materials in a practical manner and gain knowledge and its usage.

**CO 4:** Apply the analytical techniques and graphical analysis to the experimental data.

**List of Experiments:**

1. Rigidity modulus of material by wire-dynamic method (torsional pendulum)
2. Determination of wavelength of a source-Diffraction Grating-Normal incidence
3. Newton's rings –Radius of Curvature of Plano Convex Lens.
4. Determination of thickness of thin wire- Air wedge method
5. Determination of wavelength of Laser Source-single slit diffraction.
6. Determine the Numerical aperture of an optical fiber.
7. Melde's experiment – Transverse and Longitudinal modes.
8. Magnetic field along the axis of a current carrying coil – Stewart and Gee's apparatus.
9. Verification of laws of stretched string by using Sonometer.
10. Calculate the energy loss in a given ferromagnetic material by plotting B-H Curve.
11. Energy Band gap of a Semiconductor p - n junction.
12. Characteristics of Thermistor – temperature coefficient

**Virtual Labs:**

1. Brewster's Angle determination(Polarization angle)
2. Hall effect experiment-determination of charge carrier density

**Text Books:**

1. Engineering Physics Lab Manual by Dr.Y. Aparna & Dr.K.Venkateswarao (V.G.S.Book links).
2. Physics Practical Manual, Lorven Publications
3. S. Balasubramanian , M.N. Srinivasan " A Text book of Practical Physics"- S Chand Publishers, 2017.

**Web References:**

1. https://www.youtube.com/watch?v=NDsSPtL9dyQ
2. https://www.youtube.com/watch?v=9agoJRCnu4w
3. https://www.youtube.com/watch?v=bv-lLJreyCU
4. http://vlab.amrita.edu/index.php

| I B.TECH II SEMESTER | L | T | P | INTERNAL MARKS | EXTERNAL MARKS | TOTAL MARKS | CREDITS |
|---|---|---|---|---|---|---|---|
| | - | - | 3 | 20 | 30 | 50 | 1.5 |
| 19BCC2LB08 | ENGINEERING WORKSHOP PRACTICE (COMMON TO CIVIL,MECH & EEE) | | | | | | |

**Course Objectives:**

- To impart knowledge to students to develop their technical skill sets for creating entities from raw material.
- To give hands on training and practice to students for use of various tools, devices, machines.
- To develop ability of students to understand, plan and implement various processes and operations to be performed on the raw material to create object of desired shape and size.

**Course Outcomes:**

**CO 1:** Make Use of the various carpentry tools, machines, devices used in engineering practice for preparing different carpentry joints.

**CO 2:** Make Use of the various fitting tools, machines, devices used in engineering practice for preparing different Fits.

**CO 3:** Develop funnel and square box thorough knowledge of various Tin Smithy tools.

**CO 4:** Demonstrate the various house wiring connections for different house wiring connections

- **CARPENTARY:**

1. Preparation of T-Joint
2. Preparation of dovetail Joint

- **FITTING:**

1. Preparation of v-fit
2. Preparation of square-fit

- **TIN SMITHY:**

1. Preparation of funnel
2. Preparation of square box

- **HOUSE WIRING:**

1. Series bulbs connection
2. Parallel bulbs connection
3. Stair case connection
4. Florescent lamp connection

| I B.TECH II SEMESTER | L | T | P | INTERNAL MARKS | EXTERNAL MARKS | TOTAL MARKS | CREDITS |
|---|---|---|---|---|---|---|---|
| | 2 | 0 | 0 | 40+40+20 | - | 100 | MC(0) |
| 19BCC2MC02 | ENVIRONMENTAL STUDIES (Common to all Branches) | | | | | | |

**Course Objectives:**

- To make the students aware about the environment and it's inter–disciplinary, to familiarize the concept of ecosystem and their importance, basic understanding of the ecosystem and its diversity.
- Overall understanding of the natural resources.
- To bring the awareness among students about the importance of biodiversity and the need for its conservation.
- To make the students understand the adverse effects of environmental pollution, its causes and measures to control it.
- Acquaintance on various environmental challenges induced due to unplanned anthropogenic activities. Awareness on the social issues, environmental legislation and global treaties understanding the environmental policies and regulations.

**Course Outcomes:**

After successful completion of this course, the students will be able to:

**CO 1:** Explain the concepts of the ecosystem and its function in the environment. The need for protecting the producers and consumers in various ecosystems and their role in the food web.

**CO 2:** Analyze the natural resources and their importance for the sustenance of the life and recognize the need to conserve the natural resources.

**CO 3:** Explain the biodiversity of India and the threats to biodiversity, and conservation practices to protect the biodiversity.

**CO 4:** Distinguish various attributes of the pollution, their impacts and measures to reduce or control the pollution along with waste management practices.

**CO 5:** Define Environmental policy, legislation, environmental assessment and the stages involved in EIA Environmental audit.

**UNIT – I**

**Multidisciplinary nature of Environmental Studies**: Definition, Scope and Importance – Need for Public Awareness. Institutions and people in Environment.

**Ecosystems:**

Definitions and concepts – Characteristics of ecosystem – Structural and functional features – Producers, consumers and decomposers and food webs – Types of ecosystems – Forests, grassland, desert, crop land, pond, lake, river and marine ecosystems – Energy flow in the ecosystem – Ecological pyramids – Ecological successions.

**UNIT – II**

**Natural Resources: Water resources**–Use and over utilization of surface and natural resourced ground water–Floods, drought, conflicts over water, dams–benefits and problems on tribal population & Environment.

**Forest resources**: Use and over–exploitation, deforestation.

**Mineral resources**: Use and exploitation, tribal & environmental effects of extracting and using mineral resources.
**Food resources:** World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer–pesticide problems, water logging, salinity–concept of sustainable agricultural methods.
**Energy Resources:** Renewable (wind energy, tidal energy) and non renewable energy resources (Fossil fuels, coal).

**UNIT – III**

**Biodiversity:** Definition: genetic, species and ecosystem diversity- classification - Value of biodiversity: consumptive use, productive use, social-Biodiversity at national and local levels. India as a mega-diversity nation - Hot-spots of biodiversity
**Conservation of biodiversity:** Threats to biodiversity: habitat loss, man wildlife conflicts - Endangered and endemic species of India – Conservation of biodiversity: In-Situ conservation and Ex- situ conservation.

**UNIT – IV**

**Environmental Pollution and Control Technologies:** Definition, Cause, effects and control measures of Air pollution, Water pollution, Soil pollution, Noise pollution, and nuclear hazards. Role of an individual in prevention of pollution. - Pollution case studies, Good Agricultural Practices – Drip irrigation, soil erosion and desertification
**Solid Waste Management:** Sources, Classification, effects and control measures of urban and industrial solid wastes. Consumerism and waste products, Biomedical, Hazardous and e – waste management.

**UNIT – V**

**Environmental Policy, Legislation and Environmental Management**: Environmental ethics: Issues and possible solutions. Environmental Protection Act, Legal aspects -Air (Prevention and Control of Pollution) Act. – Water (Prevention and control of Pollution) Act - Wildlife Protection Act -Forest Conservation Act-Issues involved in enforcement of environmental legislation.
Impact Assessment and its significance - various stages of EIA, preparation of EMP and EIS, Environmental audit, Ecotourism.
Visit to some local Polluted Site: Study of an industrially Polluted area.

**Text Books:**

1. AnubhaKaushik& C. P. Kaushik, Environmental Studies, New Age International (P) Ltd., New Delhi. Fourth edition, 2014.
2. P. N. Palanisamy, P. Manikandan, A. Geetha, and K. Manjula Rani,Environmental Studies, Pearson Education, Chennai.ISBN 978-93-325-2052-3,Second edition-2014.

**Reference Books:**

1. Deekshita Dave & P. Udaya Bhaskar, Text Book of Environmental Studies Cengage Learning.
2. Shaashi Chawla, a Textbook of Environmental Studies, TMH, New Delhi.
3. Benny Joseph Environmental Studies, Tata McGraw Hill Co, New Delhi.
4. Dr.K.V.S.G. Murali Krishna, Environmental Studies VGS Publishers, Vijayawada, First Edition 2016.
5. Bharucha, E. Text book of Environmental Studies, First edition, Universities Press (India) Pvt., Ltd., Hyderabad, 2005.

**Web References:**

1. URL:https://www.youtube.com/watch?v=7G3eXI_DPn8
2. URL: https://www.eolss.net/sample-chapters/C09/E6-70-05-01.pdf
3. URL: https://www.youtube.com/watch?v=QuRL6NbyvEQ
4. URL: https://google/ Introduction to Environmental Studies 5JM1G2
5. URL:http://www.teacherspayteachers.com/Product/Food-Chains-Trophic-Levels-and-Ecological- Pyramids-PowerPoint Click the above
6. URL:http://iadc-dredging.com/en/371/environment/ecosystem-services/ this webinar will focus on the concept of ecosystem services
7. URL: http://mocomi.com/ presents: What is Air Pollution? Air pollution is the introduction of foreign products into the atmosphere.
8. URL: https://en.wikipedia.org/wiki/green_impact_assessment

**E-Books:**

1. https://faculty.psau.edu.sa/.../doc-5-pdf-d78456fce3bebc84d9320fa2f9cf9e2a-original
2. https://www.researchgate.net/.../273775623_Introduction_to_Environmental_Sciences

**II B.TECH. – I SEMESTER**

| S.No. | Subject Code | Subject | Cat. Code | Internal Marks | External Marks | Total Marks | L | T | P | Credits |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 19BCC3TH01 | Numerical Methods & Transformations | BS | 40 | 60 | 100 | 3 | - | - | 3 |
| 2 | 19BEE3TH02 | Electronic Devices and Circuits | ES | 40 | 60 | 100 | 3 | - | - | 3 |
| 3 | 19BEE3TH03 | Electrical Circuit Analysis - II | PC | 40 | 60 | 100 | 3 | - | - | 3 |
| 4 | 19BEE3TH04 | Electrical Machines-I | PC | 40 | 60 | 100 | 3 | - | - | 3 |
| 5 | 19BEE3TH05 | Electro Magnetic Fields | PC | 40 | 60 | 100 | 3 | - | - | 3 |
| 6 | 19BEE3TH06 | Analog Electronics | PC | 40 | 60 | 100 | 3 | - | - | 3 |
| 7 | 19BEE3LB01 | Electronic Devices and Circuits Lab | ES | 20 | 30 | 50 | - | - | 3 | 1.5 |
| 8 | 19BEE3LB02 | Electrical Circuit Analysis Lab | PC | 20 | 30 | 50 | - | - | 3 | 1.5 |
| 9 | 19BCC3MC02 | Community Service | MC | - | - | - | - | - | - | - |
| | | **Total** | | **280** | **420** | **700** | **18** | **-** | **6** | **21** |

| II B. TECH I SEMESTER | L | T | P | INTERNAL MARKS | EXTERNAL MARKS | TOTAL MARKS | CREDITS |
|---|---|---|---|---|---|---|---|
| | 3 | 0 | 0 | 40 | 60 | 100 | 3 |
| 19BCC3TH01 | NUMERICAL METHODS AND TRANSFORMATIONS (Common to CIVIL, EEE, ME) | | | | | | |

**Course Objectives:**

- To elucidate the different numerical methods to solve nonlinear algebraic equations.
- To propagate the use of different numerical techniques for carrying out numerical integration.
- Explore the use of Laplace transform method to solve with initial value problems of ODE.
- To acquire fundamental Knowledge of Fourier series and Fourier Transform and able to give Fourier expansions of a given function.

**Course Outcomes:**

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

**1.** Evaluate approximating roots of polynomials and transcendental equations by different algorithms.

**2.** Apply Newton's forward backward and Lagrange's interpolation for equal and unequal intervals.

**3.** Apply different algorithms for approximating solutions of ordinary differential equation to its analytical computations.

**4.** Select appropriate technique of Laplace transforms in solving differential equations.

**5.** Relate Fourier series, integral, transforms techniques in their core.

**UNIT-I: Solutions to Algebraic Equations and Interpolation:**

Solution of polynomial and transcendental equations: bisection method, Regula-Falsi method and Newton-Raphson method. Finite differences, relation between operators, interpolation using Newton's, Gauss's forward and backward difference formulae. Interpolation with unequal intervals: Newton's divided difference and Lagrange's formulae.

**UNIT –II: Numerical Solutions of ODE and Integration:**

Numerical Differentiation, Ordinary differential equations-Taylor's series, Euler and modified Euler's methods. Runge-Kutta method of fourth order for solving first and second order equations. Numerical integration- trapezoidal rule and Simpson's 1/3rd and $3/8^{th}$ rules.

**UNIT-III: Laplace Transformations:**

Laplace transform and its properties, Transform of derivatives and integrals, Multiplication by $t^n$, division by t, Unit step function and unit impulse function. Transform of periodic functions, Evolutions of integrals by Laplace Transforms. Finding inverse transforms by the method of partial fractions, other methods of finding inverse Laplace Transforms, Convolution theorem(without proof), Solutions of Initial and Boundary Value Problems.

**UNIT – IV: Fourier Series:**

Introduction, Euler's formulae, Periodic functions, Dirichlet's conditions, conditions for a Fourier expansion, functions of any period, functions having points of discontinuity, odd and even functions - half range series.

**UNIT – V: Fourier Transforms:**
Fourier integral theorem (without proof), Fourier cosine and sine integrals, Fourier transform, Fourier sine and cosine transforms, properties of Fourier Transforms, convolution theorem (without proof).

**Text Book:**
**1.** B.S.Grewal, Higher Engineering Mathematics, 43rd Edition, Khanna Publisher.

**References Books:**
**1.** N.P. Bali, Bhavanari Satyanarayana, Indrani Promod Kelkar, "Engineering Mathematics", University Science Press, (An Imprint of Lakshmi Publications Pvt., Ltd) New Delhi, 2012.
**2.** B.V. Ramana, Higher Engineering Mathematics, Tata McGrawhill.
**3.** Erwin Kreyszig, Advanced Engineering Mathematics, 9thEditiwiley-India.
Peter V. O'Neil, "Advanced Engineering Mathematics", 7th Edition, Cengage Learning, 2011.

| II B.TECH I-SEMESTER | L | T | P | INTERNAL MARKS | EXTERNAL MARKS | TOTAL MARKS | CREDITS |
|---|---|---|---|---|---|---|---|
| | 3 | 0 | 0 | 40 | 60 | 100 | 3 |
| 19BEE3TH02 | ELECTRONIC DEVICES AND CIRCUITS | | | | | | |

**Course Objectives:**

- Analyze the operation and principles of P-N diode.
- Classify various types of Special diodes, rectifiers and filters.
- Discuss the working of BJT.
- Explain the need for transistor biasing techniques.
- Discuss the working of FET and other Transistors.

**Course Outcomes:**

After completion of the course, the students will be able to

**CO 1:** Use P-N diodes in electronic circuits.
**CO 2:** Use special diodes and rectifiers in electronic circuits.
**CO 3:** Explore the operation of BJT and its applications.
**CO 4:** Analyse the thermal stability of BJT.
**CO 5:** Explore the operation of FET, other transistors and their applications.

**UNIT- I: PN Junction Diode Characteristics**

Insulators, Semiconductors and Metals – Classification using Energy gap, Intrinsic and Extrinsic Semiconductors. P-N Junction Diode - Formation of P-N Junction, Open Circuited P-N Junction, Biased P-N Junction - Forward Bias, Reverse Bias, Current Components in PN Junction Diode, Law of Junction, Diode Current Equation - Quantitative Analysis, V-I Characteristics of Diode - Forward Bias, Reverse Bias, Breakdown in P-N Junction Diode, Temperature Dependence on V-I Characteristics, Diode Resistance-Static Resistance, Dynamic Resistance, Reverse Resistance, Diode Capacitance - Transition Capacitance, Diffusion Capacitance, Energy Band Diagram of PN Junction Diode.

**UNIT- II: Special Diodes and Rectifiers**

**SPECIAL DIODES:** Zener Diode - V-I Characteristics, Applications, Breakdown Mechanisms - Zener Breakdown and Avalanche Breakdown, Construction, Operation, Characteristics and applications of LED, LCD, Photodiode, Varactor Diode and Tunnel diode.
**RECTIFIERS:** Basic Rectifier setup, Half Wave Rectifier, Full Wave Rectifier, Bridge Rectifier, Inductive and Capacitive Filters, L– Section and π- Section, Derive and compare rectifier parameters with and without filter.

**UNIT- III: Bipolar Junction Transistor (BJT)**

Bipolar Junction Transistor – Types, Symbols and Operation, Transistor Current Components, Transistor Equation - Relation among $I_C$, $I_B$, $I_{CBO}$, Transistor Configurations - CB, CE and CC, Transistor as a switch, Transistor switching times, Transistor as an Amplifier, Characteristics of Transistor in Common Base Configuration, Common Emitter and Common Collector Configurations - Input and output characteristics, Early effect, Transistor parameters, Current amplification factor, Relation among α, β, and γ, Comparison of CB, CE and CC Configurations, Typical transistor junction voltage values.

**UNIT- IV: BJT Biasing**

Need For Biasing, Operating Point, Load Line Analysis - D.C. Load Line, A.C. Load Line, Biasing - Methods, Basic Stability, Fixed Bias, Collector-to-base Bias and Self Bias.

**UNIT- V: FET & Other Transistors**

FET Types and Symbols - JFET and MOSFET/IGFET, JFET: N- Channel and P-Channel Construction, Operation, Characteristics - Drain and Transfer, Parameters - Drain Resistance, Amplification factor, Transconductance, Pinch-off voltage, MOSFET - Types - Depletion MOSFET - N Channel and P Channel, Enhancement MOSFET - N-Channel and P-Channel, Construction, Operation, Characteristics - Transfer and Drain Characteristics for Depletion and Enhancement Modes , Comparison between JFET and MOSFET.SCR- Symbol, Two-Transistor version, DIAC, TRIAC, UJT - Negative Resistance Property and Applications.

**Text Books:**

1. Electronic Devices and Circuits – J. Millman, C. Halkias, Tata McGraw-Hill, Third Edition, 2010.
2. Electronic Devices and Circuits – Allen Mottershed, PHI, 2011.
3. Electronic Devices and Circuits – Salivahanan, N. Suresh Kumar, A. Vallavaraj, Tata McGraw-Hill, Second Edition, 2008.

**Reference Books:**

1. Integrated Electronics – Jacob Millman, C. Halkies, C.D. Parikh, Satyabrata Jit, Tata McGraw-Hill, Second Edition, 2011.
2. Electronic Devices and Circuit Theory – R.L. Boylestad and Louis Nashelsky, Pearson Publications, Eleventh Edition, 2013.
3. Electronic Devices and Circuits – A.P. Godse and U.A. Bakshi, Technical Publications, First Edition, 2009.

| II B.TECH I SEMESTER | L | T | P | INTERNAL MARKS | EXTERNAL MARKS | TOTAL MARKS | CREDITS |
|---|---|---|---|---|---|---|---|
| | 3 | 0 | 0 | 40 | 60 | 100 | 3 |
| 19BEE3TH03 | ELECTRICAL CIRCUIT ANALYSIS - II | | | | | | |

**Course Objectives:**

- To apply circuit analysis to AC Poly phase circuits
- To analyse R, L, C components for transient response.
- To study the basic concepts of different types of filters

**Course Outcomes:**

After successful completion of this course, the students will be able to:

**CO 1:** Analyse the balanced three phase supply connected to balanced systems.
**CO 2:** Analyse the balanced three phase supply connected to unbalanced systems.
**CO 3:** Ability to analyse steady state and transient response of various electrical networks.
**CO 4:** Estimate the different types of two port network parameters.
**CO 5:** Acquire knowledge on Filters.

**UNIT–I Balanced three phase circuits**

Advantages of a three phase system - Generation of three phase voltages- Phase sequence - star and delta connection - Relation between line and phase voltages and currents in balanced systems - Analysis of balanced three phase circuits - Three phase four wire supply connected to balanced star connected load - Three phase three wire supply connected to balanced star connected load - Three phase three wire supply connected to balanced delta connected load - Measurement of active and reactive power in balanced three phase systems.

**UNIT-II Unbalanced three phase circuits**

Analysis of Unbalanced three phase circuits - Three phase four wire supply connected to unbalanced star connected load - Three phase three wire supply connected to unbalanced star connected load -Three phase three wire supply connected to unbalanced delta connected load. Loop method - Star-Delta transformation technique. Three phase three wire supply connected to unbalanced delta connected load - Three wattmeter method and Two wattmeter methods for measurement of three phase power - Power factor by Two wattmeter method.

**UNIT–III Transient Response Analysis**

Steady state and Transient response of RL, RC & RLC Circuits for DC input and A.C. sinusoidal input. Solutions using differential equations and Laplace transforms.

**UNIT-IV Two – Port Network**

Two Port network - Z parameters - Y parameters - Transmission line parameters - h- parameters - Inverse h parameters - Inverse Transmission line parameters - Relationship between parameter sets - T and π representation. series connection of two port networks - Parallel connection of two port networks - Cascading of two port networks - Lattice Network.

**UNIT-V: Filters**

Classification of Filters - Low pass filter - High pass filter - Band pass filter - Band elimination filter - Filter networks - Equations of Filter networks - T Network-Propagation constant of T

network - π network - Propagation constant of π network - Classification of Pass band and stop band - characteristic Impedance in the Pass and Stop bands.

**Text Books:**

1. William H. Hayt, Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuit Analysis", TMH, 8th Edition, 2012
2. Chakrabarti A, "Circuits Theory (Analysis and synthesis), Dhanpath Rai & Sons, New Delhi, 1999.

**Reference Books:**

1. M.E. Vanvalkenburg, "Network Analysis", PHI, 3rd Edition, 2006.
2. A Sudhakar and Shyam Mohan SP, "Circuits and Networks: Analysis and Synthesis", TMH, 5th Edition, 2015.

**Web References:**

1. http://www.egate.ws/
2. http://cosmolearning.org/courses/circuit-theory/
3. http://www.nptelvideos.in/2012/11/circuit-theory.html
4. http://pbtstudies.blogspot.in/

**E-Books:**

1. http://elearning.vtu.ac.in/P9/notes/06ES34/Unit1-KCV.pdf

| II B.TECH I SEMESTER | L | T | P | INTERNAL MARKS | EXTERNAL MARKS | TOTAL MARKS | CREDITS |
|---|---|---|---|---|---|---|---|
| | 3 | 0 | 0 | 40 | 60 | 100 | 3 |
| 19BEE3TH04 | ELECTRICAL MACHINES-I | | | | | | |

**Course objectives:**

- To familiarize with basic Electromechanical energy conversion principle & the constructional details and working principles of D.C. machines
- To introduce the methods of starting, speed control and testing of D.C. Machines.
- To impart knowledge on constructional details, working principles, and performance characteristics of transformers.

**Course Outcomes:**

After successful completion of this course, the students will be able to:

**CO 1:** Gain the knowledge of electromechanical energy conversion principles for rotating machines.

**CO 2:** Determine the performance of D.C generator for various operating conditions.

**CO 3:** Select suitable speed control and testing methods of D.C motor for various applications

**CO 4:** Acquire knowledge about the constructional details, principle of operation, testing and applications of single phase transformers.

**CO 5:** Implement parallel operation and three phase transformer Connections.

**UNIT-I: Electromechanical Energy Conversion and introduction to DC machines**

Principles of electromechanical energy conversion – singly excited and multi excited system– Calculation of force and torque using the concept of co-energy.

Construction and principle of operation of DC machine – EMF equation for generator – Classification of DC machines based on excitation – OCC of DC shunt generator.

**UNIT-II: Performance of D.C. Machines**

Torque and back-emf equations of dc motors– Armature reaction and commutation – characteristics of separately-excited, shunt, series and compound motors - losses and efficiency- applications of dc motors.

**UNIT-III: Starting, Speed Control and Testing of D.C. Machines**

Necessity of starter – Starting by 3 point and 4 point starters – 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 -- separation of losses.

**UNIT-IV: Single-phase Transformers**

Types and constructional details - principle of operation - emf equation - operation on no load and on load – lagging, leading and unity power factors loads - phasor diagrams of transformers – Tests on single phase transformers – open circuit and short circuit tests – Sumpner's test - equivalent circuit – regulation – losses and efficiency — All day efficiency – parallel operation with equal voltage ratios – auto transformer

**UNIT-V: 3-Phase Transformers**

Polyphone connections - Y/Y, Y/Δ, Δ/Y, Δ/Δ and open Δ -- Third harmonics in phase voltages-three winding transformers: determination of Zp, Zs and Zt -- transients in switching – off load and on load tap changers -- Scott connection.

**Text Books:**

1. P.S. Bimbhra, Electrical Machinery, Khanna Publishers.
2. Nagrath I J and D P Kothari - Electric Machines – Tata McGraw Hill, 4th edition, 2010.
3. J.B. Gupta, "Theory & Performance of Electrical Machines", S. K. Kataria& Sons, 2013.

**Reference Books:**

1. R.K. Rajput, Electrical Machines in S.I. Units, Laxmi Publica tions (P) Ltd, 6th edition, New Delhi, 2017.
2. B.L. Theraja and A.K. Theraja, A Text Book of Electrical Technology in S. I. Units, Vol.2, S. Chand & Company Ltd, Multicolour illustrative edition, New Delhi, 2014.
3. Asfaq Hussain 'Electrical Machines second edition by Dhanpatrai publications.

| II B.TECH I SEMESTER | L | T | P | INTERNAL MARKS | EXTERNAL MARKS | TOTAL MARKS | CREDITS |
|---|---|---|---|---|---|---|---|
| | 3 | 0 | 0 | 40 | 60 | 100 | 3 |
| 19BEE3TH05 | ELECTRO MAGNETIC FIELDS | | | | | | |

**Course Objectives:**

- To acquire the knowledge in electrostatic fields, electrical potential, energy density and their applications.
- To gain the knowledge in magnetic fields produced by currents in various configurations, application of Ampere's and Biot-Savart's Law.
- To study the magnetic force and torque through Lorentz's force equation in magnetic field environment.
- To develop a solid grasp about Maxwell's equations and their usage in solving time varying field problems.

**Course Outcomes:**

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

**CO 1:** Acquire knowledge in the laws of Electrostatics and apply them in electrostatic field.

**CO 2:** Gain the knowledge in laws of Magneto statics and apply them in static magnetic field.

**CO 3:** Compute the force experienced by charged bodies in magnetic field and identifies magnetic potential and its properties.

**CO 4:** Identify the time varying field and understand Faraday's Laws of Electromagnetic Induction.

**UNIT-1: Electrostatics – I**

Coordinate systems: Cartesian - cylindrical-spherical co-ordinates- coulombs law-Electric field intensity-Field due to a point charge - line charge - sheet of charge.

Definition of potential and potential difference - the potential field of a point charge - a line charge - sheet of charge - potential gradient - the dipole - dipole moment - Energy stored and Energy density in electrostatic field.

**UNIT-2: Electrostatics – II**

Electric flux density - Gauss's law - Applications of Gauss law - Maxwell's First equation (Electrostatics) div(D) = ρv - Current and current density - continuity of current - conductor properties and boundary conditions - Boundary conditions for perfect dielectric materials- Derivations of Poisson's and Laplace's equations.

**UNIT-3: Magnetostatics**

Capacitance - Capacitance of parallel plates - Spherical and Coaxial Cables with composite dielectrics - Biot-Savart's Law - Ampere's Circuital Law - Magnetic Flux and Magnetic Flux Density (B) - scalar and vector magnetic potentials - Magnetic Field Intensity (MFI) due to straight current carrying filament - Infinite sheet of current - circular loop - rectangular and square loop - Maxwell's Second equation div(B)=0 and Third Equation Curl H = J.

**UNIT-4: Magnetic Forces**

Force on a moving charge- Lorentz force equation - Force on a differential current element - Force between differential current elements - Force and torque on current loop placed in magnetic fields - Inductors and inductances: Inductor - Self Inductance - mutual inductance - energy stored and energy density in a magnetic field.

**UNIT-5: Time Varying Fields**

Magnetic Circuits - Faraday's law of electromagnetic fields– static and motional EMF – Displacement current – Point form of Maxwell's equations and Integral form of Maxwell's equations. The Uniform Plane Wave: Wave propagation in free space, dielectrics and good conductors: skin effect, Poynting theorem and wave power.

**Text Books:**

1. W H Hayt, J A Buck 'Engineering Electromagnetics', 8th Edition TMH, 2012.
2. Mathew NO Sadiku, 'Elements of Electromagnetics', 6th Edition Oxford University Press, 2014.

**Reference Books:**

1. Joseph A Edminister, 'Theory and Problems of Electromagnetics', 4th Edition, Schaum's Outline Series, Mc-Graw Hill International, 2014
2. EC Jordan and KG Balmain, 'Electromagnetic Waves and Radiating Systems', 2nd Edition PHI 2003.

**Web References:**

1. http://nptel.ac.in/courses/108106073/
2. http://ocw.mit.edu/resources/res-6-001-electromagnetic-fields-and-energy-spring-2008/
3. http://freevideolectures.com/Course/2340/Electromagnetic-Fields#
4. https://www.brainkart.com/article/Electrostatics_12824/
5. https://www.brainkart.com/article/Magnetostatics_12825/

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| II B.TECH I SEMESTER | L | T | P | INTERNAL MARKS | EXTERNAL MARKS | TOTAL MARKS | CREDITS |
|---|---|---|---|---|---|---|---|
| | 3 | 0 | 0 | 40 | 60 | 100 | 3 |
| 19BEE3TH06 | ANALOG ELECTRONICS | | | | | | |

**Course Objectives:**

- Design and understand the operation of analog electronics circuits such as feedback amplifiers,
- Operational Amplifiers and its applications.
- Discuss the operation of Linear, Non-Linear wave shaping circuits and its applications
- Analyze the different basic op-amp circuits.
- Compare the working of multivibrators using op-amp, IC 555and the operation of different oscillators.
- Discuss the operation of the most commonly used D/A and A/D converters.

**Course Outcomes:**

After completion of this course, the students will be able to

**CO 1:** Design the operation of feedback amplifiers.
**CO 2:** Explain different wave shaping circuits
**CO 3:** Design different basic op-amp circuits.
**CO 4:** Design different multivibrators using op-amp and 555 timers, different oscillators.
**CO 5:** Analyze about different D/A and A/D converters.

**UNIT -I: Feedback Amplifiers**

Feedback principle and concept, Types of feedback, Classification of amplifiers-Voltage amplifier, Current amplifier, Trans conductance amplifier, Trans resistance amplifier, Feedback topologies, Characteristics of negative feedback amplifiers, General analysis of feedback amplifiers-input resistance and output resistance, Performance comparison of feedback amplifiers, Method of analysis of feedback amplifiers, Analysis feedback amplifier-Voltage series feedback, Current shunt feedback.

**UNIT -II: Linear and Non-Linear Wave Shaping**

**Linear Wave Shaping:** The high pass and low pass RC circuits: Sinusoidal input, Step input, Pulse input, Square and Ramp input, RC network as a differentiator and an integrator.

**Non-Linear Wave Shaping:** Diode and its characteristics, Diode series clippers, Diode parallel clippers, Two level clipping circuits and Emitter coupled clipper, Clamping operation, Clamping circuits using diode with different inputs.

**UNIT -III: Operational Amplifier and its Applications**

Different stages of Operational Amplifier: Differential Amplifier, Ideal and practical Op-Amp. Characteristics of OP-Amps, DC and AC characteristics, Inverting and Non-inverting amplifier, Integrator and differentiator, Difference amplifier, Instrumentation amplifier, V to I and I to V converters, Comparators, Log and Anti log amplifiers.

**UNIT -IV: Multivibrators and Timers**

Multivibrators: Monostable, Bistable and Astable multivibrators using Op-amp. Timers: Introduction to 555 timer, Functional diagram, Monostable and Astable operation using 555 timer

**UNIT -V: Active Filters, D/A and A/D Converters**

Active Filters Introduction–Merits and demerits of active filters over passive filters–1st order, 2nd order LPF, HPF filters, Band pass, Band reject and All pass filters. D/A and A/D Converters: Introduction, Basic DAC techniques, Weighted resistor DAC, R-2R ladder DAC, Inverted R-2R DAC, Different types of ADCs -Parallel comparator type ADC, Counter type ADC, Successive approximation ADC and Dual slope ADC.

**Text Books:**

1. Integrated Electronics-Jacob Millman, C. Halkies, C.D. Parikh, Satyabrata Jit, Tata McGraw-Hill,Second Edition, 2011.
2. Linear Integrated Circuits -D. Roy Chowdhury, New Age International Pvt Ltd, Second Edition, 2003.
3. Pulse, Digital and Switching Waveforms –J. Millman, H. Taub and Mothiki S. Prakash Rao, Tata
4. McGraw-Hill, Second Edition, 2008.

**Reference Books:**

1. Op-Amps & Linear ICs -Ramakanth A. Gayakwad, Pearson Education, Fourth Edition, 2015.
2. Electronic Devices and Circuit Theory–R.L. Boylestad and Louis Nashelsky, Pearson Publications, Eleventh Edition, 2013.
3. Operational Amplifiers with Linear Integrated Circuits–William D. Stanley, Pearson Education India, Fourth Edition, 2002.

| II B.TECH I-SEMESTER | L | T | P | INTERNAL MARKS | EXTERNAL MARKS | TOTAL MARKS | CREDITS |
|---|---|---|---|---|---|---|---|
| | 0 | 0 | 3 | 25 | 50 | 75 | 1.5 |
| 19BEE3LB01 | ELECTRONIC DEVICES AND CIRCUITS LAB | | | | | | |

**Course Objectives:**

- Analyze the operation of PN diode and Zener diode.
- Identify and verify the efficiency of Half wave and Full wave Rectifiers.
- Explain the characteristics of transistor.
- Discuss the UJT characteristics.
- Discuss the working of FET.

**Course Outcomes:**

After the completion of this course, the students will able to

**CO 1:** Analyze the behavior of PN junction diode, Zener diode.
**CO 2:** Discuss the operational difference between Half wave and Full wave Rectifiers.
**CO 3:** Analyze the characteristics of transistor.
**CO 4:** Identify and analyze the UJT characteristics and its applications.
**CO 5:** Design transistor and FET amplifier circuits.

**List of Experiments**

**1.** P- N Junction diode characteristics
Part A: Germanium Diode (Forward bias & Reverse bias)
Part B: Silicon Diode (Forward bias & Reverse bias)
**2.** Zener diode characteristics
Part A: V-I characteristics.
Part B: zener diode as voltage regulator.
**3.** Rectifiers (with and without c-filter)
Part A: Half-wave Rectifier
Part B: Full-wave Rectifier
**4.** BJT Characteristics (CE configuration)
Part A: input characteristics
Part B: output characteristics
**5.** FET characteristics(CS configuration)
Part A: Drain characteristics
Part B: Transfer characteristics
**6.** SCR Characteristics.
**7.** UJT characteristics
**8.** CRO Operation and its Measurements
**9.** BJT-CE Amplifier
**10.** FET-CS Amplifier

**VIRTUAL LAB EXPERIMENTS:**

1. Zener Diode as Voltage Regulator.
2. BJT Characteristics (Common Base & Common Emitter Configuration).

| I B.TECH II SEMESTER | L | T | P | INTERNAL MARKS | EXTERNAL MARKS | TOTAL MARKS | CREDITS |
|---|---|---|---|---|---|---|---|
| | 0 | 0 | 3 | 20 | 30 | 50 | 1.5 |
| 19BEE3LB02 | ELECTRICAL CIRCUIT ANALYSIS LAB | | | | | | |

**Course Objectives:**

- To learn the methods used for verification of circuit theorems.
- To study the concepts of resonance in series and parallel circuits.
- To understand the measurement of active and reactive power in a three-phase system
- To conduct experiment to calculate network parameters
- To learn the measurement of inductance of a mutually coupled coil.

**Course Outcomes:**

Upon successful completion of the course, the students able to

**CO 1:** Become familiar with the basic circuit components and know how to connect them to make a real electrical circuit.

**CO 2:** Verify the basic network theorems and understand the relationships and differences between theory and practice.

**CO 3:** Estimate the different types of two port network parameters

**CO 4:** Analyse the balanced three phase supply connected to balanced and unbalanced systems

**List of Experiments**

**Any 10 of the following experiments to be conducted:**

1. Verification of Thevenin's and Norton's Theorems.
2. Verification of Superposition theorem.
3. Verification of Maximum Power Transfer Theorem.
4. Verification of Reciprocity Theorem.
5. Verification of Millman's Theorem.
6. Series and Parallel Resonance of a RLC circuit.
7. Determination of Self, Mutual Inductances and Coefficient of coupling.
8. Z and Y Parameters of a Two-Port Network.
9. Transmission and hybrid parameters of a Two-Port Network.
10. Measurement of Active Power for Star and Delta connected balanced loads.
11. Measurement of Reactive Power for Star and Delta connected balanced loads.
12. Measurement of 3-phase Power by two wattmeter method for unbalanced loads.
13. Verification of Thevenin's and Norton's Theorems.( **virtual experiment**)
14. Series and Parallel Resonance of a RLC circuit(**virtual experiment**)

**II B.TECH. – II SEMESTER**

| S.No. | Subject Code | Subject | Cat. Code | Internal Marks | External Marks | Total Marks | L | T | P | Credits |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 19BCC4TH01 | Complex Variables , Probability & Statistics | BS | 40 | 60 | 100 | 3 | - | - | 3 |
| 2 | 19BEE4TH02 | Problem Solving with Python | ES | 40 | 60 | 100 | 3 | - | - | 3 |
| 3 | 19BEE4TH03 | Digital logic and circuits | PC | 40 | 60 | 100 | 3 | - | - | 3 |
| 4 | 19BEE4TH04 | Electrical Machines-II | PC | 40 | 60 | 100 | 3 | - | - | 3 |
| 5 | | **Open Elective-I** | OE | 40 | 60 | 100 | 3 | - | - | 3 |
| 6 | 19BCC4LB01 | English Communication Skills Lab-II | HS | 20 | 30 | 50 | - | - | 3 | 1.5 |
| 7 | 19BEE4LB02 | Python Lab | ES | 20 | 30 | 50 | - | - | 3 | 1.5 |
| 8 | 19BEE4LB03 | Electrical Machines Lab-I | PC | 20 | 30 | 50 | - | - | 3 | 1.5 |
| 9 | 19BEE4LB04 | Analog and Digital Circuits Lab | PC | 20 | 30 | 50 | - | - | 3 | 1.5 |
| 10 | 19BCC4MC02 | Quantitative Aptitude and Reasoning | MC | - | - | - | 3 | - | - | - |
| | | **Total** | | **280** | **420** | **700** | **18** | **-** | **12** | **21** |

| II B.TECH II SEMESTER | L | T | P | INTERNAL MARKS | EXTERNAL MARKS | TOTAL MARKS | CREDITS |
|---|---|---|---|---|---|---|---|
| | 3 | 0 | 0 | 40 | 60 | 100 | 3 |
| 19BCC4TH01 | COMPLEX VARIABLES, PROBABILITY AND STATISTICS (CIVIL, EEE & ME(VI-semester)) | | | | | | |

**Course Objectives:**

- To analyze the function of complex variable and its analytic property with a review of elementary complex function.
- To understand the Taylor and Laurent expansion with their use in finding out the residue and improper integral.
- To revise the elementary concepts of probability
- To introduce techniques for carrying out probability calculations and identifying probability distributions.

**Course Outcomes:**

On successful completion of this course, student will be able to:

**CO 1:** Apply the probability concepts in their respective engineering data.
**CO 2:** Apply discrete and continuous probability distributions to solve various engineering problems.
**CO 3:** Analyze the multivariate problems in engineering.
**CO 4:** Apply the method of least squares to estimate the parameters of a regression model.
**CO 5:** Determine the confidence interval for a population parameter for single sample and two sample cases.

**UNIT I: FUNCTIONS OF COMPLEX VARIABLES:**

Limit and Continuity of f(z), Derivative of f(z), Cauchy-Riemann equations, analytic functions, harmonic functions, Orthogonal system. Application: Flow problems.

**UNIT II: COMPLEX INTEGRATION:**

Integration of Complex functions, Cauchy theorem (without proof), Cauchy integral formula (without proof), Series of complex terms, Taylor's series, Laurent's series, zeros and singularities of analytic functions, residues and residue theorem(without proof), Calculation of residues. Applications: Evaluation of real definite integrals (Integration around the semi-circle and Unit Circle)

**UNIT III: PROBABILITY AND RANDOM VARIABLES:**

Probability axioms, addition law and multiplicative law of probability, conditional probability, Baye's theorem, random variables (discrete and continuous)**,** Binomial - Poisson approximation to the binomial distribution and normal distribution-their properties.

**UNIT IV: SAMPLING DISTRIBUTION:**

Estimation: Point Estimation, Interval Estimation, Bayesian Estimation.

**UNIT V: TESTING OF HYPOTHESIS:**

Formulation of null hypothesis, critical regions, level of significance.

**Large sample tests**: test for single proportion, difference of proportions, test for single mean and difference of means. Student t-distribution (single mean, two means and paired t-test), Testing of equality of variances (F-test), $\chi 2$ - test for goodness of fit, $\chi 2$ - test for independence of attributes.

**Text Books:**

1. B.S. Grewal, Higher Engineering Mathematics, 44th Edition, Khanna Publishers.
2. S. C. Gupta and V. K. Kapoor, Fundamentals of Mathematical Statistics, 11/e (Reprint) 2019, Sultan Chand & Sons Publications.

**Reference Books:**

1. Miller and Freund's, Probability and Statistics for Engineers, 7/e, Pearson, 2008.
2. T. K. V. Iyenger, Probability and Statistics, S. Chand & Company Ltd, 2015.
3. Jay I. Devore, Probability and Statistics for Engineering and the Sciences, 8th Edition, Cengage.

| II B.TECH II SEMESTER | L | T | P | INTERNAL MARKS | EXTERNAL MARKS | TOTAL MARKS | CREDITS |
|---|---|---|---|---|---|---|---|
| | 3 | - | - | 40 | 60 | 100 | 3 |
| 19BEE4TH02 | PROBLEM SOLVING USING PYTHON | | | | | | |

**Course Objective:**

- To teach problem solving through flow charting tool-Raptor.
- To elucidate problem solving through python programming language.
- To introduce function oriented programming paradigm through python.
- To train in development of solutions using modular concepts.

**Course Outcomes:**

After successful completion of this course, the students should be able to:

**CO 1:** Summarize the fundamental concepts of computer and python programming.
**CO 2:** Solve the given problems using raptor.
**CO 3:** Interpret object oriented and event driven programming in python.
**CO 4:** Apply the suitable data structures to solve the real time situational problems.

**UNIT-I**

**Introduction to computers:** Conceptual introduction: topics in computer science, algorithms; modern computer systems: hardware architecture, data representation in computers, software and operating system.

**UNIT-II**

**Flowchart design though raptor**: Flowchart symbols, input/output, assignment, operators, conditional if, repetition, function and sub charts, example problems-finding max.of 3 numbers, unit converters, interest calculators, multiplication tables, gcd of 2 numbers, Fibonacci generation, prime number generation, minimum, maximum and average of n numbers, linear search, binary search.

**UNIT-III**

**Introduction to python**: Python-numbers, strings, variables, operators, expressions, statements, string operations, math function calls, Input/output statements, conditional if, while and for loops

**Functions**: user defined functions, parameters to functions, recursive functions, and turtle graphics.

**UNIT-IV**

**Data structures**: Lists- basic list operators, replacing, inserting, removing an element; searching and sorting lists; tuples, dictionaries- dictionary literals, adding and removing keys, accessing and replacing values; traversing dictionaries. Strings, files and their libraries.

**UNIT-V**

**Event driven programming**: Turtle bar chart, event driven programming, key press events, mouse events, timer events.

**OOP:** Classes and OOP: classes, objects, attributes and methods; defining classes; design with classes, data modeling; persistent storage of objects ,inheritance, polymorphism, operator overloading (_eq_, _str_, etc); abstract classes; exception handling, try block.

**Text Books:**

1. Kenneth Lambert,"Fundamentals of Python: First Programs", ISBN-13: 978-1337560092,cengage learning publishers, first edition,2012.
2. Allen B. Downey, "think python: how to think like a computer scientist", ISBN-13: 978-1491939369, O'reilly, 2nd edition, 2016.
3. Reema Thareja, "Python Programming using Problem Solving Approach", ISBN-13:978-0-19-948017-3, Oxford University Press, 2017.

**Reference Books:**

1. Vamsi kurama, "Python programming: A modern approach", ISBN-978-93-325-8752-6, pearson, 2018.
2. Mark Lutz , "Learning python", ISBN: 1-56592-464-9,Orielly, 4th edition, 1999 .
3. W.Chun, "Core python programming", ISBN-13: 978-0132269933, pearson, 2nd edition, 2016.

**Web Resources:**

1. https://raptor.martincarlisle.com/
2. http://www.ict.ru.ac.za/Resources/cspw/thinkcspy3/thinkcspy3.pdf
3. https://zhanxw.com/blog/wp-content/uploads/2013/03/BeautifulCode_2.pdf
4. http://www.ict.ru.ac.za/Resources/cspw/thinkcspy3/thinkcspy3.pdf
5. https://www.cse.msu.edu/~stockman/ITEC/Scratch/BGC2011Scratch-Rev1.pdf
6. https://nostarch.com/scratchplayground
7. http://fusecontent.education.vic.gov.au/9f79537a-66fc-4070-a5cee3aa315888a1/scratchreferenceguide14.pdf

| II B.TECH II SEMESTER | L | T | P | INTERNAL MARKS | EXTERNAL MARKS | TOTAL MARKS | CREDITS |
|---|---|---|---|---|---|---|---|
| | 3 | - | - | 40 | 60 | 100 | 3 |
| 19BEE4TH03 | DIGITAL LOGIC CIRCUITS | | | | | | |

**Course Objectives:**

- To learn basic techniques for the design of digital circuits and fundamental concepts used in the design of digital systems.
- To discuss common forms of number representation in digital electronic circuits and to be able to convert between different representations.
- To implement simple logical operations & to familiarize with the concepts of Boolean algebra.
- To design combinational & sequential logic circuits for Various Applications.
- To implement the logic circuits on Programmable Logic Devices such as PROM, PLA, PAL.

**Course Outcomes:**

After completion of this course, the students will be able to

**CO 1:** Manipulate numeric information in different forms, e.g. different bases, signed integers, various codes such as ASCII, Gray, and BCD.

**CO 2:** Deploy simple Boolean expressions using the theorems and postulates of Boolean algebra and to minimize combinational functions.

**CO 3:** Design and analyze combinational circuits for various Applications.

**CO 4:** Design and analyze sequential circuits for various Applications.

**CO 5:** Implement the logic circuits on PLD's such as PROM, PAL, PLA, CPLD and FPGAs.

**UNIT- I: NUMBER SYSTEMS & CODES**

Number systems: 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. Arithmetic operations (addition & subtraction): Binary, Octal, Decimal & Hexadecimal. Binary Codes: Classifications, BCD, Execess-3, Gray and their Properties.

**UNIT- II: LOGIC OPERATIONS AND MINIMIZATION TECHNIQUES**

**Logic Operations:** Basic logic operations- AND, OR, NOT, Universal building blocks, EX-OR, EX- NOR gates, Boolean theorems, Principle of complementation & Duality, De-Morgan theorems, Standard SOP & POS forms and their conversions, Two level NAND – NAND and NOR- NOR realizations.

**Minimization Techniques:** Minimization of logic functions using Boolean theorems, minimization of switching functions using K-Map up to 4 variables, Tabular (Quine-McCluskey) minimization, Problem solving.

**UNIT- III: COMBINATIONAL LOGIC CIRCUIT DESIGN**

Introduction, Design of Half adder, Full adder, half subtractor, Full subtractor. Applications: 4-bit binary parallel adder, Binary parallel subtractor, Adder-Subtractor circuits & Look ahead carry adder. BCD adder circuit, Excess 3 adder circuit. Encoders & Decoder: Design of decoder, Encoder, priority encoder, Realization of Boolean functions using decoders. Multiplexers & Demultiplexer: Design, Higher order, Realization of Boolean functions using multiplexers & demultiplexer. Comparators: Design of 2, 3 & 4-bit digital comparator.

**UNIT- IV: SEQUENTIAL LOGIC CIRCUIT DESIGN**

Introduction, Distinctions between Combinational and Sequential circuits.

**Latches and Flip Flops:** SR, JK, D and T type Flip Flops, Race around Condition in JK, JK Master Slave flip flop, Excitation table of all Flip Flops. Conversion from one flip-flop to another flip-flop. **Registers and Counters:** Shift Registers, Data Transmission in Shift Registers, Operation of Shift Registers, Bidirectional Shift Registers, and Universal Shift register. Design of synchronous and Asynchronous Counters, Design and Operation of Ring and Twisted Ring Counter.

**UNIT- V: INTRODUCTION TO PLDs**

Introduction to PLDs, Realization of switching functions using PROM, PLA and PAL, Basics structures, Programming tables of PLDs, Merits & demerits of PROM, PAL and PLA comparison, Implementation of code converters, Introduction to CPLDs and FPGAs.

**TEXT BOOKS:**

1. Digital Design – M. Morris Mano, PHI, Fourth Edition, 2008.
2. Switching and Finite Automata Theory – Zvi Kohavi, Cambridge University Press, Third Edition, 2009.
3. Switching Theory and Logic Design – A. Anand Kumar, Prentice-Hall of India Pvt. Ltd, Second Edition, 2014.

**REFERENCE BOOKS:**

1. Modern Digital Electronics – R. P. Jain, TMH, Fourth Edition, 2010.
2. Fundamentals of Logic Design – Charles H. Roth, Jr, Jaico Publishing House, Fourth Edition, 2006.
3. Microelectronics – Jacob Millman, Arvin Grabel, TMH, Second Edition, 2009.
4. Introduction to Switching Theory & Logical Design – Frederick J. Hill & Gerald R. Peterson, John Wiley & Sons Inc, Second Edition, 2012.

| II B.TECH II SEMESTER | L | T | P | INTERNAL MARKS | EXTERNAL MARKS | TOTAL MARKS | CREDITS |
|---|---|---|---|---|---|---|---|
| | 3 | 0 | 0 | 40 | 60 | 100 | 3 |
| 19BEE4TH04 | ELECTRICAL MACHINES – II | | | | | | |

**Course Objectives:**

- To familiarize with Construction, principle of operation and performance of induction machines.
- To introduce the methods Starting and speed control of three-phase induction motors.
- To impart basic knowledge on construction, principle of operation and performance of single phase induction motors
- To understand common performance of salient and non – salient type synchronous generators.
- To learn the basic principle of operation and performance of synchronous motor.

**Course Outcomes:**

After successful completion of this course, the students will be able to:

**CO 1:** Explain the working of poly phase induction motor and its testing and to draw Equivalent circuit.
**CO 2:** Use suitable starting and speed control methods to enhance the performance of three phase induction motors.
**CO 3:** Acquire the knowledge of 1-ph induction motors and their characteristics and their applications.
**CO 4:** Gain the knowledge on the construction and performance of Sailent and Non-Sailent Synchronous Generator
**CO 5:** Recall the knowledge on the construction and performance of Sailent and Non-Salient type Synchronous Motor.

**UNIT-I: Three Phase Induction Motor**

Constructional details - Types of rotors- Principle of operation - Slip –cogging and crawling- Equivalent circuit – Torque-Slip characteristics - Condition for maximum torque –Losses and efficiency – Load test - No load and blocked rotor tests - Circle diagram –Separation of losses – Double cage induction motors –Induction generators

**UNIT-II: Starting and Speed Control of Three Phase Induction Motor**

Need for starting – Types of starters – DOL, Rotor resistance, Autotransformer and Star delta starters – Speed control – Voltage control, Frequency control and pole changing –Cascaded connection-V/f control – Slip power recovery scheme-Braking of three phase induction motor: Plugging, dynamic braking and regenerative braking.

**UNIT-III: Single Phase Induction Motors**

Constructional details of single phase induction motor – Double field revolving theory and operation – Equivalent circuit -No load and blocked rotor test – Performance analysis – Starting methods of single-phase induction motors – Capacitor-start capacitor run Induction motor-Shaded pole induction motor - Linear induction motor – Repulsion motor -Hysteresis motor .

**UNIT-IV: Synchronous Generator**

Constructional details – Types of rotors –winding factors- emf equation – Synchronous reactance – Armature reaction – Phasor diagrams - synchronous generator connected to infinite bus-Synchronizing and parallel operation-Voltage regulation-EMF-MMF-ZPF and ASA methods–slip test

**UNIT-V: Synchronous Motor**

Principle of operation – Torque equation – Operation on infinite bus bars - V and Inverted V curves – Power input and power developed equations – Starting methods – constant power input-constant excitation and constant power developed-Hunting — damper windings-synchronous condenser.

**Text Books:**

1. D.P. Kothari and I.J. Nagrath, 'Electric Machines', McGraw Hill Publishing Company Ltd, 2002.
2. P.S. Bhimbhra, 'Electrical Machinery', Khanna Publishers, 2003.

**Reference Books:**

1. Vincent Del Toro, 'Basic Electric Machines' Pearson India Education, 2016
2. M.N. Bandyopadhyay, Electrical Machines Theory and Practice, PHI Learning PVT LTD., New Delhi, 2009.
3. B.R.Gupta,'Fundamental of Electric Machines' New age International Publishers, 3rd Edition , Reprint 2015.
4. Murugesh Kumar, 'Electric Machines', Vikas Publishing House Pvt. Ltd, 2002.

**Web Resources:**

1. www.allaboutcircuits.com/vol_2/chpt_13/7.html % poly phase induction

| II B.TECH II SEMESTER | L | T | P | INTERNAL MARKS | EXTERNAL MARKS | TOTAL MARKS | CREDITS |
|---|---|---|---|---|---|---|---|
| | - | - | 3 | 20 | 30 | 50 | 1.5 |
| 19BCC4LB01 | ENGLISH COMMUNICATION SKILLS LAB-II (Common to All Branches) | | | | | | |

**Course Objectives:**

- To train the students to use language effectively in various professional interactions like Group Discussions, Public Speaking, Presentations and Interviews.
- To make the students understand the importance of body language.
- To provide exposure to students to soft skills like Goal Setting, Assertiveness, Time Management, Positive Attitude and Stress Management
- To expose the students to variety of a self-instructional, learner friendly, electronic media and stimulate intellectual faculties/resources

**Course Outcomes:**

After successful completion of this course, the students will be able to:

**CO 1:** Utilize Non-verbal cues and interpret nonverbal symbols.
**CO 2:** Develop presentation Skills and make formal presentations using strategies.
**CO 3:** Analyse problem solving skills effectively to participate in Group Discussions.
**CO 4:** Build interview skills for employability.

**UNIT– I**

Body Language

**UNIT–II**

Presentation Skills

**UNIT–III**

Group Discussions

**UNIT-IV**

Interviews and Telephonic Interviews

**UNIT-V**

Debates

**Text Books:**

1. "Strengthen Your Communication Skills", Maruthi Publications, 2013.

**Reference Books:**

1. "Personality Development and Soft Skills", Oxford University Press, New Delhi.
2. M Ashraf Rizvi, "Effective Technical Communication skills", McGraw-Hill, 2005.
3. Barun K Mitra, "Personality Development and Soft Skills", Oxford University Press, 2011.
4. Konar N, "Communication Skills for Professionals", PHI Learning Private Limited, 2011.

| II B.TECH II SEMESTER | L | T | P | INTERNAL MARKS | EXTERNAL MARKS | TOTAL MARKS | CREDITS |
|---|---|---|---|---|---|---|---|
| | - | - | 3 | 20 | 30 | 50 | 1.5 |
| 19BEE4LB02 | PYTHON LAB | | | | | | |

**Course Objective:**

- To introduce programming through Visual programming tool - Scratch
- To teach problem solving through Flow charting tool - Raptor
- To elucidate problem solving through python programming language
- To introduce function-oriented programming paradigm through python
- To train in development of solutions using modular concepts
- To teach practical Pythonic solution patterns

**Course Outcomes:**

After successful completion of this course, the students should be able to:

**CO 1:** Develop interactive visual programs using Scratch.
**CO 2:** Develop flowcharts using raptor to solve the given problems.
**CO 3:** Develop Python programs for numerical and text based problems.
**CO 4:** Develop graphics and event based programming using Python.

**Laboratory Experiments**

1. Design a script in Scratch to make a sprite to draw geometrical shapes such as Circle, Triangle, Square, and Pentagon.
2. Design a script in Scratch to make a sprite to ask the user to enter two different numbers and an arithmetic operator and then calculate and display the result.
3. Design a Memory Game in Scratch which allows the user to identify positions of similar objects in a 3 x 3 matrix.
4. Construct flowcharts to
    a. calculate the maximum, minimum and average of N numbers
    b. Develop a calculator to convert time, distance, area, volume and temperature from one unit to another.
5. Construct flowcharts with separate procedures to

a) calculate simple and compound interest for various parameters specified by the user

b) Calculate the greatest common divisor using iteration and recursion for two numbers as specified by the user

6. Construct flowcharts with procedures to
    a)generate first N numbers in the Fibonacci series
    b) Generate N Prime numbers
7. Design a flowchart to perform Linear search on list of N unsorted numbers(Iterative and recursive)
8. Design a flowchart to perform Binary search on list of N sorted numbers(Iterative and recursive)
9. Design a flowchart to determine the number of characters and lines in a text file specified by the user
10. Design a Python script to convert a Binary number to Decimal number and verify if it is a Perfect number.
11. Design a Python script to determine if a given string is a Palindrome using recursion

12. Design a Python script to sort numbers specified in a text file using lists.
13. Design a Python script to determine the difference in date for given two dates in YYYY:MM:DD format(0 <= YYYY <= 9999, 1 <= MM <= 12, 1 <= DD <= 31) following the leap year rules.
14. Design a Python Script to determine the Square Root of a given number without using inbuilt functions in Python.
15. Design a Python Script to determine the time difference between two given times in HH:MM:SS format.( 0 <= HH <= 23, 0 <= MM <= 59, 0 <= SS <= 59)
16. Design a Python Script to find the value of (Sine, Cosine, Log, PI, e ) of a given number using infinite series of the function.
17. Design a Python Script to convert a given number to words
18. Design a Python Script to convert a given number to roman number.
19. Design a Python Script to generate the frequency count of words in a text file.
20. Design a Python Script to print a spiral pattern for a 2 dimensional matrix.
21. Design a Python Script to implement Gaussian Elimination method.
22. Design a Python script to generate statistical reports(Minimum, Maximum, Count, Average, Sum etc) on public datasets.
23. Design a Python script using the Turtle graphics library to construct a turtle bar chart representing the grades obtained by N students read from a file categorising them into distinction, first class, second class, third class and failed.
24. Design a Python script on oop's concepts: Class variables and instance variable
i) Robot ii) ATM Machine
25. Virtual Lab: http://ps-iiith.vlabs.ac.in/

Any three programs must be submitted with result from the above link

**Text Books:**

1. Kenneth Lambert, "Fundamentals of Python: First Programs" , ISBN-13: 978-1337560092,cengage learning publishers, first edition,2012.
2. Allen B. Downey, "think python: how to think like a computer scientist", ISBN-13: 978-1491939369, O'reilly, 2nd edition, 2016.
3. Reema Thareja, "Python Programming using Problem Solving Approach", ISBN-13:978-0-19-948017-3, Oxford University Press, 2017.

**Reference Books:**

1. Vamsi kurama, "Python programming : A modern approach", ISBN-978-93-325-8752-6, pearson,2018.
2. Mark Lutz , "Learning python", ISBN: 1-56592-464-9,Orielly, 4th edition, 1999 .
3. W.Chun, "Core python programming", ISBN-13: 978-0132269933, pearson, 2nd edition, 2016.

**Web Resources:**

1. https://raptor.martincarlisle.com/
2. http://www.ict.ru.ac.za/Resources/cspw/thinkcspy3/thinkcspy3.pdf
3. https://zhanxw.com/blog/wp-content/uploads/2013/03/BeautifulCode_2.pdf
4. http://www.ict.ru.ac.za/Resources/cspw/thinkcspy3/thinkcspy3.pdf
5. https://www.cse.msu.edu/~stockman/ITEC/Scratch/BGC2011Scratch-Rev1.pdf
6. https://nostarch.com/scratchplayground
7. http://fusecontent.education.vic.gov.au/9f79537a-66fc-4070-a5ce e3aa315888a1/scratchreferenceguide14.pdf

| II B.TECH II SEMESTER | L | T | P | INTERNAL MARKS | EXTERNAL MARKS | TOTAL MARKS | CREDITS |
|---|---|---|---|---|---|---|---|
| | 0 | 0 | 3 | 20 | 30 | 50 | 1.5 |
| 19BEE4LB03 | ELECTRICAL MACHINES LAB-I | | | | | | |

**Course Objectives:**

- To expose the students to the operation of D.C. machines and transformers and give them experimental skill.
- To familiarize various testing methods and speed control of DC Machines.
- To disseminate knowledge on various tests and parallel operation of single-phase transformers.

**Course Outcomes:**

Upon successful completion of the course, the students will be able to

**CO 1:** Select the appropriate apparatus for determining the performance of DC machines and transformers based on the capacity experimentally.

**CO 2:** Determine the equivalent circuit parameters of transformers experimentally.

**CO 3:** Compute the performance characteristics of transformers and DC machines through suitable tests

**List of Experiments**

**Any 10 of the following experiments are to be conducted**

1. Magnetization characteristics of DC shunt generator. Determination of critical field resistance and critical speed.
2. Load test on D.C Shunt Generator.
3. Load test on D.C series generator.
4. Brake test on DC shunt motor. Determination of performance curves.
5. Fields test on DC series machines. Determination of efficiency.
6. Hopkinson's test on DC shunts machines. Predetermination of efficiency.
7. Swinburne's test and Predetermination of efficiencies as Generator and Motor.
8. Speed control of DC shunt motor by Field and armature Control.
9. Sumpner's test on a pair of single-phase transformers.
10. Parallel operation of two single phase transformers.
11. Load test on single-phase transformer
12. Scott connection of transformers.
13. Speed control of DC shunt motor by Field and armature Control**(Virtual experiment)**
14. Determination of Transformer equivalent circuit from Open Circuit and Short Circuit Test **(Virtual experiment).**

| II B.TECH II SEMESTER | L | T | P | INTERNAL MARKS | EXTERNAL MARKS | TOTAL MARKS | CREDITS |
|---|---|---|---|---|---|---|---|
| | 0 | 0 | 3 | 25 | 50 | 75 | 1.5 |
| 19BEE4LB04 | ANALOG AND DIGITAL CIRCUITS LAB | | | | | | |

**Course objectives:**

- Discuss the realization of logic gates, realize the logic gates with universal gates and realize the Flip-Flops.
- Realization of Adder, Subtractor, Comparator, Differentiator, Integrator and Schmitt trigger circuit using op-amp.
- Realization of LPF, HPF, and RC Phase shift oscillator (first order) using Op-amp.
- Analyzing linear wave shaping and nonlinear wave shaping
- Explain multivibrators using 555 IC timers

**Course Outcomes:**

After completion of this course, the students will be able to

**CO 1:** Realization of logic gates using universal gates and realization of Flip-Flops.

**CO 2:** Designing Adder, Subtractor, Comparator, Differentiator and Integrator using Op-amp.

**CO 3:** Designing LPF, HPF, and RC Phase shift oscillator (first order) using Op-amp.

**CO 4:** Design and analyze clippers, Clampers and also implement the applications using op-amps.

**CO 5:** Design of multivibrators using 555 IC timers and Schmitt trigger circuit using op-amp.

**List of experiments:**

1. Realization of logicgates.
2. Representation of logic gates with universal gates.
3. Verification of SR and JK Flip-Flops operation.
4. Design of half adder, full adder and half subtractor.
5. Linear wave shaping-low pass and high pass circuits.
6. Nonlinear wave shaping-clippers and clampers circuits.
7. Realization of adder, subtractor, and comparator circuits using Op-amp.
8. Designing LPF, HPF (first order) using Op-amp.
9. Designing Differentiator and Integrator using Op-amp.
10. Designing Monostable and Astable operation circuits using IC 555timer.
11. Designing RC Phase shift oscillator using Op-amp
12. Design of Schmitt trigger using Op-amp

| II B.TECH II SEMESTER | L | T | P | INTERNAL MARKS | EXTERNAL MARKS | TOTAL MARKS | CREDITS |
|---|---|---|---|---|---|---|---|
| | 3 | - | - | - | - | - | - |
| 19BCCMC01 | QUANTITATIVE APTITUDE AND REASONING | | | | | | |

**Course Objectives:**

- To train students in analyzing real life scenarios considering all factors
- To educate the students on principles of mathematical problems and problem solving methods
- To train students for campus placements

**Course Outcomes:**

After thorough learning of Quantitative Aptitude and Reasoning, a student:

- Will be able to prepare well for clearing Quantitative Aptitude and Reasoning tests for campus placements
- Will be able to critically evaluate various real life situations by resorting to Analysis of key issues and factors.
- Will be able to demonstrate various principles involved in solving mathematical Problems and thereby reducing the time taken for performing job functions.

**SYLLABUS FOR QUANTITATIVE APTITUDE**

**UNIT - I**

**Simple equations, Ratio, Proportion, Variation, Percentages**

1. **Simple equations**
   a. Definition of Linear Equations
   b. Formation of simple equations
   c. Problems on Ages, Fractions and Digits
   d. Indeterminate system of equations
   e. Special cases in indeterminate system of equations

2. **Ratio and proportion**
   a) Definition of Ratio
   b) Properties of Ratios
   c) Comparison of Ratios
   d) Problems on Ratios
   e) Compound Ratio
   f) Problems on Proportion, Mean proportional and Continued Proportion
3. **Variation**
   a) Direct variation b) Inverse variation
   c) Joint variation d) Problems on Variations

**UNIT-II**

**Percentages, Profit and loss, Partnership, Simple interest and Compound interest, Quadratic equations, Progressions**

1. **Percentages**
   a) Introduction
   b) Converting a percentage into decimals
   c) Converting a Decimal into a percentage
   d) Percentage equivalent of fractions
   e) Problems on percentages

2. **Profit And Loss**
   a) Problems on Profit and Loss percentage
   b) Relation between Cost Price and Selling price
   c) Discount and Marked Price
   d) Two different articles sold at same Cost Price
   e) Two different articles sold at same Selling Price
   f) Gain% / Loss% on Selling Price

3. **Partnership**
   a) Introduction
   b) Relation between capitals, Period of investments and Shares

4. **Simple Interest**
   a) Definitions
   b) Problems on interest and amount
   c) Problems when rate of interest and time period are numerically equal

5. **Compound Interest**
   a) Definition and formula for amount in compound interest
   b) Difference between simple interest and compound interest for 2 years on the same principle and time period

6. **Quadratic equations**
   a) General form of Quadratic equations
   b) Finding the roots of Quadratic equations
   c) Nature of the roots
   d) Relation between the roots
   e) Maximum and minimum value of Quadratic Expression

7. **Progressions**
   a) Arithmetic Progression b) Geometric Progression
   c) Harmonic Progression d) Arithmetic Mean, Geometric Mean and Harmonic Mean and their relation.

**SYLLABUS FOR REASONING**
**UNIT-III**
**Deductions & Connectives**

**1. Deductions**
   a) Finding the conclusions using Venn diagram method
   b) Finding the conclusions using syllogism method

**2. Connectives**
   a) Definition of a simple statement
   b) Definition of compound statement
   c) Finding the Implications for compound statements
   d) Finding the Negations for compound statements

**UNIT-IV**
**Analytical Reasoning puzzles**
   a) Problems on Linear arrangement
   b) Problems on Circular arrangement
   c) Problems on Double line-up
   d) Problems on Selections
   e) Problems on Comparisons

**UNIT-IV**

**Clocks, Calendars & Blood relations**

1. **Clocks**
   a) Finding the angle when the time is given
   b) Finding the time when the angle is known
   c) Relation between Angle, Minutes and Hours
   d) Exceptional cases in clocks

2. **Calendars**
   a) Definition of a Leap Year
   b) Finding the number of Odd days
   c) Framing the year code for centuries
   d) Finding the day of any random calendar date

3. **Blood relations**
   a) Defining the various relations among the members of a family
   b) Solving Blood Relation puzzles
   c) Solving the problems on Blood Relations using symbols and notations

**TEXT BOOKS**:

1. GL Barrons, Mc Graw Hills, Thorpe's verbal reasoning, LSAT Materials
2. R S Agarwal, S.Chand , 'A modern approach to Logical reasoning'
3. R S Agarwal, S Chand, 'Quantitative Aptitude'
4. Quantitative Aptitude - G. L BARRONS
5. Quantitative Aptitude - Abhijit Guha Mc Graw Hills

**REFERENCES:**

1. www.careerbless.com/**aptitude**/qa/home.php
2. www.affairscloud.com/**quantitative-aptitude**-questions
3. www.careerafter.com/rs-aggarwal-**quantitative-aptitude**-pdf/
4. www.amazon.in/**Quantitative-Aptitude**-Competitive-Examinations.../8121924987
5. www.indiabix.com

**III B.TECH. – I SEMESTER**

| S.No. | Subject Code | Subject | Cat. Code | Internal Marks | External Marks | Total Marks | L | T | P | Credits |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 19BEE5TH01 | Control Systems | PC | 40 | 60 | 100 | 3 | - | - | 3 |
| 2 | 19BEE5TH02 | Power Electronics | PC | 40 | 60 | 100 | 3 | - | - | 3 |
| 3 | 19BEE5TH03 | Electrical Transmission System | PC | 40 | 60 | 100 | 3 | - | - | 3 |
| 4 | 19BEE5TH04 | Electrical Measurements | PC | 40 | 60 | 100 | 3 | - | - | 3 |
| 5 | 19BEE5PE05 | **Professional Elective-I** a. Special Electrical Machines | PE | 40 | 60 | 100 | 3 | - | - | 3 |
| | 19BEE5PE06 | b. Intellectual Property Rights | | | | | | | | |
| | 19BEE5PE07 | c. Signals and System | | | | | | | | |
| | 19BEE5PE08 | d. Electrical Energy Conservation and Auditing | | | | | | | | |
| 6 | | **Open Elective-II** | OE | 40 | 60 | 100 | 3 | - | - | 3 |
| 7 | 19BEE5LB01 | Electrical Machines Lab-II | PC | 20 | 30 | 50 | | - | 3 | 1.5 |
| 8 | 19BEE5LB02 | Power Electronics Lab | PC | 20 | 30 | 50 | | - | 3 | 1.5 |
| 9 | 19BEE5LB03 | Control System & Measurements Lab | PC | 20 | 30 | 50 | | - | 3 | 1.5 |
| 10 | 19BCC5MC01 | Advanced Communication Skills | MC | - | - | - | - | - | 3 | - |
| | | **Total** | | **300** | **450** | **750** | **18** | **-** | **12** | **22.5** |

| III B.TECH I-SEMESTER | L | T | P | INTERNAL MARKS | EXTERNAL MARKS | TOTAL MARKS | CREDITS |
|---|---|---|---|---|---|---|---|
| | 3 | - | - | 40 | 60 | 100 | 3 |
| 19BEE5TH01 | CONTROL SYSTEMS | | | | | | |

**Course Objectives:**

1. In this course it is aimed to provide sound knowledge in the basic concepts of linear control theory, design of control system and giving an exposure to the students on characteristics, stability of linear systems and addresses the analysis of feedback systems and finally to equip the student with the ability to select and design suitable control systems.
2. To employ time domain analysis to predict and diagnose transient performance parameters of the system for standard input functions and identify the needs of different types of controllers and compensator to ascertain the required dynamic response from the system
3. Compute stability of linear systems using the Routh array test and use this to generate control design constraints
4. Formulate different types of analysis in frequency domain to explain the nature of stability of the system.

**Course Outcomes:**

Upon completion of the course, students will be able to:

1. **Develop** the mathematical model of the physical systems and analyse feedback characteristics of linear control system to reduce the disturbance
2. **Analyse** time response of first and second order control systems for different standard test signals
3. **Analyse** the system response and stability in both time-domain and frequency domain
4. **To perform** frequency domain analysis of linear control system using bode plot and nyquist stability criterion
5. **Develop** and **analyse** state space models

**UNIT-I: Introduction**

Concepts of Control Systems - Open Loop and closed loop control systems and their differences - Different examples of control systems - Classification of control systems - Effects of feedback - Concept of Transfer function - Impulse response - Mathematical models – Differential equations - Finding Transfer function for mechanical systems (Translational and Rotational) - Electrical systems and electrical analogous of mechanical systems - Transfer Function of DC Servo motor - AC Servo motor - Synchro transmitter and Receiver.

**UNIT-II: Transfer Function Representation**

Block diagram algebra - Reduction techniques – Representation by Signal flow graph - Reduction using Mason's gain formula - **Time Response Analysis -** Standard test signals - Time response of first order systems – Characteristic Equation of Feedback control systems - Transient response of second order systems - Time domain specifications – Steady state response - Steady state errors and static error constants.

**UNIT-III: Stability Analysis in S-Domain**

Stability of linear systems - BIBO stability - Concept of absolute stability - Relative stability - Stability analysis using Routh - Hurwitz Criterion - **Root Locus Technique:-**The root locus concept - construction of root loci.

**UNIT-IV: Frequency Domain Analysis of Control Systems and Stability**

Introduction - Frequency domain specifications - Polar Plots- stability analysis of Nyquist Plots - Bode plots Magnitude vs. phase plot – Phase margin and Gain margin - **Design of Compensators:-**Compensation techniques – Lag, Lead, and Lead - Lag Controllers design in frequency Domain - PID Controllers.

**UNIT-V: State Space Analysis of Continuous Systems**

Concepts of state - State variables and state model - Derivation of state models from block diagrams - Conversion of state variable model to transfer function model and vice-versa - Solving the Time invariant state Equations - State Transition Matrix and it's Properties – Concepts of Controllability and Observability.

**Text Books:**

1. "Automatic Control Systems" by 'B. C. Kuo', John Wiley and Sons-8th edition, 2003.
2. "Control Systems Engineering" by 'I. J. Nagrath and M. Gopal', New Age International Pvt.Ltd. Publishers-5th edition, 2009.
3. "Modern Control Engineering" by 'Katsuhiko Ogata', Prentice Hall of India Pvt. Ltd.-3rd edition, 1998.

**Reference Books:**

1. "Control Systems Engineering" by 'Norman S.Nise', John Wiley 6th Edition 2011.
2. "Modern Control Engineering" by 'K P Mohandas Sanguine', Pearson Revised Edition, 2010.
3. "Modern Control Systems Richard" by 'C. Dorf and Robert H. Bishop Addison' – Wesley, 1999.
4. "Linear Control System Analysis and Design" by 'John J.DAzzo & Constantine H.Houpis', Tata Mc Graw-Hill, Inc., 1995.

| III B.TECH I-SEMESTER | L | T | P | INTERNAL MARKS | EXTERNAL MARKS | TOTAL MARKS | CREDITS |
|---|---|---|---|---|---|---|---|
| | 3 | - | - | 40 | 60 | 100 | 3 |
| 19BEE5TH02 | POWER ELECTRONICS | | | | | | |

**Course Objectives:**

1. To study the characteristics of various power semiconductor devices like BJT, MOSFET, and IGBT &SCR.
2. To study the operation of 1-Ø &3-Ø AC-DC Converters and their analysis.
3. To study the operation of AC- Converters like AC Voltage regulators & Cyclo converters.
4. To study the operation of DC-DC Converters like Choppers.
5. To understand the working of inverters and application of PWM techniques for voltage control and harmonic mitigation.

**Course Outcomes:**

Upon successful completion of the course, the students will be able to

1. Demonstrate the different types of power semiconductor devices and their characteristics.
2. Analyze the performance of controlled single- phase and three- phase converters.
3. Employ suitable ac voltage controllers and cyclo-converters for a particular industrial applications
4. Examine dc-dc converters without electrical isolation.
5. Develop control methods for inverters and harmonic mitigation.

**UNIT–I: Power Semi-Conductor Devices**

Power BJT–Power MOSFET - Power IGBT– Their input and output characteristics - Thyristor – Silicon Controlled Rectifiers (SCR's) –Basic theory of operation of SCR– Triggering methods–Static, Dynamic characteristics of SCR - Series and parallel connections of SCR's– Snubber circuits– Numerical problems.

**UNIT–II:Single Phase Converters**

Phase control technique - Natural Commutation- Single-phase Half-Controlled Converter– R,RL & RLE load - Half wave Controlled Converters: R and RL loads (Principle of operation only) - Fully Controlled Converters: Midpoint converter with R-Load (Principle of operation only) - Bridge connections with RL, RLE load without and with Freewheeling Diode – Derivation of average load voltage and current.

**UNIT–III: Three Phase Converters**

Three phase converters – Three pulse and six pulse converters – average load voltage with R and RL loads. Effect of source inductance (for single phase and three phase converters–Dual converters (both single phase and three phase).

**UNIT - IV: AC Voltage Controllers & Cyclo-Converters**

Single Phase AC Voltage Controllers –Two SCRs in anti-parallel – With R and RL loads - Derivation of RMS load voltage, current and power factor – Numerical problems -Cyclo-Converters: Single phase mid-point cyclo – Converters - Bridge configuration with Resistive and inductive load (Principle of operation only) - Introduction to bidirectional converters.

**UNIT - V: DC-DC Converters and DC-AC Converters**

Choppers: Introduction - Operation of Buck Converter - Boost Converter, Buck-Boost Converter – Derivation of Output Voltage – Current -Duty ratio & Numerical Problems - Inverters: Single phase inverter – Basic series inverter – Parallel inverter – Bridge inverter– Waveforms- Voltage control techniques for inverters - three Phase –1200 and 1800 modes of operation.

**Text Books:**

1. Power Electronics – by P.S.Bhimbra, Khanna Publishers.
2. Power Electronics: Circuits, Devices and Applications – by M. H. Rashid, Prentice Hall of India, 2nd edition, 1998.
3. Power Electronics-by M.D. Singh, Tata McGraw-Hill Education, 2008.

**Reference Books:**

1. Power Electronics-by P.C.Sen,TataMcGraw-Hill Publishing.
2. Erickson, Robert W., and DraganMaksimovic. Fundamentals of Power Electronics. Springer Science & Business Media, 2007.

| III B.TECH I - SEMESTER | L | T | P | INTERNAL MARKS | EXTERNAL MARKS | TOTAL MARKS | CREDITS |
|---|---|---|---|---|---|---|---|
| | 3 | - | - | 40 | 60 | 100 | 3 |
| 19BEE5TH03 | ELECTRICAL TRANSMISSION SYSTEM | | | | | | |

**Course objectives:**

1. To introduce the transmission line parameters and methods for calculation of line parameters for the single phase and three phase circuits.
2. To obtain the equivalent circuits for the transmission lines based on distance and to determine voltage regulation and efficiency.
3. To study effect of power system transients on transmission lines.
4. To understand the mechanical design of transmission lines and to analyse the voltage distribution in insulator strings to improve the efficiency.
5. To study the types and grading of cables and effect of corona on transmission line

**Course Outcomes**

After completion of this course, Students will be able to

1. Apply the knowledge for deriving the inductance and capacitance for various conductor configurations and to find ABCD constants for different transmission lines.
2. Model the transmission line and find the efficiency and regulation.
3. Analyze the different waves and transients in power systems.
4. Acquire the knowledge on design of transmission line and estimate distribution of voltage over a string of insulators.
5. Acquire the knowledge on insulated Cables and effect of corona.

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**UNIT–I: Transmission Line Parameter**

Introduction - Types of conductors - Line Resistance - Skin and Proximity effects - Inductance of a conductor due to internal flux - Inductance due to external flux linkage - Inductance of single phase two-wire line - Flux linkages of one conductor in a group - Inductance of composite conductor - Inductance of three phase transmission line - Symmetrical Spacing- Transposition cycle - Asymmetrical Spacing - GMR of bundled conductors - Inductance of three phase double circuit lines – Numerical problems – Capacitance of a single-phase lines – Capacitance of three phase lines – Equilateral Spacing – Unsymmetrical Spacing – Effect of Earth on the capacitance of three phase lines – Numerical Problem.

**UNIT–II: Performance of Transmission Lines**

Representation of lines – Short line: Model, Generalized circuit constants, Voltage regulation and efficiency – Medium length line: Model: Nominal–$\tau$ and Nominal–$\pi$, generalized circuit constants, Voltage regulation and Efficiency – Long transmission line – Solution of the differential equations – Interpretation of the equations – Hyperbolic form of the equations – Equivalent–$\pi$ circuit–Equivalent–$\tau$ circuit – Numerical Problem.

**UNIT–III: Power System Transients**

Introduction, Transients in simple circuits – Travelling waves on transmission lines – Open Circuited Line–Short Circuited Line – Line terminated through a resistance- Line connected to a cable- Reflection and Refraction at T-Junction– Line terminated through a capacitance- Attenuation of Travelling waves-Numerical Problems.

**UNIT–IV: Mechanical Design of Transmission Lines and Overhead Line Insulators**

Introduction – calculation of sag and tension – Effects of wind and ice loading – Supports at different levels – String chart and sag template – Numerical Problems – Types of insulators – Potential distribution over a string of suspension insulators – String Efficiency – Methods for equalizing the potential – Numerical problems.

**UNIT–V: Insulated Cables**

Insulating materials – Low voltage and extra high voltage Cables – Electrostatic stress in a single – core cables – Grading of cables – Capacitance of insulated cables – Corona – Critical voltage – Factors affecting corona – Advantages and disadvantages of corona – Radio interference.

**Text Books:**

1. Electrical Power Systems by C.L. Wadhwa, New Academic Science Ltd, 2009.
2. Electric Power Transmission and Distribution by S.Sivanagaraju & S.Satyanarayana, Pearson Education, New Delhi.
3. Electric Power Generation, Transmission and Distribution by. S.N. Singh, Prentice Hall of India Pvt. Ltd, New Delhi, Second Edition, 2011.

**Reference Books:**

1. Modern Power System Analysis by D.P.Kothari, I.J. Nagarath ', Tata McGraw-Hill, New Delhi, Fourth Edition, 2013.
2. The Transmission and Distribution of Electrical Energy by Harry Cotton, H. Barbe, English Universities Press, 1970.
3. Electrical power systems by Dr.S.L.Uppal, Khanna publishers.

| III B.TECH I-SEMESTER | L | T | P | INTERNAL MARKS | EXTERNAL MARKS | TOTAL MARKS | CREDITS |
|---|---|---|---|---|---|---|---|
| | 3 | - | - | 40 | 60 | 100 | 3 |
| 19BEE5TH04 | ELECTRICAL MEASUREMENTS | | | | | | |

**Course Objectives:**

1. To understand different electrical measurements and instruments.
2. To learn the usage of bridges for the measurement of resistance, inductance and capacitance.
3. To learn the usage of digital meters and types of transducers.

**Course Outcomes:**

After completion of this course, Students will be able to

1. Analyse and describe construction, principle of construction operation, errors, and compensations and the extension of ranges of different electrical measurement instruments and understanding of error analysis and CT, PT and calculate Ratio and phase angle errors and
2. To be acquainted with the knowledge of instruments that is useful for the measurement of power and energy
3. Calibrate the PF meters and Analyse the usage of DC Bridge for the measurement of resistance,
4. Analyse the usage of AC bridges for the measurement of inductance and capacitance
5. Apply the knowledge about various types of transducers: Electrical, Mechanical, Electromechanical, Optical etc.

**UNIT – I: Measuring Instruments**

Classification – Deflecting, control and damping torques – Ammeters and Voltmeters – PMMC, moving iron type, dynamometer 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 – Design considerations.

**UNIT – II: Measurement of Power and Energy**

Single phase and three phase dynamometer wattmeter – LPF and UPF – Expression for deflecting and control torques – 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 using R.S.S. meter .

**UNIT – III: Measurement of Power Factor and DC Bridges**

Type of P.F. Meters – 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 – Loss of charge method for measurement of high resistance.

**UNIT – IV: AC Bridges**

Measurement of inductance – Quality Factor – Maxwell's bridge – Hay's bridge – Anderson's bridge – Measurement of capacitance and loss angle – Desauty bridge – Schering Bridge – Wagner's earthing device – Wien's bridge- Megger-Measurement of earth resistance.

**UNIT – V: Transducers**

Definition of transducers – Classification of transducers – Advantages of Electrical transducers – Characteristics and choice of transducers – Principle operation of resistor, inductor, inductive and capacitor transducers – LVDT Applications – Strain gauge and its principle of operation – Gauge factor.

**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 and Electronic Measurements and instrumentation by R.K.Rajput , S.Chand Sukhatme, "Solar Energy", Tata McGraw-Hill Education.
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.

| III B.TECH I-SEMESTER | L | T | P | INTERNAL MARKS | EXTERNAL MARKS | TOTAL MARKS | CREDITS |
|---|---|---|---|---|---|---|---|
| | 3 | - | - | 40 | 60 | 100 | 3 |
| 19BEE5PE05 | SPECIAL ELECTRICAL MACHINES (Professional Elective-I) | | | | | | |

**Course Objectives:**

1 Operating principle, control and performance of stepping motors.
2 Operating principle, Characteristics and control of switched reluctance motors.
3 Construction, principle of operation, control and performance of permanent magnet brushless D.C. motors.
4 Construction, principle of operation and performance of permanent magnet synchronous motors.
5 Construction, principle of operation and performance of other special Machines.

**Course Outcomes:**

After completion of this course, Students will be able to

1. Acquire the knowledge on operation of stepper motor and design controllers for special electrical machines.
2. Acquire the knowledge principle of operation, characteristics and control of switched reluctance motors.
3. Acquire the knowledge on commutation technique and control of BLDC motors.
4. Acquire the knowledge on torque development and explain the characteristics of permanent magnet synchronous motors.
5. Analyse the operation and control of various special Machine for a particular application.

**UNIT-I: Stepper Motors**

Types - Constructional features – Principle of operation - Torque equation – Characteristics - Drive circuits - Open loop and Closed loop control – Comparison of stepper motors - Applications.

**UNIT-II: Switched Reluctance Motors**

Constructional features – Principle of operation - Torque Equation- Characteristics - Power Converter - Control of SRM - Rotor Position Sensors - Sensor less operation of SRM - Advantages and Disadvantages of SRM - Applications.

**UNIT-III: Permanent Magnet Brushless D.C. Motors**

Classifications - Construction - Commutation-principle of operation - EMF and Torque equations –types - Control of BLDC motor - Sensor less control of BLDC motor - Applications.

**UNIT-IV: Permanent Magnet Synchronous Motors**

Construction - Principle of operation- EMF and Torque equations - Phasor Diagram – Torque - Speed Characteristics - Control of PMSM - Applications.

**UNIT-V: Other Special Machines**

Constructional features – Principle of operation and Characteristics of Hysteresis motor - Synchronous Reluctance Motor – Linear Induction motor - Repulsion motor - Applications.

**Text Books:**

1. K.Venkataratnam , 'Special Electrical Machines', Universities Press (India) Private Limited, 2008.
2. T. Kenjo, 'Stepping Motors and Their Microprocessor Controls', Clarendon Press London, 1984.
3. E.G. Janardanan, 'Special electrical machines', PHI learning Private Limited, Delhi, 2014.

**References Books:**

1. R.Krishnan, 'Switched Reluctance Motor Drives – Modeling, Simulation, Analysis, Design and Application', CRC Press, New York, 2001.
2. T. Kenjo and S. Nagamori, 'Permanent Magnet and Brushless DC Motors', Clarendon Press, London, 1988.
3. T.J.E.Miller,'Brushless Permanent-Magnet and Reluctance Motor Drives', Oxford University Press, 1989.
4. R.Srinivasan, 'Special Electrical Machines', Lakshmi Publications, 2013.

| III B.TECH I-SEMESTER | L | T | P | INTERNAL MARKS | EXTERNAL MARKS | TOTAL MARKS | CREDITS |
|---|---|---|---|---|---|---|---|
| | 3 | - | - | 40 | 60 | 100 | 3 |
| 19BEE5PE06 | INTELLECTUAL PROPERTY RIGHTS AND PATENTS (Professional Elective-I) | | | | | | |

**Course Objectives:**

1 To enable the students about Intellectual property law and understand the concepts of copyrights, trademarks and Intellectual Property registration of the organization.
2 To enrich the student in the area of patent registration infringement of patent.
3 To enable the student to know about trade mark maintenance, claims and dilution of ownership.
4 To create the awareness to student about cybercrimes, cyber law, E-Commerce and data security.

**Course Outcomes: The student is able to**

1 Understand the Intellectual Property Rights and its importance. [K2]
2 Apply the Copyright Formalities and Registration. [K3]
3 Explain the Patent Application Process and Granting of Patent. [K2]
4 Develop the Trade Mark and know the importance of Trade Mark. [K3]
5 Apply the Trade Secrets and Understand the Cyber Law. [K3]

**Unit I Introduction to Intellectual Property Law**

Evolutionary past – Intellectual Property Law Basics - Types of Intellectual Property - Innovations and Inventions of Trade related Intellectual Property Rights – Agencies Responsible for Intellectual Property Registration – Infringement - Regulatory – Over use or Misuse of Intellectual Property Rights - Compliance and Liability Issues.

**Unit II Introduction to Copyrights**

Principles of Copyright – Subject Matters of Copyright – Rights Afforded by Copyright Law –Copyright Ownership – Transfer and Duration – Right to Prepare Derivative Works –Rights of Distribution – Rights of performers – Copyright Formalities and Registration – Limitations – Infringement of Copyright – International Copyright Law Semiconductor Chip Protection Act.

**Unit III Introduction to Patent Law**

Rights and Limitations – Rights under Patent Law – Patent Requirements – Ownership and Transfer – Patent Application Process and Granting of Patent – Patent Infringement and Litigation – International Patent Law – Patent Cooperation Treaty – New developments in Patent Law- Invention Developers and Promoters.

**Unit IV Introduction to Trade Mark**

Trade Mark Registration Process – Post registration procedures – Trade Mark maintenance – Transfer of rights – Inter parties Proceedings – Infringement – Dilution of Ownership of Trade Mark – Likelihood of confusion – Trade Mark claims – Trade Marks Litigation – International Trade Mark Law

**Unit V Introduction to Trade Secrets and Cyber Law**

Maintaining Trade Secret – Physical Security – Employee Access Limitation – Employee Confidentiality Agreement Trade Secret Law – Unfair Competition – Trade Secret Litigation Introduction to Cyber Law – Information Technology Act - Cyber Crime and E-commerce – Data Security – Confidentiality – Privacy - International aspects of Computer and Online Crime.

**Text Books:**

1. Richard Stim: "Intellectual Property", Cengage Learning, New Delhi.
2. R. Radha Krishnan, S. Balasubramanian: "Intellectual Property Rights",Excel Books. New Delhi.
3. M. Ashok Kumar and Mohd.Iqbal Ali: “Intellectual Property Right”
4. Cyber Law. Texts & Cases, South-Western’s Special Topics Collections
5. Prabhuddha Ganguli: ‘ Intellectual Property Rights” Tata Mc-Graw – Hill, New Delhi

**Reference Books:**

1. 1. Deborah E.Bouchoux: “Intellectual Property”. Cengage learning , New Delhi
2. 2. Kompal Bansal & Parishit Bansal "Fundamentals of IPR for Engineers", BS Publications (Press)

| III B.TECH I-SEMESTER | L | T | P | INTERNAL MARKS | EXTERNAL MARKS | TOTAL MARKS | CREDITS |
|---|---|---|---|---|---|---|---|
| | 3 | - | - | 40 | 60 | 100 | 3 |
| 19BEE5PE07 | SIGNALS AND SYSTEMS (Professional Elective-I) | | | | | | |

**Course Objectives:**

1 To get an in-depth knowledge about signals and analysis of the same using various transforms.
2 Able to know different types of signals and their frequency domain analysis.
3 Understand the principle, filter characteristics and bandwidth of a linear system.
4 Understand the concepts of auto correlation, cross correlation and power density.

**Course Outcomes:**

After completion of this course, the students would be able to

1 Remember basic signals and its operations.
2 Understand Fourier series representation of different signals.
3 Translate signals from time-domain to frequency-domain and vice versa.
4 Understand the LTI system and responses for different inputs.
5 Understand different properties of Sampling.

**UNIT-I: Signal Analysis**

Classification of Signals: Analog, Discrete, Digital, Deterministic & Random, Periodic & Aperiodic, Even & Odd, Energy & Power signals. Basic Operations on Signals: Time-Shifting, Time-Scaling, Time-Reversal, Amplitude Scaling and Signal Addition. Elementary Signals: Unit Step, Unit Ramp, Unit Parabolic, Impulse, Sinusoidal function, Exponential function, Gate function, Triangular function, Sinc function andSignum function. Signal approximation using orthogonal functions, Mean square error.

**UNIT-II: Fourier Series**

Representation of Fourier series, Continuous time periodic signals, Properties of Fourier Series, Dirichlet‘s conditions, Trigonometric Fourier Series and Exponential Fourier Series, Conversion of Exponential Fourier Series from Trigonometric Fourier series & vice versa.

**UNIT-III: Fourier Transforms**

Deriving Fourier Transform from Fourier series, Fourier Transform of arbitrary signal, FourierTransform of standard signals, Fourier Transform of periodic signals, Properties of FourierTransform, Fourier Transforms involving Impulse function and Signum function.

**UNIT-IV: Signal Transmission through Linear Systems**

System and its types: Linear & Non-Linear, Time Variant & Time Invariant, Causal & Non Causal, Static & Dynamic, Stable & Unstable.Impulse response of a linear time invariant (LTI) system and linear time variant (LTV) system, Transfer function of a LTI system, Filter characteristics of linear systems, Distortion less transmission through a system, Signal bandwidth, System bandwidth, Ideal LPF, HPF and BPF and its characteristics, Causality and Paley-Wiener criterion for physical realization, Relationship between bandwidth and rise time.

**UNIT-V: Sampling**

Sampling theorem, Types of Sampling: Impulse Sampling, Natural and flattop Sampling, Reconstruction of signal from its samples, Effect of under sampling – Aliasing.

**Text Books:**

1. B.P. Lathi "Signals, Systems and Communications" –BS Publications, 2008.
2. Simon Haykin and Van Veen, Wiley "Signals and Systems"2nd Edition, 2003.

**Reference Books:**

1. A.V. Oppenheim, A.S. Will sky and S.H. Nawab "Signals and Systems" 2nd Edition, PHI, 2013.
2. P. Ramesh Babu, "Signals and Systems", 3rd Edition, SciTech Publications, 2011.
3. A.Anand Kumar, "Signals and Systems", 3rd Edition, PHI Publications, 2013.

| III B.TECH I-SEMESTER | L | T | P | INTERNAL MARKS | EXTERNAL MARKS | TOTAL MARKS | CREDITS |
|---|---|---|---|---|---|---|---|
| | 3 | - | - | 40 | 60 | 100 | 3 |
| 19BEE5PE08 | ELECTRICAL ENERGY CONSERVATION AND AUDITING (Professional Elective-1) | | | | | | |

**Course Objectives:**

1. To introduce the basic concepts of Energy Auditing and Management.
2. To enable the students to understand the concept of energy management and energy management opportunities.
3. To illustrate the factors to increase the efficiency of electrical equipment of motors
4. To understand the different methods used to Power factor improvement and various energy measuring instruments.
5. To understand the different methods used for the economic analysis of energy projects.

**Course Outcome:**

Upon the completion of this course, the student will be able to

1. Demonstrate skills required for energy audit and management.
2. Identify different areas of Energy conservation and management.
3. Develop cost-effective measures towards improving energy efficient and energy conservation.
4. Analyze the power factor and to design a good illumination system and can find the applications of all the areas in day to day life.
5. Examine pay back periods for energy saving equipment.

**UNIT-I: Basic Principles of Energy Audit:**

Energy audit – Definitions - Concept - Types of audit - Energy index - Cost index - Pie charts - Sankey diagrams - Load profiles - Energy conservation schemes - Energy audit of industries - Energy saving potential - Energy audit of process industry - Thermal power station - Building energy audit.

**UNIT-II: Energy Management:**

Principles of energy management - Organizing energy management program – Initiating – Planning – Controlling – Promoting – Monitoring - Reporting - Energy manger - Qualities and functions, - Language - Questionnaire – Check list for top management.

**UNIT-III: Energy Efficient Motors:**

Energy efficient motors - factors affecting efficiency - Loss distribution - Constructional details - Characteristics – Variable speed - Variable duty cycle systems - RMS hp - Voltage variation - Voltage unbalance - Over motoring - Motor energy audit.

**UNIT-IV: Power Factor Improvement, Lighting and Energy Instruments**:

Power factor – Methods of improvement - Location of capacitors - Power factor with nonlinear loads - Effect of harmonics on power factor - Power factor motor controllers – Good lighting system design and practice - Lighting control - Lighting energy audit – Energy Instruments – Wattmeter - Data loggers – Thermocouples – Pyrometers - Lux meters - Tongue testers - Application of PLC's.

**UNIT-V: Economic Aspects and Analysis:**
Economics Analysis - Depreciation Methods - Time value of money - Rate of return - Present worth method - Replacement analysis - Life cycle costing analysis - Energy efficient motors - Calculation of simple payback method , Net present worth method - Power factor correction - Lighting – Applications of life cycle costing analysis , Return on investment .

**Text Book:**

1. Energy management by W.R. Murphy AND G. Mckay Butter worth, Heinemann publications.
2. Energy management by Paul o' Callaghan, Mc-graw Hill Book company-1st edition, 1998.
3. Energy efficient electric motors by John .C. Andreas, Marcel Dekker Inc Ltd, 2nd edition, 1995.

**Reference books:**

1. Energy efficient electric motors by John .C. Andreas, Marcel Dekker Inc Ltd-2nd edition, 1995.
2. Energy management hand book by W.C.Turner, John wiley and sons.
3. Energy management and good lighting practice: fuel efficiency- booklet 12-EEO.
4. Electric Energy Utilization and Conservation by S C Tripathy, Tata McGraw hill publishing company Ltd. New Delhi.

| III B.TECH I-SEMESTER | L | T | P | INTERNAL MARKS | EXTERNAL MARKS | TOTAL MARKS | CREDITS |
|---|---|---|---|---|---|---|---|
| | - | - | 3 | 20 | 30 | 50 | 1.5 |
| 19BEE5LB01 | ELECTRICAL MACHINES LAB-II | | | | | | |

**Course Objectives:**

1. To predetermine the regulation of three–phase alternator by various methods.
2. To find Xd/Xq ratio of alternator and asses the performance of three–phase synchronous motor.
3. To perform various tests on Induction motor for assessing its performance

**Course Outcomes:**

After completion of this course students will be able to

1. Perform test on synchronous Machine to find Direct and quadrature axis reactance.
2. Conduct No Load and Full load tests on Induction Motor.
3. Calculate torque and speed of given Machine.

**List of Experiments**

**Any Ten experiments from the following list are required to be conducted.**

1. Brake test on three-phase Slip Ring induction motor.
2. No-load & blocked rotor tests on three- phase induction motor and circle diagram.
3. Determination of equivalent circuit parameters of a single phase induction motor.
4. Regulation of a three-phase alternator by synchronous impedance, M.M.F. Methods.
5. Determination of Xd and Xq of a salient pole synchronous generator.
6. Measurement of Negative & Zero sequence impedance of a three-phase alternator
7. Load Test on Single Phase Induction Motor.
8. Separation of Core loss for a Single Phase Transformer.
9. Regulation of Alternator by ZPF Method.
10. Determination of sub-Transient Reactance of Salient pole Synchronous Machine.
11. Load test on Three Phase Alternator.
12. Brake Test on Squirrel Cage Induction Motor.

| III B.TECH I-SEMESTER | L | T | P | INTERNAL MARKS | EXTERNAL MARKS | TOTAL MARKS | CREDITS |
|---|---|---|---|---|---|---|---|
| | - | - | 3 | 20 | 30 | 50 | 1.5 |
| 19BEE5LB02 | POWER ELECTRONICS LAB | | | | | | |

**Course Objectives:**

1. To study the characteristics of various power electronic devices and analyse firing circuits and commutation circuits of SCR.
2. To analyse the performance of single–phase and three–phase full wave bridge converters, single–phase dual converter with both resistive and inductive loads.
3. To understand the operation of AC voltage controller and cyclo converter with resistive and inductive loads.
4. And the working of Buck converter, Boost converter, single–phase bridge inverter and PWM inverter.

**Course Outcomes:**

After completion of this course student will be able to

1. Study the characteristics of various power electronic devices and analyse firing circuits and commutation circuits of SCR.
2. Analyse the performance of single–phase and half wave and Full wave bridge converters, single–phase dual converter with both resistive and inductive loads.
3. Understand the operation of AC voltage controller and cyclo converter with resistive and inductive loads.
4. Understand the working of Buck converter, Boost converter, single–phase bridge inverter and PWM inverter.

**List of Experiments**

**Any 10 of the following experiments are to be conducted:**

1. Study of Characteristics of SCR, MOSFET &IGBT
2. Study of Gate firing circuits for SCR‟s
3. Forced commutation circuits(Class A, Class B, Class C, Class D)
4. Single -Phase Half controlled converter with R and RL load
5. Single -Phase fully controlled bridge converter with R and RL loads
6. Single -Phase AC Voltage Controller with R and RL Loads
7. Single -Phase Cyclo–converter with R and RL loads
8. Single -Phase Bridge Inverter with R and RL Loads
9. Single -Phase dual converter with R and RL Loads
10. Single -Phase parallel inverter with R and RL Loads
11. Three -Phase half controlled bridge converter with RL load.
12. Three- Phase full converter with RL–load.
13. Single -phase PWM inverter.

| III B.TECH I-SEMESTER | L | T | P | INTERNAL MARKS | EXTERNAL MARKS | TOTAL MARKS | CREDITS |
|---|---|---|---|---|---|---|---|
| | - | - | 3 | 20 | 30 | 50 | 1.5 |
| 19BEE5LB03 | CONTROL SYSTEM & MEASUREMENTS LAB | | | | | | |

**Course Objectives:**

1. To apply the correct function of electrical parameters and calibration of voltage, current, single phase and three phase power and energy.
2. To analyse the testing of transformer oil & measure the parameters of choke coil.
3. To impart hands on experience to understand the performance of basic control system components such as magnetic amplifiers, DC servo motors, AC Servo motors, stepper motor and potentiometer.

**Course Outcomes:**

After completion of this course student will be able to

1. Measure accurately the electrical parameters voltage, current, power, energy.
2. To test transformer oil for its effectiveness and measure the parameters of Choke coil.
3. Analyse the performance and working Magnetic amplifier, D.C. servo motors, A.C.Servo motors
4. Design P, PI, PD and PID controllers and lag, lead and lag–lead compensators.

**List of Experiments**

**Any 10 of the following experiments are to be conducted:**

1. Transfer function of DC generator.
2. Characteristics of AC servomotor.
3. Lag and lead compensation – Magnitude and phase plot.
4. Characteristics of DC Servomotor.
5. Characteristics of Magnetic amplifier.
6. Time response of a second order system.
7. Effect of P, PD, PI, PID Controller on a second order system.
8. Kelvin's double Bridge - Measurement of resistance.
9. Capacitance measurement using Anderson Bridge.
10. Calibration and testing of single phase energy meter
11. Measurement of parameters of a choke coil using 3 voltmeter and 3 ammeter methods.
12. Crompton DC potentiometer- Calibration of PMMC Ammeter and PMMC Voltmeter.
13. C.T Testing using mutual inductor- measurement of % ratio error and phase angle error of given C.T by Null method.
14. LVDT and Capacitance pickup – Characteristics and Calibration.
15. Dielectric Oil Testing of Transformer Oil.

| III B.TECH I-SEMESTER | L | T | P | INTERNAL MARKS | EXTERNAL MARKS | TOTAL MARKS | CREDITS |
|---|---|---|---|---|---|---|---|
| | - | - | 3 | 20 | 30 | 50 | 1.5 |
| 19BCC5MC01 | ADVANCED COMMUNICATION SKILLS LAB (Common to All Branches) | | | | | | |

**Course objectives:**

1. To train the students to use language effectively in professional situations like group discussions, public speaking, presentations and interviews.
2. To make the students understand the importance of body language.
3. To provide exposure to students to soft skills like Goal Setting, Assertiveness, Time Management, Positive Attitude and Stress Management
4. To expose the students to SWOT Analysis, Interpersonal Skills, Intra Personal Skills, Leadership Qualities and Emotional Intelligence.

**Course outcomes:**

After successful completion of this course, the students will be able to:

1. Understand the nuances of the written language and write letters, emails and Resume effectively.
2. Know how body language is used in communication and interpret non-verbal symbols
3. Participate in Group Discussions using analytical and problem solving skills.
4. Face job interviews confidently and enhance employability.

**UNIT– I**

Resume Writing, Email & Letter Writing

**UNIT–II**

Non Verbal Communication skills

**UNIT–III**

Personal Introduction & JAM

**UNIT-IV**

Group Discussion

**UNIT-V**

Interview skills

**Reference books:**

1. Rajendra Pal, J S KorlahaHi, Essentials of Business Communication, Sultan Chand & Sons
2. Andrea J. Rutherford, Basic Communication Skills for Technology, Pearson Education Asia
3. V. Prasad, Advanced Communication Skills, Atma Ram Publications
4. Sanjay Kumar, Pushp Lata, Communication Skills, Oxford University Press
5. Meenakshi Raman, Sangeeta Sharma, Fundamentals of Technical Communication, Oxford University Press

**III B.TECH. – II SEMESTER**

| S.No. | Subject Code | Subject | Cat. Code | Internal Marks | External Marks | Total Marks | L | T | P | Credits |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 19BEE6TH02 | Microprocessor & Microcontrollers | PC | 40 | 60 | 100 | 3 | - | - | 3 |
| 2 | 19BEE6TH03 | Internet of Things | ES | 40 | 60 | 100 | 2 | 1 | - | 3 |
| 3 | 19BEE6TH04 | Power System Analysis | PC | 40 | 60 | 100 | 3 | - | - | 3 |
| 4 | 19BEE6PE05 | **Professional Elective-II** a. Flexible AC Transmission Systems | PE | 40 | 60 | 100 | 3 | - | - | 3 |
| | 19BEE6PE06 | b. Advanced Power Electronic Converters | | | | | | | | |
| | 19BEE6PE07 | c. Control of Electrical Drives | | | | | | | | |
| | 19BEE6PE08 | d. Electrical Machine Design | | | | | | | | |
| 5 | 19BCC6TH01 | Entrepreneurship and Innovation | HS | 40 | 60 | 100 | 3 | - | - | 2 |
| 6 | | **Open Elective-III** | OE | 40 | 60 | 100 | 3 | - | - | 3 |
| 7 | 19BEE6LB01 | Microprocessors and Microcontrollers Lab | PC | 20 | 30 | 50 | | - | 3 | 1.5 |
| 8 | 19BEE6LB02 | Process Automation Lab (Skill Lab) | PR | 20 | 30 | 50 | | - | 3 | 1 |
| 9 | 19BEE6MP | Mini Project | PR | 50 | - | 50 | - | - | 3 | 1.5 |
| | | **Total** | | **330** | **420** | **750** | **18** | **-** | **9** | **21** |

| III B.TECH II-SEMESTER | L | T | P | INTERNAL MARKS | EXTERNAL MARKS | TOTAL MARKS | CREDITS |
|---|---|---|---|---|---|---|---|
| | 3 | 1 | 0 | 40 | 60 | 100 | 3 |
| 19BEE6TH02 | MICROPROCESSORS & MICROCONTROLLERS | | | | | | |

**Course Objectives:**

1. To understand the organization and architecture of Micro Processor
2. To explain the addressing modes to access memory
3. Explore how to interface microprocessor with I/O as well as other devices.
4. To familiarize 8051 micro controller architecture
5. To know the programming principles for 8086 and 8051

**Course Outcomes:**

After completion of the course, the student will be able to

1. Recall the basic concepts, elements & operations of digital computer system.
2. Demonstrate memory organization and I/O processing for microprocessor and microcontroller.
3. Make use of Instruction set to develop Assembly Language Programming for computational operations.
4. Model a microprocessor based system by interfacing different electronic devices.
5. Illustrate the instruction set present in a microcontroller for different operations.

**UNIT-I: INTRODUCTION TO 8086 MICROPROCESSOR**

Introduction and evolution of Microprocessors, Architecture of 8086, Register Organization of 8086, Physical memory organization of 8086, General bus operation of 8086, Introduction to 80286–80386 and 80486 and Pentium.

**UNIT-II: MINIMUM AND MAXIMUM MODE OPERATIONS**

Minimum and Maximum mode operations of 8086, 8086 Control signal interfacing, Timing diagrams, Instruction set, Addressing modes.

**UNIT-III: ASSEMBLY LANGUAGE PROGRAMMING**

Assembler Directives, Macro's, Algorithms for Implementation of FOR Loop–WHILE–REPEAT and IF-THEN-ELSE. Addressing modes and Instruction set of 8051, Assembly language programming of 8051, Development systems and tools.

**UNIT-IV: 8086 INTERFACING**

8255 PPI– Architecture of 8255&Modes of operation, Interfacing I/O devices to 8086 using 8255, Interfacing A to D converters & Interfacing D to A converters, Stepper motor interfacing, Static memory interfacing with 8086, DMA controller (8257)–Architecture & Interfacing 8257 DMA controller, Programmable Interrupt Controller (8259)–Command words, operating modes & Interfacing of 8259, Keyboard/display controller (8279)–Architecture, Modes of operation, Command words & Interfacing of 8279.

**UNIT-V: INTRODUCTION TO 8051 MICRO CONTROLLER**

8051 Microcontroller Architecture, Register set of 8051, I/O ports and Memory Organization, Modes of timer operation, Serial port operation, Interrupt structure of 8051.

**Text Books:**

1. A.K.Ray, K.M.Bhurchandi ,"Advanced Microprocessors and Peripherals", Tata McGraw Hill Publications, 2000.
2. Douglas V Hall "Microprocessors and Interfacing" 2nd Edition,Mc–Graw Hill,.
3. Kenneth J Ayala, "The 8051 Micro Controller Architecture, Programming and Applications", 2nd Edition Thomson Publishers,.

**Reference Books:**

1. R.S. Kaler, " A Text book of Microprocessors and Micro Controllers", I.K. International Publishing House Pvt. Ltd.
2. Ajay V Deshmukh, "Microcontrollers", TATA McGraw Hill publications, 2012.
3. Krishna Kant, "Microprocessors and Microcontrollers", PHI Publications, 2010.

| III B.TECH II-SEMESTER | L | T | P | INTERNAL MARKS | EXTERNAL MARKS | TOTAL MARKS | CREDITS |
|---|---|---|---|---|---|---|---|
| | 3 | 0 | 0 | 40 | 60 | 100 | 3 |
| 19BEE6TH03 | INTERNET OF THINGS | | | | | | |

**Course Objectives:**

1. To present interconnection and integration of the physical world and the cyber space.
2. To demonstrate applications of Internet of Things
3. To educate building blocks and characteristics of Internet of Things
4. To introduce communication protocols used in Internet of Things
5. To impart knowledge on design & develop IoT devices

**Course Outcomes:**

After completion of this course, the students will be able to

1. Examine the application areas of IoT
2. Illustrate revolution of Internet in Mobile Devices, Cloud & Sensor Networks
3. Examine communication protocols used in IoT
4. Make use of python programming to implement Internet of Things
5. Design IoT applications using Raspberry Pi

**UNIT- I: Introduction & Concepts**

Introduction to Internet of Things, physical design of IoT, logical design of IoT, IoT enabling Technologies, IoT levels.

**UNIT- II: Domain Specific IOT's**

Home Automation, Cities, Environment, Energy, Retail, Logistics, Agriculture, Industry, Health & Life Style.

**UNIT- III: IOT &M2M**

M2M, Difference between IOT andM2M, SDN and NFV for IOT, Software defined Networking, Network FunctionVirtualization

**UNIT- IV: M2M & System Management with NETCONF-YANG**

Need for IOT Systems Management, Simple Network Management Protocol,Limitations of SNMP, Network Operator Requirements, NETCONF, YANG, IOT Systemsmanagement with NETCONF-YANG

**UNIT- V: IOT Physical Devices & Endpoints**

What is an IOT Device, Exemplary Device, Board, Linux on Raspberry Pi, Interfaces, and Programming with Python; Python web application framework – Django, Designing a Restful web API.

**Text Books:**

1. Vijay Madisetti, ArshdeepBahga, Internet of Things A Hands-On- Approach,2014.

**Reference Books:**

1. Matt Richardson & Shane Wallace, Getting Started with Rasperry Pi, O'Reilly (SPD), 2014.
2. Adrian McEwen, Designing the Internet of Things, Wiley Publishers, 2013
3. Daniel Kellmereit, The Silent Intelligence: The Internet of Things, 2013

| III B.TECH II-SEMESTER | L | T | P | INTERNAL MARKS | EXTERNAL MARKS | TOTAL MARKS | CREDITS |
|---|---|---|---|---|---|---|---|
| | 3 | - | - | 40 | 60 | 100 | 3 |
| 19BEE6TH04 | POWER SYSTEM ANALYSIS | | | | | | |

**Course Objectives:**

1. Analyse multi-node power systems using an admittance matrix or impedance matrix representation of the power system.
2. Understand the formulation of power flow problem and have the ability to cast any given system in this framework.
3. Develop understanding of the concepts of fault analysis in interconnected systems.

**Course Outcomes:**

After completion of this course student will be able to

1. Convert a power system from one base to another base.
2. Modify an impedance matrix with any addition or removal of element.
3. Formulate the power flow problem and analyse the power system.
4. Develop and solve the positive, negative, and zero sequence networks for systems consisting of machines, transmission lines and transformers.
5. Solve for the fault voltages and currents for various faults.

**UNIT I: Representation**

Per UNIT quantities - Single line diagram - Impedance diagram of a power system - Graph theory definition - Formulation of Y-Bus & Z-Bus.

**UNIT II: Power flow studies**

Necessity of power flow studies – Derivation of Static power flow equations – Guass - Seidel method (limited to 3 buses) - Algorithm. Newton - Raphson method in rectangular and polar coordinates form - Derivation of Jacobean matrix - Power flow solution using N- R method-(3 bus) - Decoupled and Fast decoupled method (3 bus) – Algorithms.

**UNIT III: Symmetrical Fault analysis & Symmetrical Components**

Three phase short circuit currents and reactance's of synchronous machines - Short circuit MVA calculations - Synthesis of unsymmetrical phasors from their symmetrical components – Operators - symmetrical components of unsymmetrical phasors - Power in terms of symmetrical components - sequence networks – Positive - Negative and zero sequence network.

**UNIT IV: Unsymmetrical Fault analysis**

Various types of unsymmetrical faults - LG, LL, LLG on unloaded alternator - Unsymmetrical faults on power systems.

**UNIT V: Power system stability analysis**

Classification of stability - Description of steady state stability power limits - Transfer reactance - Synchronizing power coefficient - Power angle curve and determination of steady

state stability - Derivation of swing equation - Determination of transient stability by equal area criterion - Application of equal area criterion - Methods to improve steady state and transient state stability.

**Text Books:**

1. Modern Power system analysis-I.J.Nagrath and D.P.Kothari- TMH, 2nd edition.
2. Computer methods in power systems analysis-Glenn W.Stagg, Ahmed H.EI. Abiad-Mc.Graw- Hill International Editions.

**Reference Books:**

1. Power system analysis-Grainger and Stevenson, Tata Mc. Graw-Hill.
2. Power system analysis-A.R.Bergen,PHI.
3. Power system analysis-Hadi saadat- TMH edition.
4. Power system analysis-B.R.Gupta-Wheeler Publications.
5. Electrical Power systems –C.L.Wadhwa -New Age International.

| III B.TECH II-SEMESTER | L | T | P | INTERNAL MARKS | EXTERNAL MARKS | TOTAL MARKS | CREDITS |
|---|---|---|---|---|---|---|---|
| | 3 | - | - | 40 | 60 | 100 | 3 |
| 19BEE6PE05 | FLEXIBLE AC TRANSMISSION SYSTEMS (Professional Elective-II) | | | | | | |

**Course Objectives:**

1. To learn the basics of power flow control in transmission lines using FACTS controllers
2. To explain operation and control of voltage source converter.
3. To understand compensation methods to improve stability and reduce power oscillations of a power system.
4. To learn the method of shunt compensation using static VAR compensators.
5. To learn the methods of compensation using series compensators.
6. To explain operation of Unified Power Flow Controller (UPFC).

**Course Outcomes:**

After completion of this course student will be able to

1. Outline power flow control in transmission lines using FACTS controllers.
2. Analyse operation and control of voltage source converter.
3. Compare compensation methods to improve stability and reduce power oscillations in the transmission lines.
4. Distinguish the method of shunt compensation using static VAR compensators.
5. Illustrate the methods of compensations using series compensators and outline the operation of Unified Power Flow Controller (UPFC).

**UNIT-I: Introduction to FACTS**

Power flow in an AC System – Loading capability limits – Dynamic stability considerations – Importance of controllable parameters – Basic types of FACTS controllers – Benefits from FACTS controllers – Requirements and characteristics of high power devices – Voltage and current rating – Losses and speed of switching.

**UNIT-II: Voltage source and Current source converters**

Concept of voltage source converter(VSC) – Single phase bridge converter – Square–wave voltage harmonics for a single–phase bridge converter – Three–phase full wave bridge converter – Three–phase current source converter – Comparison of current source converter with voltage source converter.

**UNIT-III Shunt Compensators–1**

Objectives of shunt compensation – Mid–point voltage regulation for line segmentation – End of line voltage support to prevent voltage instability – Improvement of transient stability – Power oscillation damping.

**UNIT-IV: Shunt Compensators–2**

Thyristor Switched Capacitor (TSC) –Thyristor Controlled Reactor (TCR) – TSC–TCR. Static VAR compensator (SVC) and Static Compensator (STATCOM)**:** The regulation and slope transfer function and dynamic performance – Transient stability enhancement and power oscillation damping – Operating point control and summary of compensation control.

**UNIT-V: Series Compensators & Combined Controllers**

Static series compensators**:** Concept of series capacitive compensation – Improvement of transient stability – Power oscillation damping – Functional requirements - Thyristor Switched Series Capacitor (TSSC) and Thyristor Controlled Series Capacitor (TCSC) - Schematic and basic operating principles of Unified Power Flow Controller (UPFC).

**Text Books:**

1. "Understanding FACTS" N.G.Hingorani and L.Guygi, IEEE Press.Indian Edition is Available:—Standard Publications, 2001.

**Reference Books:**

1. "Flexible ac transmission system (FACTS)" Edited by Yong Hue Song and Allan T Johns, Institution of Electrical Engineers, London.
2. Thyristor-based FACTS Controllers for Electrical Transmission Systems, by R.Mohan Mathur and Rajiv k.Varma, Wiley.

| III B.TECH II-SEMESTER | L | T | P | INTERNAL MARKS | EXTERNAL MARKS | TOTAL MARKS | CREDITS |
|---|---|---|---|---|---|---|---|
| | 3 | - | - | 40 | 60 | 100 | 3 |
| 19BEE6PE06 | ADVANCED POWER ELECTRONIC CONVERTERS (Professional Elective-II) | | | | | | |

**Course Objectives:**

1. To review basic concepts of power electronics in the field of power control and drives
2. To address the underlying concepts and methods behind DC-DC Switched Mode Converters.
3. To summarize the various PWM concepts and methods behind DC-AC Switched Mode Converters.
4. To impart knowledge of multilevel Inverters & its varieties.
5. To demonstrate the underlying concepts and methods behind Resonant Converters.

**Course Outcomes:**

Upon the completion of this course, the student will be able to

1. Examine different types of power semiconductor devices and their characteristics.
2. Analyse the performance of DC-DC Switched Modeconverters and its applications.
3. Demonstrate the operation of various modes DC-AC converters and their comparisons.
4. Summarize the various categories of multi-level inverters operation clearly.
5. Analyze the working of Zero voltage and zero current switching & resonant switch converters.

**UNIT-I: Introduction**

Review of power semiconductor devices: Thyristor, IGBT, MOSFET, IGCT, GTO and their driver circuits - Role of Sic in power semiconductor technology.

**UNIT-II: DC-DC Switched Mode Converters**

Topologies - Buck, Boost, Buck-Boost, and Cuk converters - Full Bridge DC-DC converter - Detailed theory, working principles - Modes of operation, with detailed circuits and wave forms – Applications - Merits and Dmerits.

**UNIT-III: DC-AC Switched Mode Inverters**

Voltage Source Inverter - PWM techniques of voltage fed converters: Selective Harmonic Elimination (SHE) - Sine modulation - Third harmonic injection - Hysteresis Current Control - Sigma-Delta Modulation - Space Vector Pulse Width Modulation - Current Source Inverter: Current Source inverters and their role in high power drives: Pulse Width Modulation of CSI Matrix converters: Three phase matrix converters and their control - Basic input filter - Protection of matrix converter.

**UNIT-IV: Multilevel Inverters:**

Diode Clamped MLI - Flying Capacitor MLI - Cascaded H-Bridge topology: operation with equal and unequal DC voltages - Carrier modulation schemes of multilevel inverter - SVPWM of Multilevel inverter - Neutral Point Balancing schemes.

**UNIT-V: Resonant Converters**

Zero voltage and zero current switching - Resonant switch converters - and comparison with hard switching - Switching locus diagrams and working principle.

**Text Books:**

1. Muhammad H. Rashid, Power Electronics Handbook, 3rd edition, Butterworth-Heinemann, San Diego, 2010.
2. Ned Mohan, Tore M. Undeland, "Power Electronics - Converters, Applications and Design", Wiley India Edition, 3rd Edition, 2012.
3. L Umanand, Power Electronics –Essentials & Applications, Willey India Pvt Ltd, 2nd Edition, 2013.

**Reference Books:**

1. P.C.Sen, Power Electronics, Tata McGraw-Hill, 1st Edition, 2001.
2. M. D. Singh & K. B. Kanchandhani, Power Electronics, Tata McGraw – Hill Publishing Company, 2nd Edition, 2010.

| III B.TECH II-SEMESTER | L | T | P | INTERNAL MARKS | EXTERNAL MARKS | TOTAL MARKS | CREDITS |
|---|---|---|---|---|---|---|---|
| | 3 | - | - | 40 | 60 | 100 | 3 |
| 19BEE6PE07 | CONTROL OF ELECTRICAL DRIVES (Professional Elective-II) | | | | | | |

**Course Objectives:**

1. To understand steady state operation and transient dynamics of a motor load system.
2. To study and analyse the operation of the converter / chopper fed dc drive, both qualitatively and quantitatively.
3. To study and understand the operation and performance of AC Induction motor Drives.
4. To study and understand the operation and performance of AC Synchronous motor Drives.
5. To analyse and design the current and speed controllers for a closed loop solid state DC motor drives.

**Course Outcomes:**

After completion of this course Students will be able to

1. Illustrate the basic requirements of motor selection for different load profiles.
2. Analyse the steady state behaviour of DC motor drive.
3. Justify the different control techniques of Induction Motor drive.
4. Select control strategy of Synchronous Motor drive.
5. Design the controller for electrical drives.

**UNIT-I: Drive Characteristics**

Electric drive – Equations governing motor load dynamics – Steady state stability – Multi quadrant Dynamics: acceleration, deceleration, starting & stopping – Typical load torque characteristics –Selection of motor.

**UNIT-II: Converter / Chopper Fed Dc Motor Drive**

Steady state analysis of the single and three phase converter fed separately excited DC motor drive – Continuous and discontinuous conduction – Time ratio and current limit control – 4 quadrant operation of converter / chopper fed drive.

**UNIT-III: Induction Motor Drives**

Stator voltage control – Energy efficient drive – v/f control – Constant air gap flux – Field weakening mode – Voltage / current fed inverter – Closed loop control.

**UNIT-IV: Synchronous Motor Drives**

V/f control and self-control of synchronous motor: Margin angle control and power factor control – Permanent magnet synchronous motor.

**UNIT-V: Design of Controllers for Drives**

Transfer function for DC motor / load and converter – Closed loop control with current and speed feedback – Armature voltage control and field weakening mode – Design of controllers; current controller and speed controller - Converter selection and characteristics.

**Text Books:**

1. Gopal K.Dubey, Fundamentals of Electrical Drives, Narosa Publishing House, 1992.
2. Bimal K.Bose. Modern Power Electronics and AC Drives, Pearson Education, 2002.

**Reference Books:**

1. S.K.Pillai, A First course on Electrical Drives, Wiley Eastern Limited, 1993.
2. Murphy J.M.D and Turnbull, Thyristor Control of AC Motor, Pergamon Press, Oxford 1988.
3. Gopal K.Dubey, Power semiconductor controlled Drives, Prentice Hall Inc., New Jersey, 1989.
4. R.Krishnan, Electric Motor & Drives: Modeling, Analysis and Control, Prentice hall of India, 2001.

| III B.TECH II-SEMESTER | L | T | P | INTERNAL MARKS | EXTERNAL MARKS | TOTAL MARKS | CREDITS |
|---|---|---|---|---|---|---|---|
| | 3 | - | - | 40 | 60 | 100 | 3 |
| 19BEE6PE08 | ELECTRICAL MACHINE DESIGN (Professional Elective-II) | | | | | | |

**Course Objectives:**

1. To familiarize Magnetic circuit parameters and thermal rating of various types of electrical machines.
2. To explain Armature and field systems for D.C. machines.
3. To impart the design knowledge about Core, yoke, windings and cooling systems of transformers.
4. To expose design concepts Design of stator and rotor of induction machines and synchronous machines.

**Course Outcomes:**

Upon successful completion of the course, the students will be able to

1. understand basics of design considerations for rotating and static electrical machines
2. design of field system for its application.
3. design sing and three phase transformer.
4. design armature and field of DC machines.
5. design stator and rotor of induction motor.
6. design and analyze synchronous machines.

**UNIT I Design of Field System and Armature**

Major considerations in Electrical Machine Design – Materials for Electrical apparatus – Design of Magnetic circuits – Magnetising current – Flux leakage – Leakage in Armature. Design of lap winding and wave winding.

**UNIT II Design of Transformers**

Construction - KVA output for single and three phase transformers – Overall dimensions – design of yoke, core and winding for core and shell type transformers – Estimation of No load current – Temperature rise in Transformers – Design of Tank and cooling tubes of Transformers

**UNIT III Design of DC Machines**

Construction - Output Equations – Main Dimensions – Choice of specific loadings – Selection of number of poles – Design of Armature – Design of commutator and brushes – design of field - Design of Armature main dimensions

**UNIT IV Design of Induction Motors**

Construction - Output equation of Induction motor – Main dimensions – choice of specific loadings – Design of squirrel cage rotor and wound rotor –Magnetic leakage calculations – Operating characteristics : Magnetizing current - Short circuit current – Circle diagram - Design of slip-ring rotor

**UNIT V Design of Synchronous Machines**

Output equations – choice of specific loadings – Design of salient pole machines – Short circuit ratio – Armature design – Estimation of air gap length – Design of rotor –Design of damper winding – Determination of full load field MMF – Design of field winding

**Text Books:**

1. Sawhney, A.K., 'A Course in Electrical Machine Design', Dhanpat Rai& Sons, New Delhi, Fifth Edition, 1984.
2. M V Deshpande 'Design and Testing of Electrical Machines' PHI learning Pvt Lt, 2011.
3. Sen, S.K., 'Principles of Electrical Machine Designs with Computer Programmes', Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, Second Edition, 2009.

**References Books:**

1. A.Shanmugasundaram, G.Gangadharan, R.Palani 'Electrical Machine Design Data Book', New Age International Pvt. Ltd., Reprint 2007.
2. 'Electrical Machine Design', Balbir Singh, Vikas Publishing House Private Limited, 1981.
3. V Rajini, V.S Nagarajan, 'Electrical Machine Design', Pearson, 2017.
4. K.M.Vishnumurthy 'Computer aided design of electrical machines' B S Publications,2008

| III B.TECH II-SEMESTER | L | T | P | INTERNAL MARKS | EXTERNAL MARKS | TOTAL MARKS | CREDITS |
|---|---|---|---|---|---|---|---|
| | - | - | 3 | 20 | 30 | 50 | 1.5 |
| 19BEE6LB02 | PROCESS AUTOMATION LAB (Skill Lab) | | | | | | |

**Course Objectives**

1. To make the students understand the fundamentals of automation and various automation systems used in industry.
2. Students should be able to determine hardware and software requirements of Automation.
3. They should further understand how to design any application based on the requirement.

**COURSE OUTCOMES**

At the end of this course the student will be able to

1. Describe the working of various blocks of basic industrial automation system.
2. Connect the peripherals with the PLC.
3. Use various PLC functions and develop small PLC programs.

**List of Experiments**

1. Study hardware and software used in PLC
2. Implementation Logic Gates
3. Implementation of DOL Starter
4. Implementation of On-Delay Timer
5. Implementation of Off-Delay Timer
6. Implementation of Up-Down Counter
7. Implementation of PLC Arithmetic Instructions
8. Implementation of PID Controller

**Web Reference:**

1. https://plccoep.vlabs.ac.in/List%20of%20experiments.html?domain=Electrical%20Engineering

**IV B.TECH. – I SEMESTER**

| S.No. | Subject Code | Subject | Cat. Code | Internal Marks | External Marks | Total Marks | L | T | P | Credits |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 19BEE7TH01 | Switchgear and Protection | PC | 40 | 60 | 100 | 3 | - | - | 3 |
| 2 | 19BEE7TH02 | Power System Operation and Control | PC | 40 | 60 | 100 | 3 | - | - | 3 |
| 3 | 19BEE7PE04 | **Professional Elective-III** a. HVDC Transmission | PE | 40 | 60 | 100 | 3 | - | - | 3 |
| | 19BEE7PE05 | b. Power System Stability | | | | | | | | |
| | 19BEE7PE06 | c. Digital Control Systems | | | | | | | | |
| | 19BEE7PE07 | d. Electrical and Hybrid Vehicles | | | | | | | | |
| 4 | 19BEE7PE08 | **Professional Elective-IV** a. Power Quality | PE | 40 | 60 | 100 | 3 | - | - | 3 |
| | 19BEE7PE09 | b. Renewable and Distributed Energy Systems | | | | | | | | |
| | 19BEE7PE10 | c. Embedded Systems | | | | | | | | |
| | 19BEE7PE11 | d. Quality Management | | | | | | | | |
| 5 | 19BEE7TH03 | Business Management concepts for Engineers | HS | 40 | 60 | 100 | 3 | - | - | 3 |
| 6 | | **Open Elective-IV** | OE | 40 | 60 | 100 | 3 | - | - | 3 |
| 7 | 19BCC6MOOC | MOOCs | PE | - | - | - | - | - | - | 1 |
| 8 | 19BCC7IPT | Internship/ Practical Training | PR | 50 | - | 50 | - | - | - | 1 |
| 9 | 19BEE7LB01 | Power Systems & Simulation Lab | PC | 20 | 30 | 50 | - | - | 3 | 1.5 |
| | | **Total** | | **360** | **390** | **750** | **18** | **-** | **5** | **21.5** |

| IV B.TECH I-SEMESTER | L | T | P | INTERNAL MARKS | EXTERNAL MARKS | TOTAL MARKS | CREDITS |
|---|---|---|---|---|---|---|---|
| | 3 | - | - | 40 | 60 | 100 | 3 |
| 19BEE7TH01 | SWITCHGEAR AND PROTECTION | | | | | | |

**Course Objectives:**

1. To study the principles, concepts of switchgear & protection.
2. To emphasize on various type of relays and circuit breakers
3. To impart knowledge of various protective schemes used for generator, transformers, feeders and bus bars.
4. To study different types of over voltages in a power system and principles of different Protective schemes for insulation co–ordination.

**Course Outcomes:**

After completion of this course student will be able to

1. Compare the different types of circuit breakers performance based on which selection of circuit breaker can be made for a given application.
2. Test the performance of different protective relays.
3. Analyze the faults and protection for the Alternators, Transformers, Feeders and Bus-Bars.
4. Employ different types of protecting devices to protect the system against over voltages and grounding.

**UNIT–I: Circuit Breakers**

Elementary principles of arc interruption– Restriking Voltage and Recovery voltages– Restriking phenomenon - RRRV– Average and Max. RRRV– Current chopping and Resistance switching– Introduction to oil circuit breakers– Description and operation of Air Blast– Vacuum and SF6 circuit breakers– CB ratings and specifications– Concept of Auto reclosing.

**UNIT–II: Electromagnetic Relays**

Relay connection – Balanced beam type, attracted armature relays - induction disc and induction cup relays–Torque equation - Relays classification–Instantaneous– DMT and IDMT types– Applications of relays: Over current and under voltage relays– Directional relays– Differential relays and percentage differential relays– Universal torque equation– Distance relays: Impedance– Reactance– Mho and offset mho relays– Characteristics of distance relays and comparison.

Static relays: Introduction to Static relays - Static relay components.

**UNIT–III: Generator and Transformer Protection**

Protection of generators against stator faults– Rotor faults and abnormal conditions– restricted earth fault and inter turn fault protection.

Protection of transformers: Percentage differential protection– Design of CT's ratio– Buchholz relay protection.

**UNIT–IV: Feeder and Bus bar Protection**

**Protection of lines:** Over current Protection schemes – Carrier current and three zone distance relay using impedance relays–Protection of bus bars by using Differential protection.

**UNIT–V: Protection against Over Voltage and Grounding**

Generation of over voltages in power systems– Protection against lightning over voltages– Valve type and zinc oxide lighting arresters– Insulation coordination– BIL– impulse ratio– Standard impulse test wave– volt-time characteristics– Grounded and ungrounded neutral systems–Effects of ungrounded neutral on system performance– Methods of neutral grounding: Solid–resistance–Reactance–Arcing grounds and grounding Practices.

**Text Books:**

1. Power System Protection and Switchgear by Badari Ram and D.N Vishwakarma, TMH Publications
2. Electrical power systems by C. L. Wadhwa, New Age International (P) Limited, and Publishers.
3. Power system protection- Static Relays with microprocessor applications.by T.S. Madhava Rao, TMH
4. Switchgear protection and power systems by Sunil S. Rao by Khanna publishers.

**Reference Books:**

1. Fundamentals of switchgear and protection by J. B. Guptha, katson publications.
2. Fundamentals of Power System Protection by Paithankar and S.R. Bhide., PHI, 2003.
3. Art & Science of Protective Relaying – by C R Mason, Wiley Eastern Ltd.
4. Protection and Switch Gear by Bhavesh Bhalja, R.P. Maheshwari, NileshG.Chothani, Oxford University Press, 2013

| IV B.TECH I-SEMESTER | L | T | P | INTERNAL MARKS | EXTERNAL MARKS | TOTAL MARKS | CREDITS |
|---|---|---|---|---|---|---|---|
| | 3 | - | - | 40 | 60 | 100 | 3 |
| 19BEE7TH02 | POWER SYSTEM OPERATION AND CONTROL | | | | | | |

**Course objectives:**

1. To make the student to understand economic load dispatch under various Operational and techniques to solve the problem.
2. To know the importance of quality of power, P-f, Q-V control loops, AGC.
3. To discuss the concept of reactive power and voltage control in detail.
4. To understand the importance of reactive power control in power system.
5. To understand the importance of computer applications in power system and how load particulars are with the increase in load demand.

**COURSE OUTCOMES:**

Upon successful completion of the course, the student will be able to:

1. Analyze the importance of economic operation of power systems.
2. Illustrating hydroelectric power plant models
3. Structuring the mathematical modelling of speed governing system.
4. Examining the Load frequency control of two area system.
5. Detecting the voltage and reactive power in practical case also.

**UNIT-I: Economic Operation of Power Systems**

Optimal operation of Generators in Thermal power stations, – Heat rate curve – Cost Curve – Incremental fuel and Production costs – Input–output characteristics – Optimum generation allocation with line losses neglected – Optimum generation allocation including the effect of transmission line losses – Loss Coefficients – General transmission line loss formula.

**UNIT-II: Hydrothermal Scheduling& Unit Commitment**

Optimal scheduling of Hydrothermal System: Hydroelectric power plant models – Scheduling problems – Short term hydrothermal scheduling problem.Optimal unit commitment problem – Need for unit commitment – Constraints in unit commitment – Cost function formulation – Solution methods – Priority ordering – Dynamic programming.

**UNIT-III: Load Frequency Control-I**

Modeling of steam turbine – Generator – Mathematical modeling of speed governing system – Transfer function – Modeling of Hydro turbine –Necessity of keeping frequency constant – Definitions of Control area – Single area control system – Block diagram representation of an isolated power system – Steady state analysis – Dynamic response – Uncontrolled case. Proportional plus Integral control of single area and its block diagram representation – Steady state response.

**UNIT-IV: Load Frequency Control-II**

Block diagram development of Load Frequency Control of two area system uncontrolled case and controlled case. Tie-line bias control. Load Frequency Control and Economic dispatch control.

**UNIT-V: Reactive Power Control**

Overview of Reactive Power control – Reactive Power compensation in transmission systems Advantages and disadvantages of different types of compensating equipment for transmission systems – Load compensation – Specifications of load compensator – Uncompensated and compensated transmission lines: Shunt and series compensation – Need for FACTS controllers.

**Text Books:**

1. Electric Energy systems Theory – by O.I.Elgerd, Tata McGraw–hill Publishing Company Ltd., Second edition.
2. Modern Power System Analysis – by I.J.Nagrath&D.P.Kothari Tata McGraw Hill Publishing Company Ltd, 2nd edition.

**Reference Books:**

1. Power System Analysis and Design by J.Duncan Glover and M.S.Sarma., Thompson, 3rdEdition.
2. Power System Analysis by Grainger and Stevenson, Tata McGraw Hill.
3. Power System Analysis by HadiSaadat – TMH Edition.
4. Power System stability & control, PrabhaKundur,TMH

**Web Resources:**

1. www.learnerstv.com/Free-Engineering
2. www.engr.usask.ca/departments/ee
3. www.elearning.vtu.ac.in/Programme12/E-Notes/PSOC/MSR.pdf

| IV B.TECH I-SEMESTER | L | T | P | INTERNAL MARKS | EXTERNAL MARKS | TOTAL MARKS | CREDITS |
|---|---|---|---|---|---|---|---|
| | 3 | - | - | 40 | 60 | 100 | 3 |
| 19BEE7PE04 | HVDC TRANSMISSION (Professional Elective-III) | | | | | | |

**Course Objectives:**

1. To impart the basic concepts of HVDC Transmission.
2. To study the converter configuration.
3. To explain the control of converter and HVDC Transmission.
4. To teach the significance of reactive power control and AC/DC load flow.
5. To study different converter faults, protection and effect of harmonics & low pass and high pass filters.

**Course Outcomes:**

After completion of this course Students will be able to

1. compare the different types of HVDC levels and basic concepts.
2. analyze the operation of different types of converters.
3. analyze the control concept of reactive power control and AC/DC load flow.
4. test the converter faults, protection and harmonic effects and design low pass and high pass filters.

**UNIT-I: Basic Concepts**

Economics & Terminal equipment of HVDC transmission systems: Types of HVDC Links - Apparatus required for HVDC Systems - Comparison of AC &DC Transmission - Application of DC Transmission System - Planning & Modern trends in D.C. Transmission.

**UNIT-II: Analysis of HVDC Converters**

Choice of converter configuration – Analysis of Graetz – Characteristics of 6 pulse & 12 pulse Converters – Cases of two 3 phase converters in star – Star mode – their performance.

**UNIT-III: Converter & HVDC System Control**

Principal of DC Link Control – Converters Control Characteristics – Firing angle control – Current and extinction angle control – Effect of source inductance on the system - Starting and stopping of DC link - Power Control.

**UNIT-IV: Reactive Power Control in HVDC**

Reactive Power Requirements in steady state-Conventional control strategies - Alternate control strategies sources of reactive power - AC Filters – shunt capacitors-synchronous condensers - Power Flow Analysis in AC/DC Systems Modelling of DC Links - DC Network - DC Converter - Controller Equations - Solution of DC load flow.

**UNIT-V: Converter Fault & Protection**

Converter faults – Protection against over current and over voltage in converter station – Surge arresters – Smoothing reactors – DC breakers – Audible noise-space charge field - Corona effects on DC lines - Radio interference - Generation of Harmonics - Characteristics of harmonics - Calculation of AC Harmonics - Non - Characteristics harmonics - Adverse effects of harmonics - Filters - Types of AC filters - Design of Single tuned filters – Design of High pass filters.

**Text Books:**

1. HVDC Power Transmission Systems: Technology and system Interactions – by
2. K.R. Padiyar, New Age International (P) Limited, and Publishers.
3. HVDC Transmission by S. Kamakshaiah and V. Kamaraju-Tata McGraw–Hill.

**Reference Books:**

1. HVDC Transmission – J. Arrillaga, by the Institution of Engineering Technology.
2. Direct Current Transmission – by E.W. Kimbark, John Wiley & Sons.
3. Power Transmission by Direct Current – by E. Uhlmann, B.S. Publications

| IV B.TECH I-SEMESTER | L | T | P | INTERNAL MARKS | EXTERNAL MARKS | TOTAL MARKS | CREDITS |
|---|---|---|---|---|---|---|---|
| | 3 | - | - | 40 | 60 | 100 | 3 |
| 19BEE7PE05 | POWER SYSTEM STABILITY (Professional Elective-III) | | | | | | |

**Course Objectives:**

1. To distinguish between the different types of power system stability studies
2. To impart knowledge on modeling of a synchronous machine for stability analysis
3. To understand the concept of small signal stability
4. To study the various solution methodologies for transient stability analysis
5. To analyse the voltage stability assessment methods

**Course Outcomes:**

After completion of this course Students will be able to

1. analyze the different types of stability in power systems.
2. examine the modelling of synchronous machine
3. analyze the significance about small signal stability analysis and its enhancement.
4. employ the various methods to enhance transient stability & the significance of voltage stability analysis.

**UNIT-1: Introduction to Power System Stability**

Basic concepts and definitions - Classification of stability - Rotor angle stability - Voltage stability and Voltage collapse - Distinction between mid-term and long-term stability - Nature of system response during severe upsets - Blackouts around the world – Ill effects of instability.

**UNIT-II: Synchronous Machine Representation in Stability Studies**

Need for reduced order models – stability of interconnected systems - Simplifications essential for large scale studies – Simplified model with amortisseurs neglected – Constant flux linkage model – Reactive capability limits.

**UNIT-III: Small Signal Stability**

State space representation – Eigen values - Modal matrices - Small signal stability of single machine infinite bus system – Effect of field circuit dynamics - Effect of excitation system - Small signal stability of multi machine system - Small signal stability enhancement methods.

**UNIT-IV: Transient Stability Analysis**

Distinction between transient and dynamic stability - An elementary view of the transient stability problem - Factors influencing transient stability - Review of numerical integration methods -Modified Euler's method and 4th order Runge-Kutta method - Transient stability enhancement methods – High speed fault clearing – Steam turbine fast valving - High speed excitation systems.

**UNIT-V: Voltage Stability Analysis**

Difficulties with reactive power transmission – Steady state stability analysis of two bus system using PV and QV curves – Voltage stability assessment using indices – Determination 30 of weakest bus or weakest bus ordering vector – Large disturbance analysis – Phase balancing and power factor correction of unsymmetrical loads.

**Text Books:**

1. KundurP, “Power System Stability and Control”, McGraw Hill Education, 2006.
2. Taylor C W, “Power System Voltage Stability”, McGraw Hill, Inc., 1994.
3. Miller T.J.E, “Reactive power control in electric systems”, Wiley India, 2010.

**Reference Books:**

1. Anderson P.N, Fouad, A.A, “Power system control and stability”, Wiley India, 2008.
2. Sauer P W and Pai M A, “Power System Dynamics and Stability”, Pearson, 2003.

| IV B.TECH I-SEMESTER | L | T | P | INTERNAL MARKS | EXTERNAL MARKS | TOTAL MARKS | CREDITS |
|---|---|---|---|---|---|---|---|
| | 3 | - | - | 40 | 60 | 100 | 3 |
| 19BEE7PE06 | DIGITAL CONTROL SYSTEMS (Professional Elective-III) | | | | | | |

**Course Objectives:**

1. To understand the concepts of digital control systems and assemble various components associated with it. Advantages compared to the analogue type.
2. The theory of z–transformations and application for the mathematical analysis of digital control systems.
3. To examine the stability of the system using different tests.
4. To examine the controllability and observability of the system.
5. To study the design of state feedback control by "the pole placement method."

**Course Outcomes:**

After completion of this course students will be able to

1. Convert a continuous-time system into a discrete-time system (frequency and time domain techniques)
2. Compute the z-transform of elementary signals and difference equations
3. Determine the stability of a closed-loop system (both continuous time and discrete time systems)
4. Determine the Controllability and Observability of a closed-loop system (discrete time systems)
5. Apply full-state feedback to achieve acceptable closed-loop behavior for discrete-time systems

**UNIT-1: Sampling and Reconstruction**

Introduction - Examples of Data control systems – Digital to Analogue conversion and analogue to Digital conversion - sample and hold operations.

**UNIT-II: The Z – Transforms**

Introduction - Linear difference equations - Pulse response - Z – transforms - Theorems of Z – Transforms - the inverse Z – Transforms - Modified Z- Transforms Z-Transform method for solving difference equations; Pulse transforms function - Block diagram analysis of sampled – Data systems - Mapping between s-plane and z-plane.

**UNIT-III: Stability Analysis**

Mapping between the S-Plane and the Z-Plane – Primary strips and Complementary Strips – Constant frequency loci - Constant damping ratio loci - Stability Analysis of closed loop systems in the Z-Plane – Jury stablility test – Stability Analysis by use of the Bilinear Transformation and Routh Stability - Criterion.

**UNIT-IV: Controllability and Observability**

Concepts of Controllability and Observability - Tests for controllability and Observability - Duality between Controllability and Observability - Controllability and Observability conditions for Pulse Transfer Function.

**UNIT-V: State Feedback Controllers and Observers**

Design of state feedback controller through pole placement – Necessary and sufficient conditions, Ackerman's formula. State Observers – Full order and Reduced order observers.

**Text Books:**

1. Discrete-Time Control systems – K. Ogata, Pearson Education/PHI, 2nd Edition. REFERENCE BOOKS:
2. Digital Control Systems, Kuo, Oxford University Press, 2nd Edition, 2003.
3. Digital Control and State Variable Methods by M.Gopal, TMH.

**Reference Books:**

1. 'Digital Control and State Variable Methods'M.Gopal, ', Tata McGraw Hill, 3rd Edition, 2009.
2. Digital Control Systems C.M. Houpis, G.B.Lamount, - Theory, Hardware, Software', International Student Edition, McGraw Hill Book Co., 1985.
3. Digital Control, Kannan M.Moddgalya, Wiley India, 2007.
4. "Feedback Control System, C.L.Philips and J.M.Pan, "Feedback Control System, Pearson.

| III B.TECH II-SEMESTER | L | T | P | INTERNAL MARKS | EXTERNAL MARKS | TOTAL MARKS | CREDITS |
|---|---|---|---|---|---|---|---|
| | 3 | - | - | 40 | 60 | 100 | 3 |
| 19BEE7PE07 | ELECTRICAL AND HYBRID VEHICLES (Professional Elective-III) | | | | | | |

**Course Objectives:**

1. To familiarize working of different configurations of electric vehicles.
2. To explain the properties of batteries and its types.
3. To familiarize the Engine rating, Requirements of Dc & Ac Electrical Machines.
4. To impart the knowledge about electric vehicle drive systems.
5. To familiarize hybrid electric vehicles.

**Course Outcomes:**

After completion of this course Students will be able to

1. Analyse the behaviour of an electrical vehicles.
2. Measure the performance quantities such as Capacity, and Properties of Batteries.
3. Know the different ratings of DC and AC Electrical Machines.
4. Classify the importance of components of Electric Vehicle Drive Train.
5. Classify the different types of HEV.

**UNIT–I: Electric Vehicles**

Introduction – Components - Vehicle mechanics – Roadway fundamentals - Vehicle kinetics, - Dynamics of vehicle motion - Propulsion System Design.

**UNIT–II: Battery**

Basics – Types, Parameters – Capacity - Discharge rate - State of charge - state of Discharge - Depth of Discharge - Technical characteristics - Battery pack Design - Properties of Batteries.

**UNIT–III: Dc & Ac Electrical Machines**

Motor and Engine rating – Requirements - DC machines - Three phase A/c machines - Induction machines - Permanent magnet machines - Switched reluctance machines.

**UNIT IV: Electric Vehicle Drive Train**

Transmission configuration-Components- Gears-Differential-Clutch-Brakes regenerative Braking - Motor sizing.

**UNIT–V: Hybrid Electric Vehicles**

Types – series - Parallel and series - Parallel configuration – Design – Drive train - Sizing of components.

**Text Books:**

1. Iqbal Hussain, “Electric & Hybrid Vehicles – Design Fundamentals”, Second Edition, CRC Press, 2011.
2. James Larminie, “Electric Vehicle Technology Explained”, John Wiley & Sons, 2003.

**Reference Books:**

1. Mehrdad Ehsani, Yimin Gao, Ali Emadi, “Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals”, CRC Press, 2010.
2. Sandeep Dhameja, “Electric Vehicle Battery Systems”, Newnes, 2000.

**Web References:**

1. http://nptel.ac.in/courses/108103009/.

| IV B.TECH I-SEMESTER | L | T | P | INTERNAL MARKS | EXTERNAL MARKS | TOTAL MARKS | CREDITS |
|---|---|---|---|---|---|---|---|
| | 3 | - | - | 40 | 60 | 100 | 3 |
| 19BEE7PE08 | POWER QUALITY (Professional Elective-IV) | | | | | | |

**Course Objectives:**

1. To explain the fundamentals of power quality problems.
2. To teach the various causes which create the distortion in the power supply.
3. To impart the knowledge on mitigation and power quality standards.
4. To study about introduction to power quality measurement devices.
5. To explain power quality issues in distributed generation.

**Course Outcomes:**

After completion of this course students will be able to

1. Analyze the power quality problem in power system.
2. Analyze the harmonic distortion due to commercial and industrial loads.
3. Identify suitable device for power quality measurements.
4. Perceive the mitigation techniques for power quality issues.
5. Apply skills in design of various custom power devices.

**UNIT-I: Fundamentals of Power Quality**

Definition of Power Quality - Classification of Power Quality Issues - Power Quality Standards - Categories and Characteristics of Electromagnetic Phenomena in Power Systems: Impulsive and Oscillatory Transients – Interruption – Sag – Swell - Sustained Interruption - Under Voltage - Over Voltage and Outage - Sources and causes of different Power Quality Disturbances.

**UNIT-II: Harmonics and Applied Harmonics**

Harmonic Distortion - Voltage vs. Current Distortion - Harmonics Vs. Transients - Power System Qualities under Non-Sinusoidal Conditions - Harmonic Indices - Harmonic Sources from Commercial Loads, Harmonic Sources from Industrial Loads - Applied Harmonics: Effects of Harmonics - harmonic distortion evaluations - Principles of controlling harmonics and devices for controlling harmonic distortion.

**UNIT-III: Voltage Regulation using Conventional Methods**

Principles of regulating the voltage - Devices for voltage regulation: utility step voltage regulators - Ferro-resonant transformers - Magnetic synthesizers - On-line UPS systems - Motor-generator sets - Static VAR compensators - Shunt capacitors and series capacitors.

**UNIT-IV: Power Quality Enhancement using Custom Power Devices**

Introduction to Custom Power Devices - Network Reconfiguring Type: Solid State Current Limiter (SSCL) - Solid State Breaker (SSB) – Solid State Transfer Switch (SSTS) - Compensating Type: Dynamic Voltage Restorer - Distribution STATCOM and Unified Power Quality Conditioner – operation - Realization and control of DVR, DSTATCOM and UPQC – load compensation. Power quality monitoring – Power quality monitoring standards.

**UNIT-V: Power Quality issues In Distributed Generation**

DG Technologies - Perspectives on DG benefits - Interface to the Utility System - power quality issues affected by DG - Operating Conflicts: Utility fault clearing - Reclosing - Interference with relaying - Voltage regulation issues - Islanding - siting DG.

**Text Books:**

1. Roger C. Dugan, Mark E. Mc. Granaghan, Surya Santosoh and H. WayneBeaty, Electrical Power Systems Quality, 2nd edition, TATA McGraw Hill,2010.
2. ArindamGhosh, Gerard Ledwich, Power Quality Enhancement Using CustomPower Devices, Springer, 2002.

**Reference Books:**

1. Math H J Bollen, "Understanding Power Quality Problems" IEEE Press, 1998.
2. C.Sankaran, Power Quality, CRC press, 2000.

**Web References:**

1. https://www.captech.com.au/what-is-power-quality/.
2. https://www.cet.edu.in/noticefiles/227_Electrical_Power_Quality-PEEL5403-8th_Sem- Electrical.pdf.

| IV B.TECH I-SEMESTER | L | T | P | INTERNAL MARKS | EXTERNAL MARKS | TOTAL MARKS | CREDITS |
|---|---|---|---|---|---|---|---|
| | 3 | - | - | 40 | 60 | 100 | 3 |
| 19BEE7PE09 | RENEWABLE AND DISTRIBUTED ENERGY SYSTEMS (Professional Elective-IV) | | | | | | |

**Course Objectives:**

1. To study the solar radiation data and radiation on earth‟s surface and solar pond.
2. To study wind energy conversion and Bio-mass.
3. To study basic principle and working of Geothermal, Tidal MHD Generators.
4. To study distributed generation and micro grid

**Course Outcomes:**

After completion of this course, Students will be able to

1. Illustrate the significance of renewable energy
2. Analyse the principles of wind energy and Biomass
3. Distinguish the principles of Geothermal, Ocean, Tidal and Wave energy.
4. Dissect the principles of MHD power generation.
5. Outline the Distributed Generation and Micro grid

**UNIT – I: Principles of Solar Radiation**

Introduction to Energy Sources and their availability- renewable sources-The solar constant-Solar Radiation at the Earth's surface- solar radiation Geometry- instruments for measuring solar radiation and sun shine- solar radiation data- solar radiation on titled surfaces-Solar Pond and its Applications- Photovoltaic energy conversion.

**UNIT – II: Wind Energy and Bio-Mass**

Principles of wind energy conversion, Components of WECS- horizontal and vertical axis windmills- performance characteristics. Bio fuels- Methods for obtaining energy from Biomass- Thermal gasification of Biomass.

**UNIT – III: Geothermal Energy, Ocean Energy, Tidal and Wave Energy**

Introduction of Geothermal Energy- Nature of Geothermal fields- Geothermal Sources-Potential of Geothermal resources in India- OTEC- Methods of ocean thermal electric power generation- Open cycle and closed cycle- Principle of Tidal power- Components of Tidal power plants- Advantages and Disadvantages of Wave energy- Energy and power from the Waves.

**UNIT – IV: MHD Power Generation**

Introduction- Principle of MHD power generation- MHD Systems- Open cycle and closed cycle Systems- Advantages of MHD Systems- International Status of MHD power generation and its future prospects.

**UNIT-V: Distributed Generation**

Distributed generation – Introduction - Integration of distributed generation to Grid – Concepts of Micro Grid - Typical Microgrid configurations - AC and DC micro grids - Interconnection of Microgrids - Technical and economical advantages of Microgrid -Challenges and disadvantages of Microgrid development.

**Text Books:**

1. G.D. Rai, “Non-Conventional Energy Sources”, Dhanpat Rai and Sons
2. Tiwari and Ghosal, “Renewable energy resources”,Narosa.

**Reference Books:**

1. Twidell& Weir, “Renewable Energy Sources“
2. Sukhatme, “Solar Energy”, Tata McGraw-HillEducation.
3. B.S Magal Frank Kreith& J.F Kreith, “Solar Power Engineering“
4. S. Chowdhury, S.P. Chowdhury and P. Crossley, Microgrids and Active Distribution Networks, ISBN 978-1-84919-014-5, IET, 2009

| IV B.TECH I-SEMESTER | L | T | P | INTERNAL MARKS | EXTERNAL MARKS | TOTAL MARKS | CREDITS |
|---|---|---|---|---|---|---|---|
| | 3 | - | - | 40 | 60 | 100 | 3 |
| 19BEE7PE09 | EMBEDDED SYSTEMS (Professional Elective-IV) | | | | | | |

**Course Objectives:**

1. To gain knowledge on fundamental concepts, Firmware and Hardware components of embedded system.
2. To learn about different communication interfaces, characteristics and quality attributes of embedded system.
3. To understand the concepts of operating systems and embedded development tools.

**Course Outcomes:**

After completion of the course, the student will be able to

1. Illustrate the classification and Characteristics of embedded systems.
2. Recall the basic passive components and core of embedded systems.
3. Summarize various Communication interface in Embedded Systems.
4. Explain the RTOS basics and various Communication &Synchronization techniques.
5. Interpret the IDE and utility tools required to design embedded systems.

**UNIT–I: Introduction**

What is an embedded system? Embedded Systems vs. general computing systems, history of embedded systems, classification of embedded systems, major application areas of embedded systems, purpose of embedded systems. Characteristics, Quality Attributes and Examples of Embedded Systems.

**UNIT–II: Typical Embedded System**

Core of the embedded system: general purpose and domain specific processors, ASICs, PLDs, Commercial Off-The-Shelf Components (COTS).Communication Interface: onboard and external Communication Interfaces

**UNIT–III: Embedded Hardware Design**

Analog and Digital electronic Components, I/O types,reset circuit, brown-out protection circuit, oscillator unit, Real Time Clock (RTC), watchdog timer, PCB and passive components.

**UNIT–IV: Embedded Firmware Design**

Embedded firmware design approaches, embedded firmware development languages, ISR concept, Interrupt sources, ISR mechanism, Multiple Interrupts, DMA, Device driver programming, Concept of Embedded C language.

**UNIT–V: Embedded System Development**

The integrated development Environment, types of files generated by compilers, Deassembler / Decompiler, Simulator, Emulators and Debugging tools, Target hardware debugging, Software utility tools, Laboratory tools.

**Text Books:**

1. Shibu K.V, “Introduction to Embedded Systems”, McGraw Hill Education, 2013.
2. Raj Kamal, “Embedded Systems”, TMH.
3. Labrosse “Embedded Systems building blocks” CMP publishers

**Reference Books:**

4. Frank Vahid, Tony Givargis,”Embedded System Design”, John Wiley.
5. Lyla, “Embedded Systems”, Pearson, 2013
6. David E. Simon, “An Embedded Software Primer”, Pearson Education.

| IV B.TECH I-SEMESTER | L | T | P | INTERNAL MARKS | EXTERNAL MARKS | TOTAL MARKS | CREDITS |
|---|---|---|---|---|---|---|---|
| | 3 | - | - | 40 | 60 | 100 | 3 |
| 19BEE7PE11 | QUALITY MANAGEMENT (Professional Elective-IV) | | | | | | |

**Course Objectives:**

1. To enable the student about quality management and modern concepts.
2. To understand various tools and techniques of manufacturing and control of a product, quality in sales and services.
3. To enrich the students in the areas of designing and fitting of different types of products.
4. To train the students in optimizing the quality cost and taking corrective measures.
5. To enlighten the student about control charts, quality circles and ISO standards.

**Course Outcome:**

After completion of the course, the student will be able to

1. Outline the basic concepts of Quality and its importance in survival of the organization. [K2]
2. Procure the verities of materials by evaluation of suppliers. [K5]
3. Design the suitable organizational structure to fit the company vision. [K6]
4. Justify quality levels with the use of control charts. [K5]
5. Apply the International standards by identifying defects in their products. [K3]

**UNIT-I: Quality Concepts**

Evolution of Quality Control, concept change, TQM Modern concept, Quality concept in design, Review of design, Evolution of proto type.

**UNIT-II: Control on Purchased Product**

Procurement of various products, evaluation of supplies, capacity verification, Development of sources, procurement procedure. MANUFACTURING QUALITY: Methods and techniques for manufacture, inspection and control of product, quality in sales and services, guarantee, analysis of claims.

**UNIT-III: Quality Management**

Organization structure and design, quality function, decentralization, designing and fitting, organization for different type products and company, economics of quality value and contribution, quality cost, optimizing quality cost, seduction program. Quality policy of top management, cooperation of groups, operators attitude, responsibility, causes of apparatus error and corrective methods.

**UNIT-IV: Control Charts**

Theory of control charts, measurement range, construction and analysis of control charts for Variables and Attributes, process capability study, uses of control charts.

**UNIT –V: ISO Standardization**

Defects diagnosis and prevention defect study, identification and analysis of defects, correcting measure, factors affecting reliability, calculation of reliability, building reliability in the product, evaluation of reliability, interpretation of test results, reliability control, maintainability, zero defects, quality circle- ISO-9000 and its concept of Quality Management ISO 9000 series, Taguchi method, JIT in some details.

**Text Books:**

1. Lt. Gen. H. Lal, “Total Quality Management”, Eastern Limited, 1990.
2. Greg Bounds, “Beyond Total Quality Management”, McGraw Hill, 1994.

**Reference Books:**

1. Menon, H.G, “TQM in New Product manufacturing”, McGraw Hill 1992.

| IV B.TECH I-SEMESTER | L | T | P | INTERNAL MARKS | EXTERNAL MARKS | TOTAL MARKS | CREDITS |
|---|---|---|---|---|---|---|---|
| | 3 | - | - | 40 | 60 | 100 | 3 |
| 19BEE7PE11 | BUSINESS MANAGEMENT CONCEPTS FOR ENGINEERS (Professional Elective-IV) | | | | | | |

**Course Objective:**

1. To provide an insight into the various economic concepts which are necessary for taking decisions related to economic aspects of the organization.
2. To provide familiarity with the accounting concepts which will help in preparation of various accounting records
3. To equip the student with the basic management concepts and functions and to provide knowledge relating to recruitment, selection, training, and motivation of employees in the organization

**Course Outcomes:**

After completion of the course, the student will be able to

1. Summarize fundamentals of Managerial economics for decision making (K2).
2. Apply concepts of Financial Accounting and BEP for business decisions (K3).
3. Evaluate fundamental concepts and principles of management (K5).
4. Discuss functional areas of management like HR, marketing and finance (K6).
5. Apply project management techniques for project planning and evaluation (K3).

**Unit-I: Introduction To Managerial Economics**

Definitions, - Nature And Scope- Relation With Other Subjects- Demand Definition- Determinants- Law of Demand and Its Exceptions- Concept of Elasticity of Demand- Cost Concepts- CVP Analysis (With Simple Problems), Significance- Limitations.

**Unit-II: Market structures and financial accounting**

Introduction to Markets – Features of various markets-Perfect competition, Monopoly and Oligopoly. Definition – Importance, limitations and basic books of financial accounting, Preparation of basic books of accounting: journal, ledger and trail balance.

**Unit-III: Introduction to Management**

Concept, Nature, Importance- Functions of Management- Henry Fayols Principles of Management- F.W.Taylors Scientific Management- Douglas Mc Gregors Theory X and Y.

**Unit-IV: Functional Areas of Management**

Concept of HRM, Functions of HR Manager- Marketing Management- Functions of Marketing Manager- Production Management-Functions of Production Management – Financial Management and functions of Financial Management.

**Unit-V: Project Management: (PERT/CPM)**

Development of Network – Difference between PERT and CPM- Problems on Critical Path- Problems on PERT Analysis.

**Text books**

1. Dr. N. APPARAO Dr. P. Vijay Kumar: "Managerial economics and financial analysis" Cengage publication's, New Delhi-2011.
2. Dr. A. R. Aryasri- Managerial Economics and Financial Analysis, TMH2011.
3. V. Maheswari: Managerial Economies, Sultan Chand.
4. Suma Damodaran: Managerial Economics, Oxford 2011.
5. Koontz & Weihrich: Essentials of Management" TMH 2011.

**References Books:**

1. Managerial economics theory & applications, DM Mithani, Himalaya Publishing House, 2013.
2. Accounting For Managers, G. Prasad, Jaibharath Publishers, 2016.
3. Dr. P. Vijaya Kumar & Dr. N. Appa Rao," Management Science" cengage. Delhi, 2012.
4. Project Planning & Control with PERT & CPM, BC Punmia & KK Khandelwal, Lakshmi Publications, New Delhi, 4th Edition – 2016. - Unit-6

| IV B.TECH I-SEMESTER | L | T | P | INTERNAL MARKS | EXTERNAL MARKS | TOTAL MARKS | CREDITS |
|---|---|---|---|---|---|---|---|
| | - | - | 3 | 20 | 30 | 50 | 1.5 |
| 19BEE7LB01 | POWER SYSTEMS & SIMULATION LAB | | | | | | |

**Course Objectives:**

1. To allow students to practically verify several concepts and procedures learned in power system modeling and analysis.
2. To develop hands-on experience of how certain procedures of power system operation are carried out.
3. To carry out system studies using state of the art power systems analysis software to assess system operation in steady state and under faulted conditions.
4. To promote teamwork among students and effective communication skills.

**Course Outcomes:**

After completion of this course students will be able to

1. Understand how to measure electrical parameters characteristics of a 3-phase transmission line.
2. Ability to simulate Rectifier, Chopper, Inverter and AC Voltage Controller.
3. Calculate the Load flow solution of power system by iterative methods
4. Analyse single area load frequency control.

**List of Experiments**

**Any 10 of the following experiments are to be conducted**

1. Calibration of Tong Tester.
2. Determination of Transmission Line Parameters
3. Sequence of Impedance of 3-Φ Transformer.
4. Simulation of single - Phase full converter using RLE loads.
5. Simulation of single - Phase Inverter with PWM control.
6. Economic Load Dispatch with and without Losses.
7. Single Area Load frequency Control without and with PI Controller.
8. Load Flow solution by using Gauss-Seidel Method.
9. Solution to Swing Equation using Point-by-Point Method.
10. Simulation of single phase AC voltage controller using RLE loads.
11. Simulation of Buck chopper.
12. Simulation of Op-Amp based Integrator & Differentiator circuits.

**IV B.TECH. – II SEMESTER**

| S.No. | Subject Code | Subject | Cat. Code | Internal Marks | External Marks | Total Marks | L | T | P | Credits |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 19BEE8TH01 | Utilization of Electrical Energy | PC | 40 | 60 | 100 | 3 | - | - | 3 |
| 2 | 19BEE8PE02 | Professional Elective-V a. Electrical Distribution Systems | PE | 40 | 60 | 100 | 3 | - | - | 3 |
| | 19BEE8PE03 | b.Smart Grids | | | | | | | | |
| | 19BEE8PE04 | c. PLC and Automation | | | | | | | | |
| | 19BEE8PE05 | d.Energy Storage Technology | | | | | | | | |
| 3 | 19BEE8PW | Project Work | PR | 80 | 120 | 200 | - | - | - | 7 |
| | | **Total** | | **160** | **240** | **400** | **6** | **-** | **-** | **13** |

| IV B.TECH II-SEMESTER | L | T | P | INTERNAL MARKS | EXTERNAL MARKS | TOTAL MARKS | CREDITS |
|---|---|---|---|---|---|---|---|
| | 3 | - | - | 40 | 60 | 100 | 3 |
| 19BEE8TH01 | UTILIZATION OF ELECTRICAL ENERGY | | | | | | |

**Course Objectives:**

1. To impart knowledge on electric heating for residential, commercial and industrial applications.
2. To impart knowledge on electrical welding methods for residential, commercial and industrial applications.
3. To familiarize with the fundamental laws of illumination, basic principle of light control and various types of lamps.
4. To understand the basic principle of electric traction including speed–time curves of Different traction services.
5. To understand the concepts and calculations of tractive effort and specific energy consumption.

**Course Outcomes:**

After completion of this course students will be able to

1. Distinguish between various types of electrical heating methods.
2. Distinguish between various types of electrical Welding methods.
3. Demonstrate the basic principles illumination and light control for residential, commercial and industrial environments.
4. Analyze various speed time curves of electric traction.
5. Examine and calculate tractive power and specific energy consumption.

**UNIT-I: Electric Heating**

Advantages and methods of electric heating - Principle - Resistance heating-Direct and Indirect resistance heating Methods –Arc furnaces- Requirements of good heating material-Causes of failure of heating elements- Induction heating and its types-Dielectric heating.

**UNIT-II: Electric Welding**

Advantages electrical welding- Principle-Electric Welding types – Resistance welding and its types- Arc welding and its types – Types of electrodes- comparison between A.C. and D.C. Welding- comparison between Resistance and Arc Welding.

**UNIT-III: Illumination**

Introduction to sources of light -Terms used in illumination -Laws of illumination - Basic principles of light control- Types of Lamps: Discharge lamps, MV and SV lamps, tungsten filament lamps and fluorescent tubes - Comparison between tungsten filament lamps and fluorescent tubes.

**UNIT-IV: Electric Traction – I**

Systems 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-V: Electric Traction – II**

Calculations of tractive effort – Power - Specific energy consumption for given run - Effect of varying acceleration and braking retardation - Adhesive weight and braking retardation adhesive weight and coefficient of adhesion.

**Text Books:**

1. Utilization of Electric Energy – by E. Openshaw Taylor, Orient Longman.
2. Utilization of Electrical Energy – by G.C.GargKhanna Publications.
3. Art & Science of Utilization of electrical Energy – by Partab, DhanpatRai& Sons.

**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.

| IV B.TECH II-SEMESTER | L | T | P | INTERNAL MARKS | EXTERNAL MARKS | TOTAL MARKS | CREDITS |
|---|---|---|---|---|---|---|---|
| | 3 | - | - | 40 | 60 | 100 | 3 |
| 19BEE8PE02 | ELECTRICAL DISTRIBUTION SYSTEMS (Professional Elective-V) | | | | | | |

**Course Objectives:**

1. To study different factors of Distribution system and the substations design.
2. To study the concepts of voltage drop and power loss.
3. To study the distribution system protection and its coordination.
4. To study the effect of compensation for power factor improvement & effect of voltage control on distribution system.

**Course Outcomes:**

After completion of this course students will be able to

1. Differentiate the types of loads and their characteristics
2. Design a radial and loop type distribution feeders.
3. Calculate the voltage drop and power loss in a distribution system.
4. Identify and design protection system
5. Identify the best methods for pf improvement and voltage control

**UNIT-I: General Concepts**

Introduction to distribution systems, Load modelling and characteristics – Coincidence factor – Contribution factor loss factor – Relationship between the load factor and loss factor – Classification of loads (Residential, commercial, Agricultural and Industrial).

**UNIT-II: Substations**

**Location of substations**: Rating of distribution substation –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.

**UNIT-III: 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 – Numerical problems - Three phase balanced primary lines.

**UNIT-IV: Protection & Coordination**

Protection: Objectives of distribution system protection –Protective devices: Principle of operation of fuses – Circuit reclosures – Line sectionalizes and circuit breakers. Coordination: General coordination procedure –Various types of coordinated operation of protective devices - Residual Current Circuit Breaker.

**UNIT-V: Compensation for Power Factor Improvement& Voltage Control**

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 Effect of series capacitors – Equipment for voltage control – Effect of series capacitors – Effect of AVB/AVR – Line drop compensation – Numerical problems.

**Text Books:**

**1.** "Electric Power Distribution system, Engineering" – by TuranGonen, McGraw–hill Book Company.

**Reference Books:**

1. Electrical Distribution Systems by Dale R.Patrick and Stephen W.Fardo, CRC press
**2.** Electric Power Distribution – by A.S. Pabla, Tata McGraw–hill Publishing Company, 4th edition, 1997. 3. Electrical Power Distribution Systems by V.Kamaraju, Right Publishers.

| IV B.TECH II-SEMESTER | L | T | P | INTERNAL MARKS | EXTERNAL MARKS | TOTAL MARKS | CREDITS |
|---|---|---|---|---|---|---|---|
| | 3 | - | - | 40 | 60 | 100 | 3 |
| 19BEE8PE03 | SMART GRIDS (Professional Elective-V) | | | | | | |

**Course Objectives:**

1. To explain the overview of the technologies required for the smart grid.
2. To impart the knowledge on switching techniques and different communication technologies for data communication.
3. To inculcate security and standards in smart grid.
4. To teach the importance of smart metering and demand side management in smart grid.
5. To explain the energy management and energy storage technologies in smart grid.

**Course Outcomes:**

After completion of this course students will be able to

1. Understand importance of smart grid initiation.
2. Apply the technologies for data communication and follow the appropriate standards.
3. Preserve data and Communication security by adopting encryption and decryption procedures.
4. Utilize the smart metering application and demand side integration.
5. Monitoring, operating, and managing the transmission and distribution tasks under smart grid environment.

**UNIT-I: The Smart Grid**

Introduction - Ageing Assets and Lack of Circuit Capacity - Thermal Constraints - Operational Constraints - Security of Supply - National Initiatives - Early Smart Grid Initiatives - Active Distribution Networks - Virtual Power Plant - Other Initiatives and Demonstrations - Overview of The Technologies Required for The Smart Grid.

**UNIT-II: Communication Technologies**

**Data Communications:** Introduction - Dedicated and Shared Communication Channels - Switching Techniques - Circuit Switching - Message Switching - Packet Switching - Communication Channels - Wired Communication - Optical Fibre - Radio Communication - Cellular Mobile Communication -

**Communication Technologies:** IEEE 802 Series - Mobile Communications - Multi Protocol Label Switching - Power line Communication - Standards for Information Exchange - Standards for Smart Metering - Modbus, DNP3, IEC61850.

**UNIT-III: III Information Security for the Smart Grid**

Introduction - Encryption and Decryption - Symmetric Key Encryption - Public Key Encryption –Authentication - Authentication Based on Shared Secret Key - Authentication Based on Key Distribution Center - Digital Signatures - Secret Key Signature - Public Key Signature - Message Digest - Cyber Security Standards - IEEE 1686: IEEE Standard for Substation Intelligent Electronic Devices(IEDs) Cyber Security Capabilities - IEC 62351: Power Systems Management And Association Information Exchange – Data and Communication Security.

**UNIT-IV: Smart Metering and Demand Side Integration**

Introduction - Smart metering – Evolution of electricity metering - Key components of smart metering, smart meters: an overview of the hardware used – signal acquisition - Signal conditioning - Analogue to digital conversion - Computation - Input/output - Communication. Communication infrastructure and protocols for smart metering- Home area network, Neighbourhood Area Network - Data Concentrator - meter data management system - Protocols for communication. Demand Side Integration- Services Provided by DSI, Implementation of DSI, Hardware Support, Flexibility Delivered by Prosumers from the Demand Side - System Support from DSI.

**UNIT-V: Transmission and Distribution Management Systems**

Data Sources, Energy Management System - Wide Area Applications - Visualization Techniques - Data Sources and Associated External Systems - SCADA, Customer Information System - Distribution System Modelling - Topology Analysis - Load Forecasting - Applications, System Monitoring, Operation, Management - Outage Management System - Energy Storage Technologies, Batteries, Flow Battery - Fuel Cell and Hydrogen Electrolyser - Flywheels, Superconducting Magnetic Energy Storage Systems - Super capacitors.

**Text Books:**

1. Smart Grid, Janaka Ekanayake, Liyanage, Wu, Akihiko Yokoyama, Jenkins, Wiley Publications, 2012, Reprint 2015.
2. Smart Grid: Fundamentals of Design and Analysis, James Momoh, Wiley, IEEE Press., 2012, Reprint 2016.

**Reference Books:**

1. The Smart Grid – Enabling Energy efficiency and demand response, Clark W. Gellings, P.E., CRC Press, Taylor & Francis group, First Indian Reprint. 2015.
2. Smart Grid – Applications, Communications, and Security Edited by Lars Torsten Berger, Krzysztof Iniewski, WILEY, 2012, Reprint 2015.
3. Practical Electrical Network Automation and Communication Systems, Cobus Strauss, ELSVIER, 2003.

| IV B.TECH II-SEMESTER | L | T | P | INTERNAL MARKS | EXTERNAL MARKS | TOTAL MARKS | CREDITS |
|---|---|---|---|---|---|---|---|
| | 3 | - | - | 40 | 60 | 100 | 3 |
| 19BEE8PE04 | PLC AND AUTOMATION (Professional Elective-V) | | | | | | |

**Course Objectives:**

1. To study the basic concepts of programmable logic controllers and its applications.
2. To familiarize the students in programming formats and construction of PLC ladder diagrams.
3. T study the various PLC registers.
4. To Study PLC functions, Data handling functions and controlling of two axes and three axes Robots with PLC.
5. To Study Analog PLC operation and different examples.

**Course Outcomes:**

After completion of this course, Students will be able to

1. Illustrate the basics of PLC & its Programming.
2. Analyze the Characteristics of Registers, module addressing and its importance in Ladder diagram.
3. Select the PLC functions according to the application.
4. Summarize various Industrial applications of PLC.
5. Differentiate the Analog modules and systems, Analog signal processing, multi bit data processing.

**UNIT-I: Basics of PLC & PLC Programming**

PLC system - I/O modules and interfacing – CPU processor - Programming equipment - Programming formats - construction of PLC ladder diagrams -Devices connected to I/O modules - Input instructions – Outputs - Operational procedures - Programming examples using contacts and coils - Ladder diagrams for process control: Ladder diagrams - ladder diagram construction and flow chart for spray process system.

**UNIT-II: PLC Registers**

Characteristics of Registers - module addressing -Holding registers - Input registers - Output registers.

**UNIT-III: PLC Functions**

PLC Functions: Timer functions and Industrial applications – Counters - Counter function industrial applications - Arithmetic functions - Number comparison functions -Number conversion functions.

**UNIT-IV: Data Handling Functions**

Data handling functions: SKIP - Master control Relay - Jump, Move, FIFO, FAL, ONS, CLR and Sweep functions and their applications. Bit Pattern and changing a bit shift register - Sequence functions and applications - Controlling of two axes and three axis Robots with PLC - Matrix function.

**UNIT-V: Analogue PLC Operation**

Analog modules and systems - Analog signal processing, multi bit data processing - Analog output application examples - PID principles - Position indicator with PID control - PID modules - PID tuning - PID functions.

**Text Books:**

1. Programmable Logic Controllers – Principle and Applications by John W. Webb and Ronald A. Reiss, Fifth Edition, PHI.
2. Programmable Logic Controllers – Programming Method and Applications by JR. Hackworth and F.D Hackworth Jr. – Pearson, 2004.

**Reference Books:**

1. Programmable Logic Controllers Hardware and Programming by Max Rabiee Goodheart- Wilcox.
2. Programmable Logic Controllers by Frank D. Petuzeela McGraw-Hill.
3. Industrial Automation and Process control by Jon Stenerson Prentice-Hall.

| IV B.TECH II-SEMESTER | L | T | P | INTERNAL MARKS | EXTERNAL MARKS | TOTAL MARKS | CREDITS |
|---|---|---|---|---|---|---|---|
| | 3 | - | - | 40 | 60 | 100 | 3 |
| 19BEE8PE05 | ENERGY STORAGE TECHNOLOGY (Professional Elective-V) | | | | | | |

**Course Objectives:**

1. To provides an overview of the fundamental operating principles of batteries and ultra-capacitors from the perspective of automotive applications.
2. To study details of various energy storage systems along with applications
3. Enabling to identify the optimal solutions to a particular energy storage application/utility

**Course Outcomes:**

After completion of this course students will be able to

1. analyse the basic components of a battery and the fundamental principles governing its operation.
2. analyse the various types of energy transformations.
3. Discriminate the factors that control battery performance and the primary mechanisms responsible for performance degradation.
4. compare different types of energy generation methods.

**UNIT-I: Storage: Historical Perspective, Introduction and Changes**

Storage Needs- Variations in Energy Demand- Variations in Energy Supply-Interruptions in Energy Supply- Transmission Congestion - Demand for Portable Energy - Demand and scale requirements - Environmental and sustainability issues.

**UNIT-II: Technical Methods of Storage**

Introduction: Energy and Energy Transformations - Potential energy (pumped hydro, compressed air, springs) - Kinetic energy (mechanical flywheels) - Thermal energy without phase change passive (adobe) and active (water) -Thermal energy with phase change (ice, molten salts, steam) - Chemical energy (hydrogen, methane, gasoline, coal, oil)- Electrochemical energy (batteries, fuel cells) - Electrostatic energy (capacitors), Electromagnetic energy (superconducting magnets) - Different Types of Energy Storage Systems.

**UNIT-III: Performance Factors of Energy Storage Systems**

Energy capture rate and efficiency - Discharge rate and efficiency - Dispatch ability and load flow characteristics - Scale flexibility, durability – Cycle lifetime, mass and safety – Risks of fire, explosion, toxicity - Ease of materials recycling and recovery - Environmental consideration and recycling - Merits and demerits of different types of Storage.

**UNIT-IV: Hydrogen Fuel Cells and Hybrid Energy**

Hydrogen Economy - Generation Techniques - Storage of Hydrogen - Hybrid Energy generation. Applications: Storage for Hybrid Electric Vehicles - Regenerative Power and capturing methods.

**UNIT-V: Flow Batteries and Super Capacitors**

Flow battery operation - Super Capacitors: power calculation - Operation and design.

**Text Books:**

1. Detlef Stolten, "Hydrogen and Fuel Cells: Fundamentals, Technologies and Applications", Wiley, 2010.
2. Jiujun Zhang, LeiZhang, Hansan Liu, Andy Sun, Ru-Shi Liu, "Electrochemical Technologies for Energy Storage and Conversion", John Wiley and Sons, 2010.
3. Francois Beguin and Elzbieta Frackowiak, "Super capacitors", Wiley, 2013.

**Reference Books:**

1. A.G.Ter-Gazarian, "Energy Storage for Power Systems", Second Edition, The Institution of Engineering and Technology (IET) Publication, UK, (ISBN - 978-1-84919-219-4), 2011.
2. A. R. Pendse, "Energy Storage Science and Technology", SBS Publishers & Distributors Pvt. Ltd., New Delhi, (ISBN - 13:9789380090122), 2011.

| II B.TECH II SEMESTER | L | T | P | INTERNAL MARKS | EXTERNAL MARKS | TOTAL MARKS | CREDITS |
|---|---|---|---|---|---|---|---|
| | 3 | 0 | 0 | 40 | 60 | 100 | 3 |
| 19BEE4OE03 | MICRO ELECTRO MECHANICAL SYSTEM (Open Elective-1) | | | | | | |

**Course Objectives:**

1. To provide knowledge of Micro Electro Mechanical Systems (MEMS).
2. To impart various sensors and actuators used in MEMS.
3. To educate the principle and various devices of MOEMS, Fluidic.
4. To educate the concepts of bio and chemical systems and devices.

**Course Outcomes:**

After completion of this course, Students will be able to

1. Apply thermal sensors and actuators for MEMS fabrication process.
2. Model various devices of MOEMS, Micro Fluidic systems.
3. Utilize the magnetic sensors and actuators in interdisciplinary studies
4. Explain the micro fluidic systems process.
5. Interpret the various sensor mechanism in chemical and bio-medical system.

**UNIT-I: Introduction & Thermal Sensors and Actuators**

Definition of MEMS, MEMS history and development, micro machining, Principles of sensing and actuation: piezo electric, strain, pressure, flow, MEMS gyroscopes, Thermal energy basics and heat transfer processes, thermo devices, thermal flow sensors, micro hot plate gas sensors, micro spring thermal actuator, data storage cantilever.

**UNIT-II: Micro-Opto-Electro Mechanical Systems**

Principle of MOEMS technology, properties of light, light modulators, beam splitter, micro lens, micro mirrors, digital micro mirror device (DMD), light detectors, grating light valve (GLV), optical switch, wave guide and tuning, shear stress measurement.

**UNIT-III Magnetic Sensors and Actuators**

Magnetic materials for MEMS and properties, magnetic sensing and detection, magneto resistive sensor, more on Hall Effect, MEMS magnetic sensor, pressure sensor utilizing MOKE, mag MEMS actuators, bidirectional micro actuator, and feedback circuit integrated magnetic actuator.

**UNIT-IV: Micro Fluidic Systems**

Applications, considerations on micro scale fluid, fluid actuation methods, electro wetting, electro thermal flow. Radio Frequency MEMS: RF - based communication systems, RF MEMS, MEMS inductors, varactors, tuner/filter, resonator, MEMS switches, phase shifter.

**UNIT-V: Chemical and Bio Medical Micro Systems**

Sensing mechanism & principle, membrane-transducer materials, chem.-lab-on-a-chip (CLOC) chemo resistors, chemo capacitors, chemo transistors, electronic nose (E-nose), mass sensitive chemo sensors, fluorescence detection, calorimetric.

**Text Books:**

1. MEMS, Nitaigour Premchand Mahalik, TMH Publishing co.

**Reference Books:**

1. Foundation of MEMS, Chang Liu, Prentice Hall Ltd.
2. MEMS and NEMS, Sergey Edwrd Lyshevski, CRC Press, Indian Edition.
3. MEMS and Micro Systems: Design and Manufacture, Tai-Ran Hsu, TMH Publishers.
4. Introductory MEMS, Thomas M Adams, Richard A Layton, Springer International Publishers.

**Web References:**

1. https://en.wikipedia.org/wiki/Microelectromechanical_systems
2. https://www.mems-exchange.org/MEMS/what-is.html

| II B.TECH II SEMESTER | L | T | P | INTERNAL MARKS | EXTERNAL MARKS | TOTAL MARKS | CREDITS |
|---|---|---|---|---|---|---|---|
| | 3 | 0 | 0 | 40 | 60 | 100 | 3 |
| 19BEE4OE04 | ENERGY AUDIT CONSERVATION AND MANAGEMENT (Open Elective-1) | | | | | | |

**Course Objectives:**

1. To introduce the basic concepts of Energy Auditing and Management.
2. To familiarize the various Techniques of Electrical Energy Conservation.

**Course Outcomes:**

After successful completion of this course, the students will be able to:

3. Explain the Process of Energy Audit of Industries.
4. Apply the concepts of Energy management for Efficient Energy Utilization and Conservation.
5. Identify a suitable method for Energy Conservation of various electric devices.
6. Acquire knowledge on Lighting and Energy Instruments
7. Analyze the benefits of energy conservation from the Economic aspects.

**UNIT - I: Basic Principles of Energy Audit**

Energy audit- definitions, concept, types of audit, energy index, cost index, pie charts, Sankey diagrams, load profiles, Energy conservation schemes- Energy audit of industries- energy saving potential, energy audit of process industry, thermal power station, building energy audit.

**UNIT - II: Energy Management**

Principles of energy management, organizing energy management program, initiating, planning, controlling, promoting, monitoring, reporting- Energy manger, Qualities and functions, language, Questionnaire – check list for top management.

**UNIT - III: Energy Efficient Motors**

Energy efficient motors, factors affecting efficiency, loss distribution, constructional details, characteristics - variable speed, variable duty cycle systems, RMS voltage variation-voltage unbalance- over motoring- motor energy audit.

**UNIT - IV: Lighting and Energy Instruments**

Good lighting system design and practice- lighting control -lighting energy audit – Energy. Instruments- wattmeter, data loggers, thermocouples, pyrometers, lux meters, tongue testers, application of PLC's.

**UNIT - V: Economic Aspects and Analysis**

Economics Analysis-Depreciation Methods, time value of money, rate of return, present worth method, replacement analysis, life cycle costing analysis- Energy efficient motors- calculation of simple payback method, net present worth method Power factor correction, lighting - Applications of life cycle costing analysis, return on investment.

**Text Books**

1. Energy management by W.R. Murphy AND G. Mckay Butter worth, Heinemann publications.
2. Energy management by Paul o' Callaghan, Mc-graw Hill Book company-1st edition, 1998

**Reference Books**

1. Energy efficient electric motors by John .C. Andreas, Marcel Dekker Inc Ltd2nd edition,1995.
2. Energy management hand book by W.C.Turner, John wiley and sons.
3. Energy management and good lighting practice: fuel efficiency- booklet12EEO.

**Web References**

1. https://www.youtube.com/watch?v=6vOg-u7c1IE
2. https://en.wikipedia.org/wiki/Economic_impact_analysis

| III B.TECH I-SEMESTER | L | T | P | INTERNAL MARKS | EXTERNAL MARKS | TOTAL MARKS | CREDITS |
|---|---|---|---|---|---|---|---|
| | 3 | - | - | 20 | 30 | 50 | 3 |
| 19BCC5OE03 | NON-CONVENTIONAL ENERGY RESOURCES (Open Elective-II) | | | | | | |

**Course Objectives:**

1. To study the solar radiation data, radiation on earth's surface and it's applications.
2. To study wind energy conversion and Bio-mass generation.
3. To study basic principle and working of Geothermal, Tidal, Ocean & Wave energy Generation.
4. To study basic principle and working of Thermal Electric Power.
5. To study the working of MHD Power Generation.

**Course Outcomes:**

After completion of this course, Students will be able to

1. Illustrate the principles of solar radiation and their applications.
2. Analyze the functioning of basic components of wind energy and understand the utilization of biomass in power generation.
3. Summarize the working principles of geothermal, ocean, tidal and wave energy techniques.
4. Interpret the functioning of Thermal Electric Power.
5. Analyze the MHD power generation and its future prospects

**UNIT – I: Introduction & Solar Energy**

Introduction to Energy Sources and their availability- renewable sources-The solar constant-Solar Radiation at the Earth's surface-instruments for measuring solar radiation - solar radiation on titled surfaces-solar ponds-Applications of Solar ponds- solar heating-Photovoltaic energy conversion.

**UNIT – II: Wind Energy and Bio-Mass**

Principles of wind energy conversion, Components of WECS- horizontal and vertical axis windmills- performance characteristics. Bio fuels- Methods for obtaining energy from Biomass- Thermal gasification of Biomass.

**UNIT – III: Geothermal Energy, Ocean Energy, Tidal and Wave Energy**

Introduction of Geothermal Energy- Nature of Geothermal fields- Geothermal Sources- OTEC-Methods of ocean thermal electric power generation- Open cycle and closed cycle- Principle of Tidal power- Components of Tidal power plants- Advantages and Disadvantages of Wave energy- Energy and power from the Waves.

**UNIT – IV: Thermal Electric Power**

Introduction- Thermo electric power generation- See-beck, Peltier, Thomson effects - Thermo electric power generation- Thermo electric materials- Selection of materials.

**UNIT – V: MHD Power Generation**

Introduction- Principle of MHD power generation- MHD Systems- Open cycle and closed cycle Systems- Advantages of MHD Systems- International Status of MHD power generation and its future prospects.

**Text Books:**

1. G.D. Rai, “Non-Conventional Energy Sources”, Dhanpat Rai and Sons
2. Tiwari and Ghosal, “Renewable energy resources”,Narosa.

**Reference Books:**

1. Twidell& Weir, “Renewable Energy Sources“
2. Sukhatme, “Solar Energy”, Tata McGraw-HillEducation.
3. B.S Magal Frank Kreith& J.F Kreith, “Solar Power Engineering“
4. Frank Krieth& John F Kreider, “Principles of Solar Energy”

| III B.TECH I-SEMESTER | L | T | P | INTERNAL MARKS | EXTERNAL MARKS | TOTAL MARKS | CREDITS |
|---|---|---|---|---|---|---|---|
| | 3 | - | - | 20 | 30 | 50 | 3 |
| 19BCC5OE04 | Basics in Electrical and Electronics Engineering (Open Elective-II) (Other than EEE) | | | | | | |

**Course Objectives:**

1. To familiarize the basic DC networks used in electrical circuits.
2. To explain the concepts of electrical machines and their characteristics.
3. To identify the importance of transformers in transmission and distribution of electric power.
4. To impart the knowledge about the characteristics, working principles and applications of Semiconductor diodes, Operational Amplifier.
5. To expose basic concepts and applications of Transistor.

**Course Outcomes:**

Upon successful completion of the course, the students will be able to

1. Analyse the behaviour of an electrical circuit.
2. Measure the performance quantities such as losses, efficiency of DC machines.
3. Create the construct of transformer and Induction motor.
4. Classify the importance and applications of p-n junction diode and OP-AMPS.
5. Evaluate the configurations and applications of Transistor.

**UNIT–I: Basic laws and Circuits**

Types of network elements - Ohms law - Kirchhoff's Laws - series and parallel circuits - Delta - Wye conversion - Mesh analysis - Nodal analysis with simple problem.

**UNIT–II: DC Machines**

Constructional features - Principle Operation - Induced EMF equation - Working of DC motor - Torque expression and different types of excitation - 3-point starter - losses and efficiency - Performance characteristics by direct loading.

**UNIT–III: AC Machines**

**Transformers:** Principle Operation - EMF equation - Voltage regulation - Losses and efficiency - Open/short - Circuit tests - **Three Phase Induction Motors:** Working principle of three phase induction motor - Torque equation and Torque - Slip characteristics.

**UNIT - IV: Rectifiers and OP AMPS**

P-N Junction diode - Rectifier circuits (half-wave, full-wave, rectifier) - characteristics of operational amplifier-Applications of OP-AMPS (Inverting, Non inverting, integrator and Differentiator).

**UNIT - V: Transistor Configurations**

Construction – Working - Transistor as amplifier - Transistor as switch - Analysis of CE, CB and CC Characteristic's - Comparison of CE - CB and CC configurations.

**Text Books:**

1. D.P.Kothari, I.J.Nagrath, Basic Electrical and Electronics Engineering, 1stedition, McGraw Hill Education (India) Private Limited, 2017.
2. Electronic Devices and Circuits, R.L.Boylestad and Louis Nashelsy, 9th edition, PEI/PHI 2006.
3. B.L.Theraja, Fundamentals of Electrical Engineering and Electronics, 1stedition, S.Chand Publishing, New Delhi, 2006.

**Reference Books:**

1. Basic Electrical Engineering by M.S.Naidu and S.Kamakshiah,TMH Publications.
2. Dharma Raj Cheruku, B T Krishna, Electronic Devices and Circuits, 2/e, Pearson Education, 2008.

**Web References:**

1. URL: https://www.youtube.com/watch?v=ohhdNRtDpCY
2. http://202.53.81.118/course/view.php?id=122

**E-Books:**

1. https://www3.nd.edu/~cpoellab/teaching/eee40814/Lecture1-Handouts.pdf
2. https://nptel.ac.in/courses/108105112/

| III B.TECH II-SEMESTER | L | T | P | INTERNAL MARKS | EXTERNAL MARKS | TOTAL MARKS | CREDITS |
|---|---|---|---|---|---|---|---|
| | 3 | - | - | 40 | 60 | 100 | 3 |
| 19BCC6OE03 | SOFT COMPUTING (Open Elective-III) | | | | | | |

**Course Objectives:**

1. To study various methods of AI, models and architecture of artificial neural networks.
2. To study the ANN paradigms.
3. To study the fuzzy sets operations and the fuzzy logic systems.
4. To study the applications of AI.

**Course Outcomes:**

After completion of this course student will be able to

1. **Understand** the Learning Process and Learning Task, Supervised Learning – Single and Multi-Layer Network.
2. **Analyze** and **Design** an back propagation networks and algorithm.
3. **Apply** the Fuzzy Sets and Membership Functions, Operations on Fuzzy Sets, Fuzzification, Fuzzy Numbers- Operations on Fuzzy Numbers, Fuzzy Relations and explain the Fuzzy Inference Systems- Architecture of Fuzzy Inference System, Fuzzy Inference Rules and Reasoning, Defuzzification, Applications of Fuzzy Logic.
4. **Design** and **Analyze** the Genetic algorithms and evolutionary computation, Applications of Genetic Algorithms.
5. **Explain** the applications of soft computing techniques in Electrical Engineering.

**UNIT–I: Artificial Intelligent Systems**

Artificial Intelligent systems – Neural Networks, Fuzzy Logic - Artificial Neural Networks – Biological neural networks – Model of an artificial neuron - Comparison between biological neuron and artificial neuron – Basic models of artificial neural network – Learning methods – Activation function and Terminologies of ANN - Mc Culloch Pitts Neuron – Perceptron Networks.

**UNIT–II: Back Propagation Networks**

Back propagation Networks : Architecture - Multi layer perceptron – Back propagation Learning – Input layer - Hidden Layer - Output Layer computations - Calculation of error - Training of ANN - Back propagation Algorithm - Selection of various parameters in BP networks.

**UNIT–III: Classical and Fuzzy Sets**

Fuzzy verses crisp sets – Crisp sets – Operations and properties of crisp sets - Partition and covering - Fuzzy sets - Membership function – Operation and properties of fuzzy sets - Crisp relations - Fuzzy Logic System Components - Fuzzy rule base system – Defuzzification - Types of Defuzzification - Fuzzy logic controller - Components of FLC.

**UNIT–IV: Genetic Algorithms**

Genetic Algorithms - Basic Concepts - Creation of off – springs - Working Principle – Encoding - Fitness function - Reproduction- Roulette - Wheel Selection, Boltzmann Selection - Tournament selection - Rank Selection - Cross Over - Inversion and deletion - Mutation Operator - Bitwise operators.

**UNIT–V: Applications to Electrical Engineering**

Speed control of D.C and A.C motors - Reactive Power Control - Load Frequency Control - Economic load dispatch - load flow studies - Load forecasting.

**Text books:**

1. S. N. Sivanandam, S. N. Deepa, Principles of Soft Computing, Wiley India Pvt. Ltd. [Module I& III].
2. R.Rajasekharan and G.A. Vijayalakshmi Pai, Neural Networks, Fuzzy Logic and Genetic Algorithms- Synthesis and Applications, Prentice Hall of India. [Module II, & IV].

**Reference books:**

1. Electric Energy Utilization and Conservation by S C Tripathy, Tata McGraw hill publishing company Ltd. New Delhi.
2. S. Haykins, Neural Networks – A Comprehensive Foundation, Prentice Hall 2002.
3. L. Fausett, Fundamentals of Neural Networks, Prentice Hall 1994.
4. T.Ross, Fuzzy Logic with Engineering Applications, Tata McGraw-Hill, New Delhi 1995.
5. D.E. Goldberg, Genetic Algorithms in search, Optimization and Machine Learning, Addison Wesley MA, 1989.
6. John Yen, Reza Lengari, Fuzzy Logic- Intelligence, Control and Information, Pearson Education.

| III B.TECH II-SEMESTER | L | T | P | INTERNAL MARKS | EXTERNAL MARKS | TOTAL MARKS | CREDITS |
|---|---|---|---|---|---|---|---|
| | 3 | - | - | 40 | 60 | 100 | 3 |
| 19BCC6OE04 | INDUSTRIAL ELECTRONICS (Open Elective-III) | | | | | | |

**Course Objectives:**

1. To study the concepts of semiconductor material and semiconductor device.
2. To study the characteristics of various power semiconductor devices.
3. To understand the concept of Transducers and Ultrasonic.
4. To acquaint with the different types of heating and welding techniques.
5. To understand the concept of Programmable logic controllers.

**Course Outcomes:**

After completion of this course student will be able to

1. Explain the structures of semiconductors.
2. Explain the characteristics of various power semiconductor devices.
3. Explain the operation of different transducers and Ultrasonic.
4. Identify most appropriate heating or welding techniques for suitable applications.
5. Draw the ladder diagrams for different operations.

**UNIT-I: Semiconductor Physics**

Introduction - Semiconductor Material - Band Structure-Charge Carriers - Intrinsic and Extrinsic Semiconductors - Semiconductor Devices - Mobility.

**UNIT-II: Power Electronic Devices**

Types of Power Semiconductor devices - Uncontrolled Devices, Controlled Devices & Partially controlled devices with Examples – V-I characteristics of SCR-Process of Commutation.

**UNIT-III: Transducers & Ultrasonic**

Classification of Transducers - Strain Gauge - Variable Resistance Transducer, Capacitive – Inductive - Piezoelectric-LVDT- Thermocouples-Transducer Applications - Accelerometers, Tachogenerators, Servomotors Ultrasonic Generation – Pulsed Echo Ultrasonic Flaw Detector.

**UNIT-IV: Industrial Heating and Welding**

Resistance Heating - Induction heating - Dielectric heating - Resistance welding - Arc welding - Comparison between AC and DC Welding - Applications.

**UNIT-V: PLC**

Programmable logic controllers - Input output devices - Number systems - I/O Processing - Ladder and functional block Diagram - Architecture of PLC - Memory organization in PLC.

**Text books:**

1. Industrial electronics and control by S K Bhattacharya and S Chatterjee, Tata Mc Graw - Hill Company Ltd.
2. Power Electronics by P.C.Sen.

**Reference Books:**

1. Utilization of Electric Energy – by G.C Garg, Khanna publications
2. Longman.User manuals of PLCs, SCADA.

| IV B.TECH I-SEMESTER | L | T | P | INTERNAL MARKS | EXTERNAL MARKS | TOTAL MARKS | CREDITS |
|---|---|---|---|---|---|---|---|
| | 3 | - | - | 40 | 60 | 100 | 3 |
| 19BCC7OE03 | CONTROL SYSTEM (Open Elective-IV) | | | | | | |

**Course Objectives:**

1. To give a basic idea about analysis of linear control systems.
2. To emphasize the student about stability analysis of a system.
3. To learn how to improve the performance of an existing system.
4. Enable an engineer to explore time domain and frequency domain tools to design and study linear control systems.
5. Enable an engineer to explore the State Space Analysis.

**Course Outcomes:**

After completion of this course student will be able to

1. Represent a system in different models.
2. Recognize and analyse feedback control mechanisms.
3. Analyse the stability of a system based on transfer function.
4. Analyse a linear control system using various time and frequency domain tools.
5. Analyse the stability of a system using State Space Analysis.

**UNIT–I: Introduction to Control Systems**

Classification of control systems – examples - Feedback Characteristics - Mathematical models – electrical - Translational and rotational mechanical systems - Transfer Function Representation: Block diagram representation of systems - Block diagram algebra – Representation by Signal flow graph - Reduction using Mason's gain formula.

**UNIT–II Time Domain Analysis:**

Standard test signals - Time response of first order systems – Characteristic equation of feedback control systems - Transient response of second order systems - Time domain specifications – Steady state response - Steady state errors and error constants - Compensators and Controllers: lead, lag and lead-lag compensators, Effects of proportional derivative (PD) - Proportional integral (PI) systems - Proportional Integral and Derivative (PID) Controllers.

**UNIT–III: Stability Analysis in S-Domain:**

The concept of stability – Routh's stability criterion – qualitative stability and conditional stability – limitations of Routh's stability. Root Locus Technique: The root locus concept - construction of root loci - effects of adding poles and zeros to open loop transfer function on the root loci.

**UNIT–IV: Frequency Response Analysis:**

Introduction - Frequency domain specifications - Bode diagrams- Determination of Frequency domain specifications and transfer function from the Bode Diagram - Phase margin and Gain margin-Stability Analysis from Bode Plots - Stability Analysis in Frequency Domain: Polar Plots - Nyquist Plots Stability Analysis.

**UNIT–V: State Space Analysis:**

State Space Analysis of Continuous Systems Concepts of state - State variables and state model - Derivation of state models from block diagrams – Diagonalization - Solving the Time invariant state Equations - State Transition Matrix and it's Properties – Concepts of Controllability and Observability.

**Text books:**

1. Control Systems Engineering – I. J.Nagrath and M.Gopal, New Age International (P) Limited, Pub. 2nd edition, 2005.
2. Modern Control Engineering, Katsuhiko Ogata, Prentice Hall of India Pvt. Ltd., 3rd ed., 1998.

**Reference books:**

1. Automatic Control Systems 8th edition–B. C. Kuo – John wiley and son's 2003.
2. Modern Control Engineering, Katsuhiko Ogata, Prentice Hall of India Pvt. Ltd., 3rded., 1998.
3. Control Systems Engg. , Nise– John wiley , 3rd Edition 2000.

| IV B.TECH I-SEMESTER | L | T | P | INTERNAL MARKS | EXTERNAL MARKS | TOTAL MARKS | CREDITS |
|---|---|---|---|---|---|---|---|
| | 3 | - | - | 40 | 60 | 100 | 3 |
| 19BCC7OE04 | EMBEDDED CONTROL OF ELECTRIC DRIVES (Open Elective-IV) | | | | | | |

**Course Objectives:**

1. To understand the basic of MC68HC11 microcontroller.
2. To know the basic of various peripherals connected to MC68HC11.
3. To study the basic of PIC16C7X microcontroller.
4. To study the basic of various peripherals connected to PIC16C7X.
5. To know basic of designing a microcontroller based system.

**Course Outcomes:**

After completion of this course student will be able to

1. Illustrate the architecture, instruction set, various peripherals of MC68HC11.
2. Analyse MC68HC11 for simple arithmetic operation and comparing.
3. Develop the architecture, instruction set, various peripherals of PIC16C7X.
4. Model PIC16C7X for simple arithmetic operation.
5. Design a microcontroller based system.

**UNIT–I: MC68HC11 Microcontroller**

Architecture memory organization - addressing modes - instruction set - programming techniques - simple programs

**UNIT–II: Peripherals of MC68HC11**

I/O ports - handshaking techniques - reset and interrupts - serial communication interface - serial peripheral interface - programmable timer - analog / digital interfacing - cache memory.

**UNIT–III: PIC 16C7X Microcontroller**

Architecture - memory organization - addressing modes - instruction set - programming techniques - simple operation.

**UNIT–IV: Peripheral of PIC 16C7X Microcontroller**

Timers - interrupts - I/O ports - I2C bus for peripheral chip access - A/D converter – UART.

**UNIT–V: System Design Using Microcontrollers**

Interfacing LCD display - Keypad interfacing - AC load control - PID control of DC motor - stepper motor control - brush less DC motor control.

**Text books:**

1. John B.Peatman, 'Design with PIC Microcontrollers, ‘Pearson Education, Asia 2004.

**Reference books:**

1. Michael Khevi, 'The M68HC11 Microcontroller Applications in control, Instrumentation and communication', Prentice Hall, New Jersey, 1997.

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