OUTCOME BASED EDUCATION
WITH
CHOICE BASED CREDIT SYSTEM

BACHELOR OF TECHNOLOGY
ELECTRICAL AND ELECTRONICS ENGINEERING

ACADEMIC REGULATIONS, COURSE STRUCTURE AND SYLLABI
(Based on AICTE Model Curriculum)

IARE - R18

B.Tech Regular Four Year Degree Program
(for the batches admitted from the academic year 2018-2019)

&

B.Tech (Lateral Entry Scheme)
(for the batches admitted from the academic year 2019-2020)

FAILURE TO READ AND UNDERSTAND THE REGULATIONS
IS NOT AN EXCUSE
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</tbody>
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“Take up one idea. Make that one idea your life-think of it, dream of it, live on that idea. Let the brain muscles, nerves, every part of your body be full of that idea and just leave every other idea alone. This is the way to success”

Swami Vivekananda
PRELIMINARY DEFINITIONS AND NOMENCLATURES

AICTE: Means All India Council for Technical Education, New Delhi.

Autonomous Institute: Means an institute designated as Autonomous by University Grants Commission (UGC), New Delhi in concurrence with affiliating University (Jawaharlal Nehru Technological University, Hyderabad) and State Government.

Academic Autonomy: Means freedom to an institute in all aspects of conducting its academic programs, granted by UGC for Promoting Excellence.

Academic Council: The Academic Council is the highest academic body of the institute and is responsible for the maintenance of standards of instruction, education and examination within the institute. Academic Council is an authority as per UGC regulations and it has the right to take decisions on all academic matters including academic research.

Academic Year: It is the period necessary to complete an actual course of study within a year. It comprises two main semesters i.e., (one odd + one even) and one supplementary semester.

Branch: Means specialization in a program like B.Tech degree program in Aeronautical Engineering, B.Tech degree program in Computer Science and Engineering etc.

Board of Studies (BOS): BOS is an authority as defined in UGC regulations, constituted by Head of the Organization for each of the departments separately. They are responsible for curriculum design and updation in respect of all the programs offered by a department.

Backlog Course: A course is considered to be a backlog course, if the student has obtained a failure grade (F) in that course.

Basic Sciences: The courses offered in the areas of Mathematics, Physics, Chemistry etc., are considered to be foundational in nature.

Betterment: Betterment is a way that contributes towards improvement of the students’ grade in any course(s). It can be done by either (a) re-appearing or (b) re-registering for the course.

Commission: Means University Grants Commission (UGC), New Delhi.

Choice Based Credit System: The credit based semester system is one which provides flexibility in designing curriculum and assigning credits based on the course content and hours of teaching along with provision of choice for the student in the course selection.

Certificate Course: It is a course that makes a student to have hands-on expertise and skills required for holistic development in a specific area/field.

Compulsory course: Course required to be undertaken for the award of the degree as per the program.

Continuous Internal Examination: It is an examination conducted towards sessional assessment.

Core: The courses that are essential constituents of each engineering discipline are categorized as professional core courses for that discipline.

Course: A course is a subject offered by a department for learning in a particular semester.

Course Outcomes: The essential skills that need to be acquired by every student through a course.

Credit: A credit is a unit that gives weight to the value, level or time requirements of an academic course. The number of ‘Contact Hours’ in a week of a particular course determines its credit value. One credit is equivalent to one lecture/tutorial hour per week.

Credit point: It is the product of grade point and number of credits for a course.
Cumulative Grade Point Average (CGPA): It is a measure of cumulative performance of a student over all the completed semesters. The CGPA is the ratio of total credit points secured by a student in various courses in all semesters and the sum of the total credits of all courses in all the semesters. It is expressed up to two decimal places.

Curriculum: Curriculum incorporates the planned interaction of students with instructional content, materials, resources, and processes for evaluating the attainment of Program Educational Objectives.

Department: An academic entity that conducts relevant curricular and co-curricular activities, involving both teaching and non-teaching staff, and other resources in the process of study for a degree.

Detention in a Course: Student who does not obtain minimum prescribed attendance in a course shall be detained in that particular course.

Dropping from Semester: Student who doesn’t want to register for any semester can apply in writing in prescribed format before the commencement of that semester.

Elective Course: A course that can be chosen from a set of courses. An elective can be Professional Elective and / or Open Elective.

Evaluation: Evaluation is the process of judging the academic performance of the student in her/his courses. It is done through a combination of continuous internal assessment and semester end examinations.

Grade: It is an index of the performance of the students in a said course. Grades are indicated by alphabets.

Grade Point: It is a numerical weight allotted to each letter grade on a 10 - point scale.

Honours: An Honours degree typically refers to a higher level of academic achievement at an undergraduate level.

Institute: Means Institute of Aeronautical Engineering, Hyderabad unless indicated otherwise by the context.

Massive Open Online Courses (MOOC): MOOC courses inculcate the habit of self learning. MOOC courses would be additional choices in all the elective group courses.

Minor: Minor are coherent sequences of courses which may be taken in addition to the courses required for the B.Tech degree.

Pre-requisite: A specific course or subject, the knowledge of which is required to complete before student register another course at the next grade level.

Professional Elective: It indicates a course that is discipline centric. An appropriate choice of minimum number of such electives as specified in the program will lead to a degree with specialization.

Program: Means, UG degree program: Bachelor of Technology (B.Tech); PG degree program: Master of Technology (M.Tech) / Master of Business Administration (MBA).

Program Educational Objectives: The broad career, professional and personal goals that every student will achieve through a strategic and sequential action plan.

Project work: It is a design or research based work to be taken up by a student during his/her final year to achieve a particular aim. It is a credit based course and is to be planned carefully by the student.

Re-Appearing: A student can reappear only in the semester end examination for theory component of a course, subject to the regulations contained herein.

Registration: Process of enrolling into a set of courses in a semester of a program.
**Regulations:** The regulations, common to all B.Tech programs offered by Institute, are designated as “IARE Regulations - R18” and are binding on all the stakeholders.

**Semester:** It is a period of study consisting of 15 to 18 weeks of academic work equivalent to normally 90 working days. Odd semester commences usually in July and even semester in December of every year.

**Semester End Examinations:** It is an examination conducted for all courses offered in a semester at the end of the semester.

**S/he:** Means “she” and “he” both.

**Student Outcomes:** The essential skill sets that need to be acquired by every student during her/his program of study. These skill sets are in the areas of employability, entrepreneurial, social and behavioral.

**University:** Means Jawaharlal Nehru Technological University Hyderabad (JNTUH), Hyderabad, is an affiliating University.

**Withdraw from a Course:** Withdrawing from a course means that a student can drop from a course within the first two weeks of odd or even semester (deadlines are different for summer sessions). However, s/he can choose a substitute course in place of it, by exercising the option within 5 working days from the date of withdrawal.
FOREWORD

The autonomy is conferred to Institute of Aeronautical Engineering (IARE), Hyderabad by University Grants Commission (UGC), New Delhi based on its performance as well as future commitment and competency to impart quality education. It is a mark of its ability to function independently in accordance with the set norms of the monitoring bodies including J N T University Hyderabad (JNTUH), Hyderabad and AICTE, New Delhi. It reflects the confidence of the affiliating University in the autonomous institution to uphold and maintain standards it expects to deliver on its own behalf. Thus, an autonomous institution is given the freedom to have its own curriculum, examination system and monitoring mechanism, independent of the affiliating University but under its observance.

IARE is proud to win the credence of all the above bodies monitoring the quality in education and has gladly accepted the responsibility of sustaining, if not improving upon the standards and ethics for which it has been striving for more than a decade in reaching its present standing in the arena of contemporary technical education. As a follow up, statutory bodies such as Academic Council and Board of Studies (BOS) are constituted with the guidance of the Governing Body of the institute and recommendations of the JNTUH to frame the regulations, course structure, and syllabi under autonomous status.

The autonomous regulations, course structure, and syllabi have been prepared after prolonged and detailed interaction with several expertise solicited from academics, industry and research, in accordance with the vision and mission of the institute in order to produce a quality engineering graduate to the society.

All the faculty, parents, and students are requested to go through all the rules and regulations carefully. Any clarifications needed are to be sought at appropriate time and from the principal of the institute, without presumptions, to avoid unwanted subsequent inconveniences and embarrassments. The cooperation of all the stake holders is requested for the successful implementation of the autonomous system in the larger interests of the institute and brighter prospects of engineering graduates.

PRINCIPAL
For pursuing four year undergraduate Bachelor of Technology degree program of study in Engineering (B.Tech) offered by Institute of Aeronautical Engineering under Autonomous status and herein after referred to as IARE.

Preamble:

All India Council for Technical Education (AICTE) has introduced Model Curriculum for Bachelor of Technology program with 160 credits in the entire program of 4 years, and additional 20 credits can be acquired for the degree of B.Tech with Honours or additional Minor in Engineering. These additional 20 credits will have to be acquired with online courses (MOOCs), perhaps for the first time in the country, to tap the zeal and excitement of learning beyond the classrooms. So, the students will have to complete additional 20 credits through MOOCs within 4 years of time. This creates an excellent opportunity for students to acquire the necessary skill set for employability through massive open online courses where the rare expertise of world famous experts from academics and industry are available.

Separate certificate will be issued in addition to regular degree program mentioning that the student has cleared Honours / Minor specialization in respective courses in addition to scheduled courses for B.Tech programs.

1. CHOICE BASED CREDIT SYSTEM

The Indian Higher Education Institutions (HEIs) are changing from the conventional course structure to Choice Based Credit System (CBCS) along with introduction to semester system in the first year itself. The semester system helps in accelerating the teaching-learning process and enables vertical and horizontal mobility in learning.

The credit based semester system provides flexibility in designing curriculum and assigning credits based on the course content and hours of teaching. The choice based credit system provides a ‘cafeteria’ type approach in which the students can take courses of their choice, learn at their own pace, undergo additional courses and acquire more than the required credits, and adopt an interdisciplinary approach to learning.

Choice Based Credit System (CBCS) is a flexible system of learning and provides choice for students to select from the prescribed elective courses. A course defines learning objectives and learning outcomes and comprises lectures / tutorials / laboratory work / field work / project work / comprehensive Examination / seminars / assignments / MOOCs / alternative assessment tools / presentations / self-study etc., or a combination of some of these.

Under the CBCS, the requirement for awarding a degree is prescribed in terms of number of credits to be completed by the students.
The CBCS permits students to:
1. Choose electives from a wide range of elective courses offered by the departments.
2. Undergo additional courses of interest.
3. Adopt an interdisciplinary approach in learning.
4. Make the best use of expertise of the available faculty.

2. MEDIUM OF INSTRUCTION
The medium of instruction shall be English for all courses, examinations, seminar presentations and project work. The curriculum will comprise courses of study as given in course structure, in accordance with the prescribed syllabi.

3. PROGRAMS OFFERED
Presently, the institute is offering Bachelor of Technology (B.Tech) degree programs in the following disciplines:
1. Aeronautical Engineering
2. Computer Science and Engineering
3. Information Technology
4. Electronics and Communication Engineering
5. Electrical and Electronics Engineering
6. Mechanical Engineering
7. Civil Engineering

4. SEMESTER STRUCTURE
Each academic year is divided into three semesters, TWO being MAIN SEMESTERS (one odd + one even) and ONE being a SUPPLEMENTARY SEMESTER. Main semesters are for regular class work. Supplementary Semester is primarily for failed students i.e. registration for a course for the first time is generally not permitted in the supplementary semester.

4.1 Each main semester shall be of 21 weeks (Table 1) duration and this period includes time for registration of courses, course work, examination preparation, and conduct of examinations.

4.2 Each main semester shall have a minimum of 90 working days; out of which 75 days are for teaching / practical and 15 days for conduct of exams and preparation.

4.3 The supplementary semester shall be a fast track semester consisting of eight weeks and this period includes time for registration of courses, course work, and examination preparation, conduct of examinations, assessment, and declaration of final results.

4.4 All subjects may not be offered in the supplementary semester. The student has to pay a stipulated fee prescribed by the institute to register for a course in the supplementary semester. The supplementary semester is provided to help the student in not losing an academic year. It is optional for a student to make use of supplementary semester. Supplementary semester is a special semester and the student cannot demand it as a matter of right and will be offered based on availability of faculty and other institute resources.

4.5 The institute may use supplementary semester to arrange add-on courses for regular students and / or for deputing them for practical training / FSI model. A student can register for a maximum number of 15 credits during a supplementary semester.

4.5.1 The registration for the supplementary semester (during May – July, every year) provides an opportunity to students to clear their backlogs (‘F’ grade) or who are prevented from appearing for SEE examinations due to shortage of attendance less than 65% in each course (‘SA’ Grade) in the earlier semesters or the courses which he / she could not register (Drop / Withdraw) due to any reason.
Students will not be permitted to register for more than 15 credits (both I and II semester) in the supplementary semester. Students required to register for supplementary semester courses are to pay a nominal fee within the stipulated time. A separate circular shall be issued at the time of supplementary semester.

It will be optional for a student to get registered in the course(s) of supplementary semester; otherwise, he / she can opt to appear directly in supplementary examination. However, if a student gets registered in a course of supplementary semester, then it will be compulsory for a student to fulfill attendance criterion (≥90%) of supplementary semester and he / she will lose option to appear in immediate supplementary examination.

The students who have earlier taken SEE examination and register afresh for the supplementary semester may revoke the CIA marks secured by them in their regular/earlier attempts in the same course. Once revoked, the students shall not seek restoration of the CIA marks.

Supplementary semester will be at an accelerated pace e.g. one credit of a course shall require two hours/week so that the total number of contact hours can be maintained same as in normal semester.

**Instructions and guidelines for the supplementary semester course:**
- A minimum of 36 to 40 hours will be taught by the faculty for every course.
- Only the students registered and having sufficient percentage of attendance for the course will be permitted to write the examination.
- The assessment procedure in a supplementary semester course will be similar to the procedure for a regular semester course.
- Student shall register for the supplementary semester as per the schedule given in academic calendar.
- Once registered, students will not be allowed to withdraw from supplementary semester.

4.5.2 The academic calendar shown in Table 1 is declared at the beginning of the academic year.

<table>
<thead>
<tr>
<th>Table 1: Academic Calendar</th>
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<table>
<thead>
<tr>
<th><strong>FIRST SEMESTER (21 weeks)</strong></th>
<th><strong>SECOND SEMESTER (21 weeks)</strong></th>
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</thead>
<tbody>
<tr>
<td>I Spell Instruction Period</td>
<td>I Spell Instruction Period</td>
</tr>
<tr>
<td>8 weeks</td>
<td>8 weeks</td>
</tr>
<tr>
<td>I Mid Examinations</td>
<td>I Mid Examinations</td>
</tr>
<tr>
<td>1 week</td>
<td>1 week</td>
</tr>
<tr>
<td>II Spell Instruction Period</td>
<td>II Spell Instruction Period</td>
</tr>
<tr>
<td>8 weeks</td>
<td>8 weeks</td>
</tr>
<tr>
<td>II Mid Examinations</td>
<td>II Mid Examinations</td>
</tr>
<tr>
<td>1 week</td>
<td>1 week</td>
</tr>
<tr>
<td>Preparation and Practical Examinations</td>
<td>Preparation &amp; Practical Examinations</td>
</tr>
<tr>
<td>1 week</td>
<td>1 week</td>
</tr>
<tr>
<td>Semester End Examinations</td>
<td>Semester End Examinations</td>
</tr>
<tr>
<td>2 weeks</td>
<td>2 weeks</td>
</tr>
<tr>
<td><strong>Semester Break and Supplementary Exams</strong></td>
<td><strong>Summer Vacation, Supplementary Semester and Remedial Exams</strong></td>
</tr>
<tr>
<td>2 weeks</td>
<td>8 weeks</td>
</tr>
</tbody>
</table>

19 weeks

2 weeks
4.6 Students admitted on transfer from JNTUH affiliated institutes, Universities and other institutes in the subjects in which they are required to earn credits so as to be on par with regular students as prescribed by concerned ‘Board of Studies’.

5.0 REGISTRATION / DROPPING / WITHDRAWAL

5.1. Each student has to compulsorily register for course work at the beginning of each semester as per the schedule mentioned in the Academic Calendar. It is compulsory for the student to register for courses in time. The registration will be organized departmentally under the supervision of the Head of the Department.

5.2. In ABSENTIA, registration will not be permitted under any circumstances.

5.3. At the time of registration, students should have cleared all the dues of Institute and Hostel for the previous semesters, paid the prescribed fees for the current semester and not been debarred from the institute for a specified period on disciplinary or any other ground.

5.4. The student has to normally register for a minimum of 17 credits and may register up to a maximum of 27 credits, in consultation with HOD/faculty mentor. On an average, a student is expected to register for 22 credits.

5.5. Dropping of Courses: Within one week after the last date of first internal assessment test or by the date notified in the academic calendar, the student may in consultation with his / her faculty mentor/adviser, drop one or more courses without prejudice to the minimum number of credits as specified in clause 5.4. The dropped courses are not recorded in the Grade Card. The student must complete the dropped subject by registering in the supplementary semester / forthcoming semester in order to earn the required credits.

5.6. Withdrawal from Courses: A student is permitted to withdraw from a course by the date notified in the academic calendar. Such withdrawals will be permitted without prejudice to the minimum number of credits as specified in clause 5.4. A student cannot withdraw a course more than once and withdrawal of reregistered subjects is not permitted.

5.7 After Dropping and / or Withdrawal of courses, minimum credits registered shall be 20.

6.0 UNIQUE COURSE IDENTIFICATION CODE

Every course of the B.Tech program will be placed in one of the seven groups of courses as listed in the Table 2. The various courses and their two-letter codes are given below;

Table 2: Group of Courses

<table>
<thead>
<tr>
<th>S. No</th>
<th>Branch</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Aeronautical Engineering</td>
<td>AE</td>
</tr>
<tr>
<td>2</td>
<td>Computer Science and Engineering</td>
<td>CS</td>
</tr>
<tr>
<td>3</td>
<td>Information Technology</td>
<td>IT</td>
</tr>
<tr>
<td>4</td>
<td>Electronics and Communication Engineering</td>
<td>EC</td>
</tr>
<tr>
<td>5</td>
<td>Electrical and Electronics Engineering</td>
<td>EE</td>
</tr>
<tr>
<td>6</td>
<td>Mechanical Engineering</td>
<td>ME</td>
</tr>
<tr>
<td>7</td>
<td>Civil Engineering</td>
<td>CE</td>
</tr>
</tbody>
</table>
7.0 CURRICULUM AND COURSE STRUCTURE

The curriculum shall comprise Theory Courses, Elective Courses, Laboratory Courses, Audit Courses, Mandatory Courses, Mini Project, Internship and Project work. The list of elective courses may also include subjects from allied discipline.

Contact Periods: Depending on the complexity and volume of the course, the number of contact periods per week will be assigned. Each Theory and Laboratory course carries credits based on the number of hours/week as follows:

- **Contact classes (Theory):** 1 credit per lecture hour per week, 1 credit per tutorial hour per week.
- **Laboratory Hours (Practical):** 1 credit for 2 practical hours per week.
- **Project Work:** 1 credit for 2 hours of project work per week.
- **Mini Project:** 1 credit for 2 hours per week

7.1 TYPES OF COURSES

Courses in a program may be of three kinds: Foundation / Skill, Core and Elective Courses.

7.1.0 Foundation / Skill Course:

Foundation courses are the courses based upon the content leads to enhancement of skill and knowledge as well as value based and are aimed at man making education. Skill subjects are those areas in which one needs to develop a set of skills to learn anything at all. They are fundamental to learning any subject.

7.1.1 Professional Core Courses:

There may be a core course in every semester. This is the course which is to be compulsorily studied by a student as a core requirement to complete the requirement of a program in the said discipline of study.

7.1.2 Elective Course:

Electives provide breadth of experience in respective branch and application areas. Elective course is a course which can be chosen from a pool of courses. It may be:

- Supportive to the discipline of study
- Providing an expanded scope
- Enabling an exposure to some other discipline / domain
- Nurturing student’s proficiency / skill.

An elective may be Professional Elective, is a discipline centric focusing on those courses which add generic proficiency to the students or may be Open Elective, chosen from unrelated disciplines.

There are six professional elective tracks; students can choose not more than two courses from each track. Overall, students can opt for six professional elective courses which suit their project work in consultation with the faculty advisor/mentor. Nevertheless, one course from each of the four open electives has to be selected. A student may also opt for more elective courses in his/her area of interest.
7.1.3 Credit distribution for courses offered is given in Table 3.

### Table 3: Credit distribution

<table>
<thead>
<tr>
<th>S. No</th>
<th>Course</th>
<th>Hours</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Theory Course</td>
<td>1 / 2 / 3 / 4</td>
<td>1 / 2 / 3 / 4</td>
</tr>
<tr>
<td>2</td>
<td>Elective Courses</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>MOOC Courses</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>Laboratory Courses</td>
<td>2 / 3 / 4</td>
<td>1 / 1.5 / 2</td>
</tr>
<tr>
<td>5</td>
<td>Audit Course / Mandatory Course</td>
<td>-</td>
<td>0</td>
</tr>
<tr>
<td>6</td>
<td>Project / Research based learning</td>
<td>-</td>
<td>4</td>
</tr>
<tr>
<td>7</td>
<td>Full Semester Internship (FSI) / Project Work</td>
<td>-</td>
<td>11</td>
</tr>
</tbody>
</table>

7.2 Course Structure

Every course of the B.Tech program will be placed in one of the eight categories with minimum credits as listed in the Table 4.

### Table 4: Category Wise Distribution of Credits

<table>
<thead>
<tr>
<th>S. No</th>
<th>Category</th>
<th>Breakup of Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Humanities and Social Sciences (HSMC), including Management.</td>
<td>12</td>
</tr>
<tr>
<td>2</td>
<td>Basic Science Courses (BSC) including Mathematics, Physics and Chemistry.</td>
<td>25</td>
</tr>
<tr>
<td>3</td>
<td>Engineering Science Courses (ESC), including Workshop, Drawing, Basics of Electrical / Electronics / Mechanical / Computer Engineering.</td>
<td>24</td>
</tr>
<tr>
<td>4</td>
<td>Professional Core Courses (PCC), relevant to the chosen specialization / branch.</td>
<td>48</td>
</tr>
<tr>
<td>5</td>
<td>Professional Electives Courses (PEC), relevant to the chosen specialization / branch.</td>
<td>18</td>
</tr>
<tr>
<td>6</td>
<td>Open Elective Courses (OEC), from other technical and/or emerging subject areas.</td>
<td>18</td>
</tr>
<tr>
<td>7</td>
<td>Project Based Learning, Research Based Learning and Project Work (PROJ) / Full Semester Internship (FSI)</td>
<td>15</td>
</tr>
<tr>
<td>8</td>
<td>Mandatory Courses / Audit Courses.</td>
<td>Non-Credit</td>
</tr>
<tr>
<td></td>
<td>TOTAL</td>
<td>160</td>
</tr>
</tbody>
</table>

7.3 Semester wise course break-up

Following are the TWO models of course structure out of which any student shall choose or will be allotted with one model based on their academic performance.

i. Full Semester Internship (FSI) Model and

ii. Non Full Semester Internship (NFSI) Model – Project work.

7.4 For Four year regular program (FSI Model):

In the FSI Model, out of the selected students - half of students shall undergo Full Semester Internship in VII semester and the remaining students in VIII semester. In the Non FSI Model,
all the selected students shall carry out the course work and Project work as specified in the course structure. A student who secures a minimum CGPA of 7.5 up to IV semester with no current arrears and maintains the CGPA of 7.5 till VI Semester shall be eligible to opt for FSI.

8.0 EVALUATION METHODOLOGY

8.1 Theory Course:
Each theory course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIA examinations or the marks scored in the make-up examination.

8.1.1 Semester End Examination (SEE):
The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into FIVE modules and each modules carries equal weightage in terms of marks distribution. The question paper pattern is as follows.

Two full questions with ‘either’ ‘or’ choice will be drawn from each module. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

The emphasis on the questions is broadly based on the following criteria:

<table>
<thead>
<tr>
<th>50 %</th>
<th>To test the objectiveness of the concept</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 %</td>
<td>To test the analytical skill of the concept OR to test the application skill of the concept</td>
</tr>
</tbody>
</table>

8.1.2 Continuous Internal Assessment (CIA):
For each theory course the CIA shall be conducted by the faculty / teacher handling the course as given in Table 5. CIA is conducted for a total of 30 marks, with 20 marks for Continuous Internal Examination (CIE), 05 marks for Quiz and 05 marks for Alternative Assessment Tool (AAT).

Table 5: Assessment pattern for Theory Courses

<table>
<thead>
<tr>
<th>COMPONENT</th>
<th>THEORY</th>
<th>TOTAL MARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of Assessment</td>
<td>CIE Exam</td>
<td>Quiz</td>
</tr>
<tr>
<td>Max. CIA Marks</td>
<td>20</td>
<td>05</td>
</tr>
</tbody>
</table>

8.1.2.1 Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 20 marks of 2 hours duration consisting of five descriptive type questions out of which four questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams. The valuation and verification of answer scripts of CIE exams shall be completed within a week after the conduct of the Examination.

8.1.2.2 Quiz – Online Examination
Two Quiz exams shall be online examination consisting of 50 multiple choice questions and are to be answered by choosing the correct answer from a given set
of choices (commonly four). Such a question paper shall be useful in testing of knowledge, skills, application, analysis, evaluation and understanding of the students. Marks shall be awarded considering the average of two quiz examinations for every course.

8.1.2.3 Alternative Assessment Tool (AAT)

In order to encourage innovative methods while delivering a course, the faculty members are encouraged to use the Alternative Assessment Tool (AAT). This AAT enables faculty to design own assessment patterns during the CIA. The AAT enhances the autonomy (freedom and flexibility) of individual faculty and enables them to create innovative pedagogical practices. If properly applied, the AAT converts the classroom into an effective learning centre. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc.

However, it is mandatory for a faculty to obtain prior permission from the concerned HOD and spell out the teaching/assessment pattern of the AAT prior to commencement of the classes.

8.2 Laboratory Course:

8.2.1 Each laboratory will be evaluated for a total of 100 marks consisting of 30 marks for internal assessment and 70 marks for semester end lab examination. Out of 30 marks of internal assessment, continuous lab assessment will be done for 20 marks for the day to day performance and 10 marks for the final internal lab assessment. The semester end lab examination for 70 marks shall be conducted by two examiners, one of them being Internal Examiner and the other being External Examiner, both nominated by the Principal from the panel of experts recommended by the Chairman, BOS.

8.2.2 All the drawing related courses are evaluated in line with laboratory courses. The distribution shall be 30 marks for internal evaluation (20 marks for day–to–day work, and 10 marks for internal tests) and 70 marks for semester end lab examination. There shall be ONE internal test of 10 marks in each semester.

8.3 Mandatory Courses (MC):

These courses are among the compulsory courses but will not carry any credits. However, a pass in each such course during the program shall be necessary requirement for the student to qualify for the award of Degree. Its result shall be declared as “Satisfactory” or “Not Satisfactory” performance.

8.4 Value Added Courses:

The value added courses are audit courses offered through joint ventures with various organizations providing ample scope for the students as well as faculty to keep pace with the latest technologies pertaining to their chosen fields of study. A plenty of value added programs will be proposed by the departments one week before the commencement of class work. The students are given the option to choose the courses according to their desires and inclinations as they choose the desired items in a cafeteria. The expertise gained through the value added programs should enable them to face the formidable challenges of the future and also assist them in exploring new opportunities. Its result shall be declared with “Satisfactory” or “Not Satisfactory” performance.
8.5 Project / Research Based Learning

This gives students a platform to experience a research driven career in engineering, while developing a device / systems and publishing in reputed SCI / SCOPUS indexed journals and/or filing an Intellectual Property (IPR-Patent/Copyright) to aid communities around the world. Students should work individually as per the guidelines issued by head of the department concerned. The benefits to students of this mode of learning include increased engagement, fostering of critical thinking and greater independence.

The topic should be so selected that the students are enabled to complete the work in the stipulated time with the available resources in the respective laboratories. The scope of the work be handling part of the consultancy work, maintenance of the existing equipment, development of new experiment setup or can be a prelude to the main project with a specific outcome.

Project report will be evaluated for 100 marks in total. Assessment will be done for 100 marks out of which, the supervisor / guide will evaluate for 30 marks based on the work and presentation / execution of the work. Subdivision for the remaining 70 marks is based on publication, report, presentation, execution and viva-voce. Evaluation shall be done by a committee comprising the supervisor, Head of the department and an examiner nominated by the Principal from the panel of experts recommended by Chairman, BOS in consultation with Head of the department.

8.6 Project work

The project work shall be evaluated for 100 marks out of which 30 marks for internal evaluation and 70 marks for semester end evaluation. The project work shall be spread over in VII semester and in VIII semester. The project work shall be somewhat innovative in nature and explore the research bent of the mind of the student. A student shall carry out the project work under the supervision of a member of the faculty or may undertake to execute the project in collaboration with an Industry, R&D organization or another academic institution/University where sufficient facilities exist to carry out the project work.

At the end of VII semester, students should submit synopsis summarizing the work done in VII semester. The project is expected to be completed by the end of VIII semester. In VII semester, a first mid review is conducted by Project Review Committee (PRC) (on the progress) for 10 marks.

In VIII semester, a second mid review is conducted by PRC (on the progress) for 10 marks. On completion of the project, a third evaluation is conducted for award of internal marks of another 10 marks before the report is submitted, making the total internal marks 30.

The end semester examination shall be based on the report submitted and a viva-voce exam for 70 marks by a committee comprising the Head of the Department, the project supervisor and an external examiner nominated by the Principal. A minimum of 40% of maximum marks shall be obtained to earn the corresponding credits.

8.7 Full Semester Internship (FSI)

FSI is a full semester internship program carrying 11 credits. The FSI shall be opted in VII semester or in VIII semester. During the FSI, student has to spend one full semester in an identified industry / firm / R & D organization or another academic institution/University where sufficient facilities exist to carry out the project work.
Following are the evaluation guidelines:

- Quizzes: 2 times
- Quiz #1 - About the industry profile, weightage: 5%
- Quiz #2 - Technical-project related, weightage: 5%
- Seminars - 2 times (once in six weeks), weightage: 7.5% + 7.5%
- Viva-voce: 2 times (once in six weeks), weightage: 7.5% + 7.5%
- Project Report, weightage: 15%
- Internship Diary, weightage: 5%
- Final Presentation, weightage: 40%

FSI shall be open to all the branches with a ceiling of maximum 10% distributed in both semesters. The selection procedure is:

- Choice of the students
- CGPA (> 7.5) up to IV semester
- Competency Mapping / Allotment

9.0 MAKEUP EXAMINATION

The make-up examination facility shall be available to students who may have missed to attend CIE exams in one or more courses in a semester for valid genuine reasons. The make-up examination shall have comprehensive online objective type questions. The syllabus for the make-up examination shall be the whole syllabus covered till the end of the semester under consideration and will be conducted at the end of the semester.

10.0 SUPPLEMENTARY EXAMINATIONS:

In addition to the Regular Semester End Examinations held at the end of each semester, Supplementary Semester End Examinations will be conducted within three weeks of the commencement of the teaching of the next semester. Candidates taking the Regular / Supplementary examinations as Supplementary candidates may have to take more than one Semester End Examination per day. A student can appear for any number of supplementary examinations till he/she clears all courses which he/she could not clear in the first attempt. However the maximum stipulated period for the course shall not be relaxed under any circumstances.

11.0 ATTENDANCE REQUIREMENTS AND DETENTION POLICY

11.1 It is desirable for a candidate to have 100% attendance in each course. In every course (theory/laboratory), student has to maintain a minimum of 75% attendance including the days of attendance in sports, games, NCC and NSS activities to be eligible for appearing in Semester End Examination of the course.

11.2 In case of medical issues, deficiency of attendance in each course to the extent of 10% may be condoned by the College Academic Committee (CAC) on the recommendation of the Head of the Department if the attendance is between 75% and 65% in every course, subjected to the submission of medical certificates, medical case file, and other needful documents to the concerned departments.

11.3 The basis for the calculation of the attendance shall be the period prescribed by the institute by its calendar of events. For late admission, attendance is reckoned from the date of admission to the program. However, in case of a student having less than 65% attendance in any course, s/he shall be detained in the course and in no case such process will be relaxed.
11.4 A candidate shall put in a minimum required attendance in at least 60% of (rounded to the next highest integer) theory courses for getting promoted to next higher class / semester. Otherwise, s/he shall be declared detained and has to repeat semester.

11.5 Students whose shortage of attendance is not condoned in any subject are not eligible to write their semester end examination of that courses and their registration shall stand cancelled.

11.6 A prescribed fee shall be payable towards condonation of shortage of attendance.

11.7 A student shall not be promoted to the next semester unless he satisfies the attendance requirement of the present semester, as applicable. They may seek readmission into that semester when offered next. If any candidate fails to fulfill the attendance requirement in the present semester, he shall not be eligible for readmission into the same class.

11.8 Any student against whom any disciplinary action by the institute is pending shall not be permitted to attend any SEE in that semester.

12.0 CONDUCT OF SEMESTER END EXAMINATIONS AND EVALUATION

12.1 Semester end examination shall be conducted by the Controller of Examinations (COE) by inviting Question Papers from the External Examiners.

12.2 Question papers may be moderated for the coverage of syllabus, pattern of questions by a Semester End Examination Committee chaired by Head of the Department one day before the commencement of semester end examinations. Internal Examiner shall prepare a detailed scheme of valuation.

12.3 The answer papers of semester end examination should be evaluated by the internal examiner immediately after the completion of exam and the award sheet should be submitted to COE in a sealed cover before the same papers are kept for second evaluation by external examiner.

12.4 In case of difference of more than 15% of marks, the answer paper shall be re-evaluated by a third examiner appointed by the Examination Committee and marks awarded by this examiner shall be taken as final.

12.5 COE shall invite 3 - 9 external examiners to evaluate all the end-semester answer scripts on a prescribed date(s). Practical laboratory exams are conducted involving external examiners.

12.6 Examinations Control Committee shall consolidate the marks awarded by internal and external examiners and award grades.

13.0 SCHEME FOR THE AWARD OF GRADE

13.1 A student shall be deemed to have satisfied the minimum academic requirements and earn the credits for each theory course, if s/he secures

i. Not less than 35% marks for each theory course in the semester end examination, and

ii. A minimum of 40% marks for each theory course considering both internal and semester end examination.

13.2 A student shall be deemed to have satisfied the minimum academic requirements and earn the credits for each Lab / Project based learning / Research based learning / Project work / FSI, if s/he secures

i. Not less than 40% marks for each Lab / Project based learning / Research based learning / Project work / FSI course in the semester end examination,

ii. A minimum of 40% marks for each Lab / Project based learning / Research based learning / Project work / FSI course considering both internal and semester end examination.
13.3 If a candidate fails to secure a pass in a particular course, it is mandatory that s/he shall register and reappear for the examination in that course during the next semester when examination is conducted in that course. It is mandatory that s/he should continue to register and reappear for the examination till s/he secures a pass.

14.0 LETTER GRADES AND GRADE POINTS

14.1 Performances of students in each course are expressed in terms of marks as well as in Letter Grades based on absolute grading system. The UGC recommends a 10-point grading system with the following letter grades as given in the Table-6.

Table-6: Grade Points Scale (Absolute Grading)

<table>
<thead>
<tr>
<th>Range of Marks</th>
<th>Grade Point</th>
<th>Letter Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 – 90</td>
<td>10</td>
<td>S (Superior)</td>
</tr>
<tr>
<td>89 – 80</td>
<td>9</td>
<td>A+ (Excellent)</td>
</tr>
<tr>
<td>79 – 70</td>
<td>8</td>
<td>A (Very Good)</td>
</tr>
<tr>
<td>69 – 60</td>
<td>7</td>
<td>B+ (Good)</td>
</tr>
<tr>
<td>59 – 50</td>
<td>6</td>
<td>B (Average)</td>
</tr>
<tr>
<td>49 – 40</td>
<td>5</td>
<td>C (Pass)</td>
</tr>
<tr>
<td>Below 40</td>
<td>0</td>
<td>F (Fail)</td>
</tr>
<tr>
<td>Absent</td>
<td>0</td>
<td>AB (Absent)</td>
</tr>
<tr>
<td>Authorized Break of Study</td>
<td>0</td>
<td>ABS</td>
</tr>
</tbody>
</table>

14.2 A student is deemed to have passed and acquired to correspondent credits in particular course if s/he obtains any one of the following grades: “S”, “A+”, “A”, “B+”, “B”, “C”.

14.3 A student obtaining Grade F shall be considered Failed and will be required to reappear in the examination.

14.4 For non credit courses, ‘Satisfactory’ or “Not Satisfactory” is indicated instead of the letter grade and this will not be counted for the computation of SGPA/CGPA.

14.5 “SA” denotes shortage of attendance (as per item 11) and hence prevention from writing Semester End Examination.

14.6 “W” denotes withdrawal from the exam for the particular course.

14.7 At the end of each semester, the institute issues grade sheet indicating the SGPA and CGPA of the student. However, grade sheet will not be issued to the student if s/he has any outstanding dues.

15.0 COMPUTATION OF SGPA AND CGPA

The UGC recommends to compute the Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA). The credit points earned by a student are used for calculating the Semester Grade Point Average (SGPA) and the Cumulative Grade Point Average (CGPA), both of which are important performance indices of the student. SGPA is equal to the sum of all the total points earned by the student in a given semester divided by the number of credits registered by the student in that semester. CGPA gives the sum of all the total points earned in all the previous semesters and the current semester divided by the number of credits registered in all these semesters. Thus,
Where, \( C_i \) is the number of credits of the \( i^{th} \) course and \( G_i \) is the grade point scored by the student in the \( i^{th} \) course and \( n \) represent the number of courses in which a student is registered in the concerned semester.

\[
SGPA = \frac{\sum_{i=1}^{n} (C_i \cdot G_i)}{\sum_{i=1}^{n} C_i}
\]

Where, \( S_j \) is the SGPA of the \( j^{th} \) semester and \( C_j \) is the total number of credits up to the semester and \( m \) represent the number of semesters completed in which a student registered up to the semester.

The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

**16.0 ILLUSTRATION OF COMPUTATION OF SGPA AND CGPA**

**16.1 Illustration for SGPA**

<table>
<thead>
<tr>
<th>Course Name</th>
<th>Course Credits</th>
<th>Grade letter</th>
<th>Grade point</th>
<th>Credit Point (Credit x Grade)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course 1</td>
<td>3</td>
<td>A</td>
<td>8</td>
<td>3 x 8 = 24</td>
</tr>
<tr>
<td>Course 2</td>
<td>4</td>
<td>B+</td>
<td>7</td>
<td>4 x 7 = 28</td>
</tr>
<tr>
<td>Course 3</td>
<td>3</td>
<td>B</td>
<td>6</td>
<td>3 x 6 = 18</td>
</tr>
<tr>
<td>Course 4</td>
<td>3</td>
<td>S</td>
<td>10</td>
<td>3 x 10 = 30</td>
</tr>
<tr>
<td>Course 5</td>
<td>3</td>
<td>C</td>
<td>5</td>
<td>3 x 5 = 15</td>
</tr>
<tr>
<td>Course 6</td>
<td>4</td>
<td>B</td>
<td>6</td>
<td>4 x 6 = 24</td>
</tr>
<tr>
<td></td>
<td>20</td>
<td></td>
<td></td>
<td>139</td>
</tr>
</tbody>
</table>

Thus, \( SGPA = \frac{139}{20} = 6.95 \)

**16.2 Illustration for CGPA**

<table>
<thead>
<tr>
<th>Semester 1</th>
<th>Semester 2</th>
<th>Semester 3</th>
<th>Semester 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Credit: 20</td>
<td>Credit: 22</td>
<td>Credit: 25</td>
<td>Credit: 26</td>
</tr>
<tr>
<td>SGPA: 6.9</td>
<td>SGPA: 7.8</td>
<td>SGPA: 5.6</td>
<td>SGPA: 6.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Semester 5</th>
<th>Semester 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Credit: 26</td>
<td>Credit: 25</td>
</tr>
<tr>
<td>SGPA: 6.3</td>
<td>SGPA: 8.0</td>
</tr>
</tbody>
</table>

Thus, \( CGPA = \frac{20 \times 6.9 + 22 \times 7.8 + 25 \times 5.6 + 26 \times 6.0 + 26 \times 6.3 + 25 \times 8.0}{144} = 6.73 \)

**17.0 PHOTOCOPY / REVALUATION**

A student, who seeks the re-valuation of the answer script, is directed to apply for the photocopy of his/her semester examination answer paper(s) in the theory course(s), within 2 working days from the declaration of results in the prescribed format to the Controller of Examinations through the Head of the department. On receiving the photocopy, the student can consult with a
competent member of faculty and seek the opinion for revaluation. Based on the recommendations, the student can register for the revaluation with prescribed fee. The Controller of Examinations shall arrange for the revaluation and declare the results. Revaluation is not permitted to the courses other than theory courses.

18.0 PROMOTION POLICIES

The following academic requirements have to be satisfied in addition to the attendance requirements mentioned in item no. 11.

18.1 For students admitted into B.Tech (Regular) program

18.1.1 A student will not be promoted from II semester to III semester unless s/he fulfills the academic requirement of securing 50% of the total credits (rounded to the next lowest integer) from I and II semester examinations, whether the candidate takes the examination(s) or not.

18.1.2 A student will not be promoted from IV semester to V semester unless s/he fulfills the academic requirement of securing 50% of the total credits (rounded to the next lowest integer) up to III semester or 50% of the total credits (rounded to the next lowest integer) up to IV semester, from all the examinations, whether the candidate takes the examination(s) or not.

18.1.3 A student shall be promoted from VI semester to VII semester only if s/he fulfills the academic requirements of securing 50% of the total credits (rounded to the next lowest integer) up to V semester or 50% of the total credits (rounded to the next lowest integer) up to VI semester from all the examinations, whether the candidate takes the examination(s) or not.

18.1.4 A student shall register for all the 160 credits and earn all the 160 credits. Marks obtained in all the 160 credits shall be considered for the award of the Grade.

18.2 For students admitted into B.Tech (lateral entry students)

18.2.1 A student will not be promoted from IV semester to V semester unless s/he fulfills the academic requirement of securing 50% of the total credits (rounded to the next lowest integer) up to IV semester, from all the examinations, whether the candidate takes the examination(s) or not.

18.2.2 A student shall be promoted from VI semester to VII semester only if s/he fulfills the academic requirements of securing 50% of the total credits (rounded to the next lowest integer) up to V semester or 50% of the total credits (rounded to the next lowest integer) up to VI semester from all the examinations, whether the candidate takes the examination(s) or not.

18.2.3 A student shall register for all the 123 credits and earn all the 123 credits. Marks obtained in all the 123 credits shall be considered for the award of the Grade.

19.0 GRADUATION REQUIREMENTS

The following academic requirements shall be met for the award of the B.Tech degree.

19.1 Student shall register and acquire minimum attendance in all courses and secure 160 credits for regular program and 123 credits for lateral entry program.

19.2 A student of a regular program, who fails to earn 160 credits within eight consecutive academic years from the year of his/her admission with a minimum CGPA of 4.0, shall forfeit his/her degree and his/her admission stands cancelled.

19.3 A student of a lateral entry program who fails to earn 123 credits within six consecutive academic years from the year of his/her admission with a minimum CGPA of 4.0, shall forfeit his/her degree and his/her admission stands cancelled.
20.0 BETTERMENT OF MARKS IN THE COURSES ALREADY PASSED

Students who clear all the courses in their first attempt and wish to improve their CGPA shall register and appear for betterment of marks for one course of any theory courses within a period of subsequent two semesters. The improved marks shall be considered for classification / distinction but not for ranking. If there is no improvement, there shall not be any change in the original marks already awarded.

21.0 AWARD OF DEGREE

21.1 Classification of degree will be as follows:

<table>
<thead>
<tr>
<th>CGPA ≥ 7.5</th>
<th>CGPA ≥ 6.5 and &lt; 7.5</th>
<th>CGPA ≥ 5.0 and &lt; 6.5</th>
<th>CGPA ≥ 4.0 and &lt; 5.0</th>
<th>CGPA &lt; 4.0</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>First Class with Distinction</strong></td>
<td><strong>First Class</strong></td>
<td><strong>Second Class</strong></td>
<td><strong>Pass Class</strong></td>
<td><strong>Fail</strong></td>
</tr>
</tbody>
</table>

21.2 In order to extend the benefit to the students with one/two backlogs after either VI semester or VIII semester, GRAFTING option is provided to the students enabling their placements and fulfilling graduation requirements. Following are the guidelines for the Grafting:

a. Grafting will be done among the courses within the semester shall draw a maximum of 7 marks from the any one of the cleared courses in the semester and will be grafted to the failed course in the same semester.

b. Students shall be given a choice of grafting only once in the 4 years program, either after VI semester (Option #1) or after VIII semester (Option #2).

c. Option#1: Applicable to students who have maximum of TWO theory courses in V and / or VI semesters.

Option#2: Applicable to students who have maximum of TWO theory courses in VII and / or VIII semesters.

d. Eligibility for grafting:

i. Prior to the conduct of the supplementary examination after the declaration of VI or VIII semester results.

ii. S/he must appear in all regular or supplementary examinations as per the provisions laid down in regulations for the courses s/he appeals for grafting.

iii. The marks obtained by her/him in latest attempt shall be taken into account for grafting of marks in the failed course(s).

21.3 Student, who clears all the courses upto VII semester, shall have a chance to appear for Quick Supplementary Examination to clear the failed courses of VIII semester.

21.4 By the end of VI semester, all the students (regular and lateral entry students) shall complete one of the audit course and mandatory course with acceptable performance.

21.5 In case, a student takes more than one attempt in clearing a course, the final marks secured shall be indicated by * mark in the grade sheet.

All the candidates who register for the semester end examination will be issued grade sheet by the institute. Apart from the semester wise grade sheet, the institute will issue the provisional certificate and consolidated grade sheet subject to the fulfillment of all the academic requirements.
Students acquiring 160 credits are eligible to get B.Tech degree in Engineering. A student will be eligible to get B.Tech degree with Honours or additional Minors in Engineering, if s/he completes an additional 20 credits (3/4 credits per course). These could be acquired through MOOCs from SWAYAM / NPTEL / edX / Coursera / Udacity /PurdueNext / Khan Academy / QEEE etc. The list for MOOCs will be a dynamic one, as new courses are added from time to time. Few essential skill sets required for employability are also identified year wise. Students interested in doing MOOC courses shall register the course title at their department office at the start of the semester against the courses that are announced by the department. Any expense incurred for the MOOC course / summer program should be met by the students.

Only students having no credit arrears and a CGPA of 7.5 or above at the end of the fourth semester are eligible to register for B.Tech (Honours / Minor). After registering for the B.Tech (Honours / Minor) program, if a student fails in any course, s/he will not be eligible for B.Tech (Honours / Minor).

Every Department to develop and submit a Honours / Minors – courses list of 5 - 6 theory courses.

Honours Certificate for Vertical in his/her OWN Branch for Research orientation; Minor in any OTHER branch for Improving Employability.

For the MOOCs platforms, where examination or assessment is absent (like SWAYAM) or where certification is costly (like Coursera or edX), faculty members of the institute prepare the examination question papers, for the courses undertaken by the students of respective Institutes, so that examinations Control Office (ECO) can conduct examination for the course. There shall be one Continuous Internal Examination (Quiz exam for 30 marks) after 8 weeks of the commencement of the course and semester end examination (Descriptive exam for 70 marks) shall be done along with the other regular courses.

A student can enroll for both Minor & Honours or for two Minors. The final grade sheet will only show the basic CGPA corresponding to the minimum requirement for the degree. The Minors/Honours will be indicated by a separate CGPA. The additional courses taken will also find separate mention in the grade sheet.

If a student drops (or terminated) from the Minor/Honours program, they cannot convert the earned credits into free or core electives; they will remain extra. These additional courses will find mention in the grade sheet (but not in the degree certificate). In such cases, the student may choose between the actual grade or a “Pass (P)” grade and also choose to omit the mention of the course as for the following:

- All the courses done under the dropped Minor/Honours will be shown in the grade sheet
- None of the courses done under the dropped Minor/Honours will be shown in the grade sheet.

Honours will be reflected in the degree certificate as “B.Tech (honours) in XYZ Engineering”. Similarly, Minor as “B.Tech in XYZ Engineering with Minor in ABC”. If a student has done both honours & minor, it will be acknowledged as “B.Tech (honours) in XYZ Engineering with Minor in ABC”. And two minors will be reflected as “B.Tech in XYZ Engineering with Minor in ABC and Minor in DEF”.

22.1. B.Tech with Honours

The total of 20 credits required to be attained for B.Tech Honours degree are distributed from V semester to VII semester in the following way:
For V semester : 4 – 8 credits
For VI semester : 4 – 8 credits
For VII semester : 4 – 8 credits

Following are the details of such Honours which include some of the most interesting areas in the profession today:

<table>
<thead>
<tr>
<th>S. No</th>
<th>Department</th>
<th>Honours scheme</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Aeronautical Engineering</td>
<td>Aerospace Engineering / Space Science etc.</td>
</tr>
<tr>
<td>2</td>
<td>Computer Science and Engineering / Information Technology</td>
<td>Big data and Analytics / Cyber Physical Systems, Information Security / Cognitive Science / Internet of Things (IoT) etc.</td>
</tr>
<tr>
<td>4</td>
<td>Electrical and Electronics Engineering</td>
<td>Renewable Energy systems / Energy and Sustainability / IoT Applications in Green Energy Systems etc.</td>
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<tr>
<td>5</td>
<td>Mechanical Engineering</td>
<td>Industrial Automation and Robotics / Manufacturing Sciences and Computation Techniques etc.</td>
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<td>6</td>
<td>Civil Engineering</td>
<td>Structural Engineering / Environmental Engineering etc.</td>
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22.2 B.Tech with additional Minor in Engineering

Every Department to develop and submit Minor Courses List of 5 - 6 Theory courses. Student from any department is eligible to apply for Minor from any other department. The total of 20 credits to complete the B.Tech (Minor) program by registering for MOOC courses each having a minimum of 3/4 credits offered by reputed institutions / organization with the approval of the department. Registration of the student for B.Tech (Minor), is from V Semester to VII Semester of the program in the following way:

For V semester : 4 – 8 credits
For VI semester : 4 – 8 credits
For VII semester : 4 – 8 credits

Only students having no credit arrears and a CGPA of 7.5 or above at the end of the fourth semester are eligible to register for B.Tech (Minor). After registering for the B.Tech (Minor) program, if a student fails in any course, s/he will not be eligible for B.Tech (Minor).

Every student shall also have the option to do a minor in engineering. A major is a primary focus of study and a minor is a secondary focus of study. The minor has to be a subject offered by a department other than the department that offers the major of the student or it can be a different major offered by the same department. For example, a student with the declared major in Computer Science and Engineering (CSE) may opt to do a minor in Physics; in which case, the student shall receive the degree B.Tech, Computer Science and Engineering with a minor in Physics. A student can do Majors in chosen filed as per the career goal, and a minor may be chosen to enhance the major thus adding the diversity, breadth and enhanced skills in the field.

Advantages of Minor in Engineering:

The minors mentioned above are having lots of advantages and a few are listed below:

1. To apply the inter-disciplinary knowledge gained through a Major (Stream) + Minor.
2. To enable students to pursue allied academic interest in contemporary areas.
3. To provide an academic mechanism for fulfilling multidisciplinary demands of industries.
4. To provide effective yet flexible options for students to achieve basic to intermediate level competence in the Minor area.
5. Provides an opportunity to students to become entrepreneurs and leaders by taking business/management minor.
6. Combination in the diverse fields of engineering e.g., CSE (Major) + Electronics (Minor) combination increases placement prospects in chip designing companies.
7. Provides an opportunity to Applicants to pursue higher studies in an inter-disciplinary field of study.
8. Provides opportunity to the Applicants to pursue interdisciplinary research.
9. To increase the overall scope of the undergraduate degrees.

**Following are the details of such Minor / Honours which include some of the most interesting areas in the profession today:**

1. Space Science
2. Information Security
3. Data Analytics
4. Cyber Physical Systems
5. Electronic System Design
6. Renewable Energy Sources
7. Energy and Sustainability
8. Industrial Automation and Robotics
9. Aerospace Engineering
10. Manufacturing Sciences and Computation Techniques
11. Structural Engineering
12. Environmental Engineering
13. Internet of Things
14. Computer Science and Engineering
15. Technological Entrepreneurship
16. Materials Engineering
17. Physics (Materials / Nuclear / Optical / Medical)
18. Mathematics (Combinatorics / Logic / Number theory / Dynamical systems and differential equations / Mathematical physics / Statistics and Probability).

**23.0 TEMPORARY BREAK OF STUDY FROM THE PROGRAM**

23.1 A candidate is normally not permitted to take a break from the study. However, if a candidate intends to temporarily discontinue the program in the middle for valid reasons (such as accident or hospitalization due to prolonged ill health) and to rejoin the program in a later respective semester, s/he shall seek the approval from the Principal in advance. Such application shall be submitted before the last date for payment of examination fee of the semester in question and forwarded through the Head of the Department stating the reasons for such withdrawal together with supporting documents and endorsement of his/her parent/guardian.
23.2 The institute shall examine such an application and if it finds the case to be genuine, it may permit the student to temporarily withdraw from the program. Such permission is accorded only to those who do not have any outstanding dues / demand at the College / University level including tuition fees, any other fees, library materials etc.

23.3 The candidate has to rejoin the program after the break from the commencement of the respective semester as and when it is offered.

23.4 The total period for completion of the program reckoned from the commencement of the semester to which the candidate was first admitted shall not exceed the maximum period specified in clause 19. The maximum period includes the break period.

23.5 If any candidate is detained for any reason, the period of detention shall not be considered as ‘Break of Study’.

24.0 TERMINATION FROM THE PROGRAM
The admission of a student to the program may be terminated and the student is asked to leave the institute in the following circumstances:

a. The student fails to satisfy the requirements of the program within the maximum period stipulated for that program.

b. A student shall not be permitted to study any semester more than three times during the entire program of study.

c. The student fails to satisfy the norms of discipline specified by the institute from time to time.

25.0 WITH-HOLDING OF RESULTS
If the candidate has not paid any dues to the institute / if any case of indiscipline / malpractice is pending against him, the results and the degree of the candidate will be withheld.

26.0 GRADUATION DAY
The institute shall have its own annual Graduation Day for the award of degrees to the students completing the prescribed academic requirements in each case, in consultation with the University and by following the provisions in the Statute. The college shall institute prizes and medals to meritorious students and award them annually at the Graduation Day. This will greatly encourage the students to strive for excellence in their academic work.

27.0 DISCIPLINE
Every student is required to observe discipline and decorum both inside and outside the institute and are expected not to indulge in any activity which will tend to bring down the honour of the institute. If a student indulges in malpractice in any of the theory / practical examination, continuous assessment examinations, he/she shall be liable for punitive action as prescribed by the institute from time to time.

28.0 GRIEVANCE REDRESSAL COMMITTEE
The institute shall form a Grievance Redressal Committee for each course in each department with the Course Teacher and the HOD as the members. This Committee shall solve all grievances related to the course under consideration.

29.0 TRANSITORY REGULATIONS
A candidate, who is detained or has discontinued a semester, on readmission shall be required to do all the courses 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 courses 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.

**a) Four Year B.Tech Regular course:**
A student who is following Jawaharlal Nehru Technological University (JNTUH) curriculum and detained due to the shortage of attendance at the end of the first semester shall join the autonomous batch of first semester. Such students shall study all the courses 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.

A student who is following JNTUH curriculum, detained due to lack of credits or shortage of attendance at the end of the second semester 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 courses 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 courses of the semester(s) of the batch which he had passed earlier and substitute courses will be offered in place of them as decided by the Board of Studies. The student has to clear all his backlog courses up to previous semester by appearing for the supplementary examinations conducted by JNTUH 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 JNTUH 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.

**b) Three Year B.Tech program under Lateral Entry Scheme:**
A student who is following JNTUH curriculum and detained due to the shortage of attendance at the end of the second semester of second year shall join the autonomous batch of third semester. Such students shall study all the courses 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.

A student who is following JNTUH curriculum, if 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 courses 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 courses of the semester(s) of the batch which he had passed earlier and substitute courses are offered in place of them as decided by the Board of Studies. The student has to clear all his backlog courses up to previous semester by appearing for the supplementary examinations conducted by JNTUH 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 JNTUH regulations and the credits prescribed for the semester in which a candidate seeks readmission and subsequent semesters under the autonomous status. The class will be awarded based on the academic performance of a student in the autonomous pattern.

**c) Transfer candidates (from non-autonomous college affiliated to JNTUH):**
A student who is following JNTUH curriculum, transferred from other college to this institute in third semester or subsequent semesters shall join with the autonomous batch in the
appropriate semester. Such candidates shall be required to pass in all the courses 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 courses of the semester(s) of the batch which he had passed earlier and substitute courses are offered in their place as decided by the Board of Studies. The student has to clear all his backlog courses up to previous semester by appearing for the supplementary examinations conducted by JNTUH 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 the previous semester under JNTUH regulations and the credits prescribed for the semester in which a candidate joined after transfer and subsequent semesters under the autonomous status. The class will be awarded based on the academic performance of a student in the autonomous pattern.

d) Transfer candidates (from an autonomous college affiliated to JNTUH):

A student who has secured the required credits up to previous semesters as per the regulations of other autonomous institutions shall also be permitted to be transferred to this institute. A student who is transferred from the other autonomous colleges to this institute in third semester or subsequent semesters shall join with the autonomous batch in the appropriate semester. Such candidates shall be required to pass in all the courses 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 courses 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 is transferred and the credits prescribed for the semester in which a candidate joined after transfer and subsequent semesters under the autonomous status. The class will be awarded based on the academic performance of a student in the autonomous pattern.

e) Readmission from IARE-R16 to IARE-R18 regulations

A student took admission in IARE-R16 Regulations, detained due to lack of required number of credits or percentage of attendance at the end of any semester is permitted to take re-admission at appropriate level under any regulations prevailing in the institute subject to the following rules and regulations.

1. Student shall pass all the courses in the earlier scheme of regulations (IARE - R16).
   However, in case of having backlog courses, they shall be cleared by appearing for supplementary examinations conducted under IARE - R16 regulations from time to time.
2. After rejoining, the student is required to study the courses as prescribed in the new regulations for the re-admitted program at that level and thereafter.
3. If the student has already passed any course(s) of readmitted program in the earlier regulation / semester of study, such courses are exempted in the new scheme to appear for the course(s).
4. The courses that are not done in the earlier regulations / semester as compared with readmitted program need to be cleared after readmission by appearing for the examinations conducted time to time under the new regulations.
5. In general, after transition, course composition and number of credits / semester shall be balanced between earlier and new regulations on case to case basis.
6. In case, the students who do not have option of acquiring required credits with the existing courses offered as per the new curriculum, credit balance can be achieved by clearing the additional courses offered by the respective departments (approved in Academic Council meeting). The additional courses that are offered can be of theory or laboratory courses and shall be offered during semester.

7. Students re-joined in III semester shall be treated on par with “Lateral Entry” students for credits and graduation requirements. However, the student shall clear all the courses in B.Tech I Semester and B.Tech II Semester as per IARE-R16 regulations.

30.0 REVISION OF REGULATIONS AND CURRICULUM

The Institute from time to time may revise, amend or change the regulations, scheme of examinations and syllabi if found necessary and on approval by the Academic Council and the Governing Body and shall be binding on the students, faculty, staff, all authorities of the Institute and others concerned.

FAILURE TO READ AND UNDERSTAND THE REGULATIONS IS NOT AN EXCUSE
## I Semester

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Subject Area</th>
<th>Category</th>
<th>Periods per week</th>
<th>Credits</th>
<th>Scheme of Examination Max. Marks</th>
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### PRACTICALS

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**TOTAL**

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Contact Classes: 30  Tutorial Classes: Nil  Practical Classes: Nil  Total Classes: 30

**OBJECTIVES:**
The course should enable the students to:
I. Communicate in an intelligible English accent and pronunciation.
II. Use the four language skills i.e., Listening, Speaking, Reading and Writing effectively.
III. Develop the art of writing accurate English with correct spelling, grammar and punctuation.

**MODULE - I**  GENERAL INTRODUCTION AND LISTENING SKILLS  Classes: 06
Introduction to communication skills; Communication process; Elements of communication; Soft skills vs hard skills; Importance of soft skills for engineering students; Listening skills; Significance; Stages of listening; Barriers to listening and effectiveness of listening; Listening comprehension.

**MODULE - II**  SPEAKING SKILLS  Classes: 06
Significance; Essentials; Barriers and effectiveness of speaking; Verbal and non-verbal communication; Generating talks based on visual prompts; Public speaking; Addressing a small group or a large formal gathering; Oral presentation; Power point presentation.

**MODULE - III**  VOCABULARY & GRAMMAR  Classes: 06
Vocabulary:
The concept of Word Formation; Root words from foreign languages and their use in English; Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives; Synonyms; Antonyms; Standard abbreviations; Idioms and phrases; One word substitutes.

Grammar:
Sentence structure; Uses of phrases and clauses; Punctuation; Subject verb agreement; Modifiers; Articles; Prepositions.

**MODULE - IV**  READING SKILLS  Classes: 06
Significance; Techniques of reading; Skimming-Reading for the gist of a text; Scanning - Reading for specific information; Intensive; Extensive reading; Reading comprehension;; Reading for information transfer; Text to diagram; Diagram to text.

**MODULE - V**  WRITING SKILLS  Classes: 06
Significance; Effectiveness of writing; Organizing principles of Paragraphs in documents; Writing introduction and conclusion; Techniques for writing precisely; Letter writing; Formal and Informal letter writing; E-mail writing, Report Writing.
### Text Books:
- Handbook of English for Communication (Prepared by Faculty of English, IARE)

### Reference Books:

### Web References:
1. www.edufind.com
2. www.myenglishpages.com

### E-Text Books:
LINEAR ALGEBRA AND CALCULUS

I Semester: AE / CSE / IT / ECE / EEE / ME / CE

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Contact Classes: 45  Tutorial Classes: 15  Practical Classes: Nil  Total Classes: 60

OBJECTIVES:
The course should enable the students to:
I. Determine rank of a matrix and solve linear differential equations of second order.
II. Determine the characteristic roots and apply double integrals to evaluate area.
III. Apply mean value theorems and apply triple integrals to evaluate volume.
IV. Determine the functional dependence and extremum value of a function.
V. Analyze gradient, divergence, curl and evaluate line, surface, volume integrals over a vector field.

Module-I  THEORY OF MATRICES AND HIGHER ORDER LINEAR DIFFERENTIAL EQUATIONS  Classes: 09

THEORY OF MATRICES: Real matrices: Symmetric, skew-symmetric and orthogonal matrices; Complex matrices: Hermitian, Skew-Hermitian and unitary matrices; Elementary row and column transformations; Rank of a matrix: Echelon form and normal form; Inverse by Gauss-Jordan method.

HIGHER ORDER LINEAR DIFFERENTIAL EQUATIONS: Linear differential equations of second and higher order with constant coefficients, non-homogeneous term of the type $f(x) = e^{-x}, \sin ax, \cos ax$ and $f(x) = x^n, e^{-x}, v(x), xv(x)$; Method of variation of parameters.

Module-II  LINEAR TRANSFORMATIONS AND DOUBLE INTEGRALS  Classes: 09

LINEAR TRANSFORMATIONS: Cayley-Hamilton theorem: Statement, verification, finding inverse and powers of a matrix; Linear dependence and independence of vectors; Eigen values and Eigen vectors of a matrix and Properties (without proof); Diagonalization of matrix by linear transformation.

DOUBLE INTEGRALS: Evaluation of double integrals in Cartesian coordinates and Polar coordinates; Change of order of integration; Area as a double integral; Transformation of coordinate system.

Module-III  FUNCTIONS OF SINGLE VARIABLES AND TRIPLE INTEGRALS  Classes: 09

FUNCTIONS OF SINGLE VARIABLES: Mean value theorems: Rolle’s theorem, Lagrange’s theorem, Cauchy’s theorem-without proof and geometrical interpretation.

TRIPLE INTEGRALS: Evaluation of triple integrals in Cartesian coordinates; volume of a region using triple integration.

Module-IV  FUNCTIONS OF SEVERAL VARIABLES AND EXTREMA OF A FUNCTION  Classes: 09

FUNCTIONS OF SEVERAL VARIABLES: Partial differentiation, functional dependence, Jacobian.

EXTREMA OF A FUNCTION: Maxima and minima of functions of two variables without constraints and with constraints; Method of Lagrange multipliers.
Module-V  VECTOR DIFFERENTIAL AND INTEGRAL CALCULUS  

**VECTOR DIFFERENTIAL CALCULUS:** Scalar and vector point functions; Definitions of Gradient, divergent and curl with examples; Solenoidal and irrotational vector point functions; Scalar potential function.

**VECTOR INTEGRAL THEOREMS:** Line integral, surface integral and volume integral, Green’s theorem in a plane, Stoke’s theorem and Gauss divergence theorem without proofs.

**Text Books:**

**Reference Books:**

**Web References:**

**E-Text Books:**
## ENGINEERING CHEMISTRY

### I Semester: CSE / IT / EEE | II Semester: AE / ECE / ME / CE

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**Contact Classes:** 45  
**Tutorial Classes:** 15  
**Practical Classes:** Nil  
**Total Classes:** 60

### OBJECTIVES:

**The course should enable the students to:**

I. Apply the electrochemical principles in batteries, understand the fundamentals of corrosion.

II. Analysis of water for its various parameters and its significance in industrial and domestic applications.

III. Analyze microscopic chemistry in terms of atomic, molecular orbitals and Intermolecular forces.

IV. Analysis of major chemical reactions that are used in the synthesis of molecules.

V. Understand the chemistry of various fuels and their combustion.

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### MODULE-I  ELECTROCHEMISTRY AND CORROSION  Classes: 09

Electro chemical cells: Electrode potential, standard electrode potential, types of electrodes; Calomel, Quinhydrone and glass electrode; Nernst equation; Electrochemical series and its applications; Numerical problems; Batteries: Primary (Dry cell) and secondary batteries (Lead-acid storage battery and Lithium ion battery).

Causes and effects of corrosion: Theories of chemical and electrochemical corrosion, mechanism of electrochemical corrosion; Types of corrosion: Galvanic, water-line and pitting corrosion; Factors affecting rate of corrosion; Corrosion control methods: Cathodic protection, sacrificial anode and impressed current; Surface coatings: Metallic coatings- Methods of coating- Hot dipping, cementation, electroplating and Electroless plating of copper.

---

### MODULE-II  WATER AND ITS TREATMENT  Classes: 08

Introduction: Hardness of water, Causes of hardness; Types of hardness: temporary and permanent, expression and units of hardness; Estimation of hardness of water by complexometric method; Potable water and its specifications, Steps involved in treatment of water, Disinfection of water by chlorination and ozonization; Boiler feed water and its treatment, Calgon conditioning, Phosphate conditioning and Colloidal conditioning; External treatment of water; Ion-exchange process; Desalination of water: Reverse osmosis, numerical problems.

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### MODULE-III  MOLECULAR STRUCTURE AND THEORIES OF BONDING  Classes: 08

Shapes of Atomic orbitals, Linear Combination of Atomic orbitals (LCAO), molecular orbitals of diatomic molecules; Molecular orbital energy level diagrams of N₂, O₂, F₂, CO and NO molecules.

Crystal Field Theory (CFT): Salient Features of CFT-Crystal Fields; Splitting of transition metal ion d-orbitals in Tetrahedral, Octahedral and square planar geometries; Band structure of solids and effect of doping on conductance.
### MODULE - IV  
**STEREOCHEMISTRY, REACTION MECHANISM AND SYNTHESIS OF DRUG MOLECULES**

Classes: 12

Introduction to representation of 3-dimensional structures: Structural and stereoisomers, configurations, symmetry and chirality; Enantiomers, diastereomers, optical activity and Absolute configuration; Confirmation analysis of n- butane. Substitution reactions: Nucleophilic substitution reactions, Mechanism of SN¹, SN² reactions; Electrophilic and nucleophilic addition reactions; Addition of HBr to propene; Markownikoff and anti Markownikoff’s additions; Grignard additions on carbonyl compounds; Elimination reactions: Dehydro halogenation of alkylhalides; Saytzeff rule; Oxidation reactions: Oxidation of alcohols using KMnO₄ and chromic acid; Reduction reactions: Reduction of carbonyl compounds using LiAlH₄ & NaBH₄; Hydroboration of olefins; Structure, synthesis and pharmaceutical applications of Paracetamol and Aspirin.

### MODULE - V  
**FUELS AND COMBUSTION**

Classes: 08

Fuels: Definition, classification of fuels and characteristics of a good fuels; Solid fuels: Coal; Analysis of coal: Proximate and ultimate analysis; Liquid fuels: Petroleum and its refining; Cracking: Fixed bed catalytic cracking; Knocking: Octane and cetane numbers; Gaseous fuels: Composition, characteristics and applications of natural gas, LPG and CNG; Combustion: Calorific value: Gross Calorific Value(GCV) and Net Calorific Value(NCV), calculation of air quantity required for complete combustion of fuel, numerical problems.

**Text Books:**


**Reference Books:**


**Web References:**

ENGLISH LANGUAGE AND COMMUNICATION SKILLS LABORATORY

I Semester: ECE / EEE / CE | II Semester: AE / CSE / IT / ME

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Contact Classes: Nil  Tutorial Classes: Nil  Practical Classes: 24  Total Classes: 24

OBJECTIVES:
The course enables the students to:
I. Improve their ability to listen and comprehend a given text.
II. Upgrade the fluency and acquire a functional knowledge of English Language.
III. Enrich thought process by viewing a problem through multiple angles.

LIST OF ACTIVITIES

Week-1 LISTENING SKILL
a. Listening to conversations and interviews of famous personalities in various fields; Listening practice related to the TV talk shows and news.
b. Listening for specific information; Listening for summarizing information – Testing.

Week-2 LISTENING SKILL
a. Listening to films of short duration and monologues for taking notes; Listening to answer multiple choice questions.
b. Listening to telephonic conversations; Listening to native Indian: Abdul Kalam, British: Helen Keller and American: Barrack Obama speakers to analyze intercultural differences – Testing.

Week-3 SPEAKING SKILL
a. Functions of English Language; Introduction to pronunciation; Vowels and Consonants
b. Tips on how to develop fluency, body language and communication; Introducing oneself: Talking about yourself, others, leave taking.

Week-4 SPEAKING SKILL
a. Sounds - Speaking exercises involving the use of Vowels and Consonant sounds in different contexts; Exercises on Homophones and Homographs
b. Just a minute (JAM) session.

Week-5 SPEAKING SKILL
a. Stress patterns.
b. Situational Conversations: common everyday situations; Acting as a compere and newsreader; Greetings for different occasions with feedback preferably through video recording.
<table>
<thead>
<tr>
<th>Week-6</th>
<th>READING SKILL</th>
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a. Intonation.  
b. Reading newspaper and magazine articles; Reading selective autobiographies for critical commentary. |

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<th>Week-7</th>
<th>READING SKILL</th>
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a. Improving pronunciation through tongue twisters.  
b. Reading advertisements, pamphlets; Reading comprehension exercises with critical and analytical questions based on context. |

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<tr>
<th>Week-8</th>
<th>WRITING SKILL</th>
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</table>
a. Listening to inspirational short stories.  
b. Writing messages, leaflets, Notice; Writing tasks; Flashcards – Exercises. |

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<tr>
<th>Week-9</th>
<th>WRITING SKILL</th>
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</table>
a. Write the review on a video clipping of short duration (5 to 10 minutes).  
b. Write a slogan related to the image; Write a short story of 6-10 lines based on the hints given. |

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<tr>
<th>Week-10</th>
<th>WRITING SKILL</th>
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</table>
a. Minimizing Mother Tongue Influence to improve fluency through watching educational videos.  
b. Writing practices – précis writing; Essay writing. |

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<tr>
<th>Week-11</th>
<th>THINKING SKILL</th>
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a. Correcting common errors in day to day conversations.  
b. Practice in preparing thinking blocks to decode diagrammatical representations into English words, expressions, idioms, proverbs. |

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<tr>
<th>Week-12</th>
<th>THINKING SKILL</th>
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</table>
a. Correcting common errors in day to day conversations.  
b. Making pictures and improvising diagrams to form English words, phrases and proverbs. |

**Reference Books:**


**Web References:**

1. http://learnenglish.britishcouncil.org  
EQUIPMENT REQUIRED FOR A BATCH OF 60 STUDENTS (ORAL AND MULTIMEDIA)

1. Career laboratory: 1 Room
2. Server computer for the laboratory with high configuration: 1 no
3. Computers: 30 nos
4. Software: K Van Solution
5. LCD Projector: 1 no
6. Speakers with amplifiers, one wireless mic and one collar mic
7. Podium: 1
8. Chairs: 30
9. Discussion Tables: 2
10. White board: 1
ENGINEERING CHEMISTRY LABORATORY

I Semester: CSE / IT / EEE | II Semester: AE / ECE / ME / CE

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Contact Classes: Nil  
Tutorial Classes: Nil  
Practical Classes: 36  
Total Classes: 36

OBJECTIVES:
The course should enable the students to:
I. Analyze, interpret, and draw conclusions from experimental data.
II. Describe the fluid property of surface tension and viscosity.
III. Perform a complexometric titration to determine the hardness of water from various sources.
IV. Comprehend the experimental results.

LIST OF EXPERIMENTS

Week-1  INTRODUCTION TO CHEMISTRY LABORATORY
Introduction to chemistry laboratory. Do's and Don'ts in chemistry laboratory.

Week-2  PREPARATION OF ORGANIC COMPOUNDS
Synthesis of Aspirin.

Week-3  VOLUMETRIC ANALYSIS
Estimation of Total hardness of water by complexometric method using EDTA.

Week-5  INSTRUMENTATION
Estimation of an HCl by conductometric titrations.

Week-6  INSTRUMENTATION
Estimation of HCl by potentiometric titrations.

Week-7  INSTRUMENTATION
Estimation of Acetic acid by Conductometric titrations.

Week-8  INSTRUMENTATION
Estimation of Fe$^{2+}$ by Potentiometry using KMnO$_4$titrations.
Week-9 | VOLUMETRIC ANALYSIS
---|---
Determination of chloride content of water by Argentometry.

Week-10 | PHYSICAL PROPERTIES
---|---
Determination of surface tension of a given liquid using Stalagmometer.

Week-11 | PHYSICAL PROPERTIES
---|---
Determination of viscosity of a given liquid using Ostwald’s viscometer.

Week-12 | PHYSICAL PROPERTIES
---|---
Verification of freundlich adsorption isotherm-adsorption of acetic and on charcoal.

Week-13 | ANALYSIS OF ORGANIC COMPOUNDS
---|---
Thin layer chromatography calculation of $R_f$ values. Eg: ortho and para nitro phenols.

Week-14 | REVISION
---|---
Revision.

Reference Books:

Web References:
http://www.iare.ac.in

LIST OF EQUIPMENT REQUIRED FOR A BATCH OF 30 STUDENTS:

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<td>Clamps with Boss heads</td>
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ENGINEERING GRAPHICS AND DESIGN LABORATORY

I Semester: ECE / EEE / CE | II Semester: AE / ME / CSE / IT

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Contact Classes: 12  Tutorial Classes: Nil  Practical Classes: 48  Total Classes: 60

OBJECTIVES:
The course should enable the students to
I. Understand the basic principles of engineering drawing and construction of curves used in engineering field.
II. Apply the knowledge of interpretation of projection in different quadrants.
III. Understand the projections of solids, when it is inclined to both planes simultaneously.
IV. Convert the pictorial views into orthographic view and vice versa.
V. Create intricate details of components through sections and develop its surfaces.

LIST OF EXPERIMENTS

MODULE - I

INTRODUCTION TO ENGINEERING DRAWING

Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involute; Scales-

MODULE - II

OVERVIEW OF COMPUTER GRAPHICS, CUSTOMIZATION & CAD DRAWING, ANNOTATIONS, LAYERING & OTHER FUNCTIONS, DEMONSTRATION OF A SIMPLE TEAM DESIGN PROJECT

Listing the computer technologies that impact on graphical communication, Demonstrating knowledge of the theory of CAD software [such as: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.; Isometric Views of lines, Planes, Simple and compound Solids].

Consisting of set up of the drawing page and the printer, including scale settings, Setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerancing; Orthographic constraints, Snap to objects manually and automatically; Producing drawings by using various coordinate input entry methods to draw straight lines. Applying various ways of drawing circles.

Applying dimensions to objects, applying annotations to drawings; Setting up and use of Layers, layers to create drawings, Create, edit and use customized layers; Changing line lengths through modifying existing lines (extend/lengthen); Printing documents to paper using the print command; orthographic projection techniques; Drawing sectional views of composite right regular geometric solids and project the true shape of the sectioned surface; Drawing annotation, Computer-aided design (CAD) software modeling of parts and assemblies. Parametric and non-parametric solid, surface, and wireframe models. Part editing and two-dimensional documentation of models. Planar projection theory, including sketching of perspective, isometric, multiview, auxiliary, and section views. Spatial visualization exercises. Dimensioning guidelines, tolerancing techniques; dimensioning and scale multi views of dwelling.
MODULE - III  ORTHOGRAPHIC PROJECTIONS

Principles of Orthographic Projections-Conventions-Projections of Points and lines inclined to both planes.

Projections of planes inclined Planes-Auxiliary Planes.

MODULE - IV  PROJECTIONS OF REGULAR SOLIDS AND SECTIONS AND SECTIONAL VIEWS OF RIGHT ANGULAR SOLIDS

Those inclined to both the Planes- Auxiliary Views; Draw simple annotation, dimensioning and scale.Floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc.
Draw the sectional orthographic views of geometrical solids of Prism, Pyramid, Cylinder and Cone; Objects from industry and dwellings (foundation to slab only).

MODULE - V  DEVELOPMENT OF SURFACES AND ISOMETRIC PROJECTIONS

Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone;
Principles of Isometric projection–Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions.

DEMONSTRATION OF A SIMPLE TEAM DESIGN PROJECT:
Geometry and topology of engineered components: creation of engineering models and their presentation in standard 2D blueprint form and as 3D wire-frame and shaded solids; meshed topologies for engineering analysis and tool-path generation for component manufacture; geometric dimensioning and tolerancing; Use of solid-modeling software for creating associative models at the component and assembly levels; floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc. Applying colour coding according to building drawing practice; Drawing sectional elevation showing foundation to ceiling; Introduction to Building Information Modelling (BIM).

Text Books:

Reference Books:

Web References:
1. http://nptel.ac.in/courses/112103019
2. http://www.autocadtutorials.net/

SOFTWARE AND HARDWARE REQUIREMENTS FOR A BATCH OF 30 STUDENTS:

SOFTWARE: AUTOCAD 2016
HARDWARE: 30 numbers of Intel Desktop Computers with 2 GB RAM
MATHEMATICAL TRANSFORM TECHNIQUES

II Semester: AE / ECE / EEE / ME / CE

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<td>3   1    -  4  30  70  100</td>
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</tbody>
</table>

Contact Classes: 45  Tutorial Classes: 15  Practical Classes: Nil  Total Classes: 60

OBJECTIVES:
The course should enable the students to:
I. Enrich the knowledge solving algebra and transcendental equations and understanding Laplace transforms.
II. Determine the unknown values of a function by interpolation and applying inverse Laplace transforms.
III. Fitting of a curve and determining the Fourier transform of a function.
IV. Solving the ordinary differential equations by numerical techniques.
V. Formulate to solve partial differential equation.

Module-I  ROOT FINDING TECHNIQUES AND LAPLACE TRANSFORMS  Classes: 09

ROOT FINDING TECHNIQUES: Root finding techniques: Solving algebraic and transcendental equations by bisection method, method of false position, Newton-Raphson method.

LAPLACE TRANSFORMS: Definition of Laplace transform, linearity property, piecewise continuous function, existence of Laplace transform, function of exponential order, first and second shifting theorems, change of scale property, Laplace transforms of derivatives and integrals, multiplied by t, divided by t, Laplace transform of periodic functions.

Module-II  INTERPOLATION AND INVERSE LAPLACE TRANSFORMS  Classes: 09

INTERPOLATION: Interpolation: Finite differences, forward differences, backward differences and central differences; Symbolic relations; Newton’s forward interpolation, Newton’s backward interpolation; Gauss forward central difference formula, Gauss backward central difference formula; Interpolation of unequal intervals: Lagrange’s interpolation.

INVERSE LAPLACE TRANSFORMS: Inverse Laplace transform: Definition of Inverse Laplace transform, linearity property, first and second shifting theorems, change of scale property, multiplied by s, divided by s; Convolution theorem and applications.

Module-III  CURVE FITTING AND FOURIER TRANSFORMS  Classes: 09

CURVE FITTING: Fitting a straight line; Second degree curves; Exponential curve, power curve by method of least squares.

FOURIER TRANSFORMS: Fourier integral theorem, Fourier sine and cosine integrals; Fourier transforms; Fourier sine and cosine transform, properties, inverse transforms, finite Fourier transforms.
### Module-IV
**NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS**

**Classes:** 09

**STEP BY STEP METHOD:** Taylor’s series method; Euler’s method, modified Euler’s method for first order differential equations.

**MULTI STEP METHOD:** Runge-Kutta method for first order differential equations.

### Module-V
**PARTIAL DIFFERENTIAL EQUATIONS AND APPLICATIONS**

**Classes:** 09

**PARTIAL DIFFERENTIAL EQUATIONS:** Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions, solutions of first order linear equation by Lagrange method.

**APPLICATIONS:** Method of separation of variables; One dimensional heat and wave equations under initial and boundary conditions.

#### Text Books:

#### Reference Books:

#### Web References:

#### E-Text Books:
WAVES AND OPTICS

I Semester: AE / ECE / ME | II Semester: EEE / CE

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Category</th>
<th>Hours / Week</th>
<th>Credits</th>
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</table>

Contact Classes: 45  Tutorial Classes: 15  Practical Classes: Nil  Total Classes: 60

OBJECTIVES:
The course should enable the students to:
I. Enrich knowledge in principals of quantum mechanics and semiconductors.
II. Correlate principles and applications of lasers and fiber optics.
III. Acquire skills allowing the student to identify and apply formulas of optics and wave physics using course literature.
IV. Develop strong fundamentals of transverse, longitudinal waves and harmonic waves.

MODULE - I  QUANTUM MECHANICS  Classes: 08

Introduction to quantum physics, Black body radiation, Planck’s law, Photoelectric effect, Compton effect, De-Broglie’s hypothesis, Wave-particle duality, Davison and Germer experiment, Time-independent Schrodinger equation for wave function, Born interpretation of the wave function, Schrodinger equation for one dimensional problems, particle in a box.

MODULE - II  INTRODUCTION TO SOLIDS AND SEMICONDUCTORS  Classes: 10

Bloch’s theorem for particles in a periodic potential, Kronig-Penney model (Qualitative treatment), Origin of energy bands. Types of electronic materials: metals, semiconductors, and insulators; Intrinsic and extrinsic semiconductors, Carrier concentration, Dependence of Fermi level on carrier-concentration and temperature, Carrier generation and recombination, Hall effect.

MODULE - III  LASERS AND FIBER OPTICS  Classes: 10

Characteristics of lasers, Spontaneous and stimulated emission of radiation, Metastable state, Population inversion, Lasing action, Ruby laser, He-Ne laser and applications of lasers.

Principle and construction of an optical fiber, Acceptance angle, Numerical aperture, Types of optical fibers (Single mode, multimode, step index, graded index), Attenuation in optical fibers, Optical fiber communication system with block diagram.

MODULE - IV  LIGHT AND OPTICS  Classes: 07

Huygens’ principle, Superposition of waves and interference of light by wavefront splitting and amplitude splitting; Young’s double slit experiment, Newton’s rings, Michelson interferometer; Fraunhofer diffraction from a single slit, circular aperture and diffraction grating.

MODULE - V  HARMONIC OSCILLATIONS AND WAVES IN ONE DIMENSION  Classes: 10

Mechanical and electrical simple harmonic oscillators, Damped harmonic oscillator, Forced mechanical and electrical oscillators, Impedance, Steady state motion of forced damped harmonic oscillator; Transverse wave on a string, the wave equation on a string, Harmonic waves, Reflection and transmission of waves at a boundary, Longitudinal waves and the wave equation for them, acoustics waves.
### Text Books:


### Reference Books:


### Web References:

2. [www.thphys.physics.ox.ac.uk](http://www.thphys.physics.ox.ac.uk)
3. [www.sciencedirect.com/science](http://www.sciencedirect.com/science)
4. [www.e-booksdirectory.com](http://www.e-booksdirectory.com)

### E-Text Books:

1. [www.peaceone.net/basic/Feynman/](http://www.peaceone.net/basic/Feynman/)
3. [www.damtp.cam.ac.uk/user/tong/statphys/sp.pdf](http://www.damtp.cam.ac.uk/user/tong/statphys/sp.pdf)
PROGRAMMING FOR PROBLEM SOLVING

I Semester: AE / ME | II Semester: CSE / IT / ECE / EEE

<table>
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<th>Course Code</th>
<th>Category</th>
<th>Hours / Week</th>
<th>Credits</th>
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<td></td>
<td>3  0  0  3  30  70  100</td>
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</table>

Contact Classes: 45  Tutorial Classes: Nil  Practical Classes: Nil  Total Classes: 45

OBJECTIVES:
The course should enable the students to:
I. Learn adequate knowledge by problem solving techniques.
II. Understand programming skills using the fundamentals and basics of C Language.
III. Improve problem solving skills using arrays, strings, and functions.
IV. Understand the dynamics of memory by pointers.
V. Study files creation process with access permissions.

MODULE - I  INTRODUCTION  Classes: 10
Introduction to Programming: Computer system, components of a computer system, computing environments, computer languages, creating and running programs, algorithms, flowcharts; Introduction to C language: Computer languages, History of C, basic structure of C programs, process of compiling and running a C program, C tokens, keywords, identifiers, constants, strings, special symbols, variables, data types; Operators and expressions.

MODULE - II  CONTROL STRUCTURES  Classes: 08
Conditional Control structures: Decision statements; Simple if, if-else, else if ladder, Nested if and Case Statement-switch statement; Loop control statements: while, for and do while loops. jump statements, break, continue, goto statements.

MODULE - III  ARRAYS AND FUNCTIONS  Classes: 10
Arrays: Concepts, one dimensional arrays, declaration and initialization of one dimensional arrays, two dimensional arrays, initialization and accessing, multi-dimensional arrays; Strings: Arrays of characters, variable length character strings, inputting character strings, character library functions, string handling functions.

Functions: Need for user defined functions, function declaration, function prototype, category of functions, inter function communication, function calls, parameter passing mechanisms, recursion, passing arrays to functions, passing strings to functions, storage classes, preprocessor directive

MODULE - IV  STRUCTURES, UNIONS AND POINTERS  Classes: 09
Structures and unions: Structure definition, initialization, accessing structures, nested structures, arrays of structures, structures and functions, passing structures through pointers, self-referential structures, unions, bit fields, typedef, enumerations; Pointers: Pointer basics, pointer arithmetic, pointers to pointers, generic pointers, array of pointers, pointers and arrays, pointers as functions arguments, functions returning pointers. Dynamic memory allocation: Basic concepts, library functions
<table>
<thead>
<tr>
<th>MODULE - V</th>
<th>FILE HANDLING AND BASICALGORITHMS</th>
<th>Classes: 08</th>
</tr>
</thead>
<tbody>
<tr>
<td>Files: Streams, basic file operations, file types, file opening modes, input and output operations with files, special functions for working with files, file positioning functions, command line arguments. Searching, basic sorting algorithms (bubble, insertion, selection), algorithm complexity through example programs (no formal definitions required).</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Text Books:**


**Reference Books:**


**Web References:**

1. https://www.bfoit.org/itp/Programming.html
2. https://www.khanacademy.org/computing/computer-programming

**E-Text Books:**


**MOOC Course**

OBJECTIVES:
The course should enable the students to:
I. Classify circuit parameters and apply Kirchhoff’s laws for network reduction.
II. Apply mesh analysis and nodal analysis to solve electrical networks.
III. Illustrate single phase AC circuits and apply steady state analysis to time varying circuits.
IV. Analyze electrical circuits with the help of network theorems

MODULE-I INTRODUCTION TO ELECTRICAL CIRCUITS Classes: 09
Circuit concept: Basic definitions, Ohm’s law at constant temperature, classifications of elements, R, L, C parameters, independent and dependent sources, voltage and current relationships for passive elements (for different input signals like square, ramp, saw tooth, triangular and complex), temperature dependence of resistance, tolerance, source transformation, Kirchhoff’s laws, equivalent resistance of series, parallel and series parallel networks.

MODULE-II ANALYSIS OF ELECTRICAL CIRCUITS Classes: 09
Circuit analysis: Star to delta and delta to star transformation, mesh analysis and nodal analysis by Kirchhoff’s laws, inspection method, super mesh, super node analysis; Network topology: definitions, incidence matrix, basic tie set and basic cut set matrices for planar networks, duality and dual networks.

MODULE-III SINGLE PHASE AC CIRCUITS AND RESONANCE Classes: 10
Single phase AC circuits: Representation of alternating quantities, instantaneous, peak, RMS, average, form factor and peak factor for different periodic wave forms, phase and phase difference, ‘j’ notation, concept of reactance, impedance, susceptance and admittance, rectangular and polar form, concept of power, real, reactive and complex power, power factor.

Steady state analysis: Steady state analysis of RL, RC and RLC circuits (in series, parallel and series parallel combinations) with sinusoidal excitation; Resonance: Series and parallel resonance, concept of band width and Q factor.

MODULE-IV MAGNETIC CIRCUITS Classes: 09

MODULE-V NETWORK THEOREMS (DC AND AC) Classes: 08
Network Theorems: Tellegen’s, superposition, reciprocity, Thevenin’s, Norton’s, maximum power transfer, Milliman’s and compensation theorems for DC and AC excitations, numerical problems.
### Text Books:


### Reference Books:


### Web References:

1. https://www.igniteengineers.com
2. https://www.ocw.nthu.edu.tw
3. https://www.uotechnology.edu.iq
4. https://www.iare.ac.in

### E-Text Books:

3. https://www.allaboutcircuits.com
PROGRAMMING FOR PROBLEM SOLVING LABORATORY

<table>
<thead>
<tr>
<th>Semester: AE / ME</th>
<th>II Semester: CSE / IT / ECE / EEE / CE</th>
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<table>
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<th>Category</th>
<th>Hours / Week</th>
<th>Credits</th>
<th>Maximum Marks</th>
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<tbody>
<tr>
<td>ACSB02</td>
<td>Foundation</td>
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<tr>
<td></td>
<td></td>
<td>0 0 4 2 30 70 100</td>
<td></td>
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</tbody>
</table>

Contact Classes: Nil  
Tutorial Classes: Nil  
Practical Classes: 48  
Total Classes: 48

OBJECTIVES:
The course should enable the students to:
I. Formulate problems and implement algorithms using C programming language.
II. Develop programs using decision structures, loops and functions.
III. Learn memory allocation techniques using pointers.
IV. Use structured programming approach for solving computing problems in real world.

LIST OF EXPERIMENTS

**Week-1**  OPERATORS AND EVALUATION OF EXPRESSIONS

a. Write a C program to check whether a number is even or odd using ternary operator.
b. Write a C program to perform the addition of two numbers without using +operator.
c. Write a C program to evaluate the arithmetic expression \((a + b / c * d - e) * (f - g)\). Read the values a, b, c, d, e, f, g from the standard input device.
d. Write a C program to find the sum of individual digits of a 3 digit number.
e. Write a C program to read the values of x and y and print the results of the following expressions in one line:
   i. \((x + y) / (x - y)\)
   ii. \((x + y)(x - y)\)

**Week-2**  CONTROL STRUCTURES

a. Write a C program to find the sum of individual digits of a positive integer.
b. A Fibonacci sequence is defined as follows: The first and second terms in the sequence are 0 and 1. Subsequent terms are found by adding the preceding two terms in the sequence. Write a C program to generate the first n terms of these sequences.
c. Write a C program to generate all the prime numbers between 1 and n, where n is a value supplied by the user.
d. A character is entered through keyboard. Write a C program to determine whether the character entered is a capital letter, a small case letter, a digit or a special symbol using if-else and switch case. The following table shows the range of ASCII values for various characters.

<table>
<thead>
<tr>
<th>Characters</th>
<th>ASCII values</th>
</tr>
</thead>
<tbody>
<tr>
<td>A–Z</td>
<td>65 –90</td>
</tr>
<tr>
<td>a – z</td>
<td>97 –122</td>
</tr>
<tr>
<td>0 – 9</td>
<td>48 – 57</td>
</tr>
<tr>
<td>Special symbols</td>
<td>0 – 47, 58 – 64, 91 – 96, 123 –127</td>
</tr>
</tbody>
</table>

e. If cost price and selling price of an item is input through the keyboard, write a program to determine whether the seller has made profit or incurred loss. Write a C program to determine how much profit or loss incurred in percentage.
### Week-3 CONTROL STRUCTURES

a. Write a C program, which takes two integer operands and one operator from the user, performs the operation and then prints the result. (Consider the operators +, -, *, /, % and use switch statement).
b. Write a C program to calculate the following sum:
   \[ \text{sum} = 1 - x^2 / 2! + x^4 / 4! - x^6 / 6! + x^8 / 8! - x^{10} / 10! \]
c. Write a C program to find the roots of a quadratic equation.
d. Write a C program to check whether a given 3 digit number is Armstrong number or not.
e. Write a C program to print the numbers in triangular form
   
   1  2
   1  2  3
   1  2  3  4

### Week-4 ARRAYS

a. Write a C program to find the second largest integer in a list of integers.
b. Write a C program to perform the following:
   i. Addition of two matrices
   ii. Multiplication of two matrices
c. Write a C program to count and display positive, negative, odd and even numbers in an array.
d. Write a C program to merge two sorted arrays into another array in a sorted order.
e. Write a C program to find the frequency of a particular number in a list of integers.

### Week-5 STRINGS

a. Write a C program that uses functions to perform the following operations:
   i. To insert a sub string into a given main string from a given position.
   ii. To delete n characters from a given position in a given string.
b. Write a C program to determine if the given string is a palindrome or not.
c. Write a C program to find a string within a sentence and replace it with another string.
d. Write a C program that reads a line of text and counts all occurrence of a particular word.
e. Write a C program that displays the position or index in the string S where the string T begins, or 1 if S doesn’t contain T.

### Week-6 FUNCTIONS

a. Write C programs that use both recursive and non-recursive functions
   i. To find the factorial of a given integer.
   ii. To find the greatest common divisor of two given integers.
b. Write C programs that use both recursive and non-recursive functions
   i. To print Fibonacci series.
   ii. To solve towers of Hanoi problem.
c. Write a C program to print the transpose of a given matrix using function.
d. Write a C program that uses a function to reverse a given string.

### Week-7 POINTERS

a. Write a C program to concatenate two strings using pointers.
b. Write a C program to find the length of string using pointers.
c. Write a C program to compare two strings using pointers.
d. Write a C program to copy a string from source to destination using pointers.
e. Write a C program to reverse a string using pointers.
### Week-8  STRUCTURES AND UNIONS

**a.** Write a C program that uses functions to perform the following operations:
   1. Reading a complex number
   2. Writing a complex number
   3. Addition and subtraction of two complex numbers
   4. Multiplication of two complex numbers. Note: represent complex number using a structure.

**b.** Write a C program to compute the monthly pay of 100 employees using each employee's name, basic pay. The DA is computed as 52% of the basic pay. Gross-salary (basic pay + DA). Print the employees name and gross salary.

**c.** Create a Book structure containing book_id, title, author name and price. Write a C program to pass a structure as a function argument and print the book details.

**d.** Create a union containing 6 strings: name, home_address, hostel_address, city, state and zip. Write a C program to display your present address.

**e.** Write a C program to define a structure named DOB, which contains name, day, month and year. Using the concept of nested structures display your name and date of birth.

### Week-9  ADDITIONAL PROGRAMS

**a.** Write a C program to read in two numbers, x and n, and then compute the sum of this geometric progression: 1+x+x^2+..............+x^n. For example: if n is 3 and x is 5, then the program computes 1+5+25+125. Print x, n, the sum. Perform error checking. For example, the formula does not make sense for negative exponents – if n is less than 0. Have your program print an error message if n<0, then go back and read in the next pair of numbers of without computing the sum. Are any values of x also illegal? If so, test for them too.

**b.** 2’s complement of a number is obtained by scanning it from right to left and complementing all the bits after the first appearance of a 1. Thus 2’s complement of 11100 is 00100. Write a C program to find the 2’s complement of a binary number.

**c.** Write a C program to convert a Roman numeral to its decimal equivalent. E.g. Roman number CD is equivalent to 400.

### Week-10  PREPROCESSOR DIRECTIVES

**a.** Define a macro with one parameter to compute the volume of a sphere. Write a C program using this macro to compute the volume for spheres of radius 5, 10 and 15 meters.

**b.** Define a macro that receives an array and the number of elements in the array as arguments. Write a C program for using this macro to print the elements of the array.

**c.** Write symbolic constants for the binary arithmetic operators +, -, * and / . Write a C program to illustrate the use of these symbolic constants.

### Week-11  FILES

**a.** Write a C program to display the contents of a file.

**b.** Write a C program to copy the contents of one file to another.

**c.** Write a C program to reverse the first n characters in a file, where n is given by the user.

**d.** Two files DATA1 and DATA2 contain sorted lists of integers. Write a C program to merge the contents of two files into a third file DATA i.e., the contents of the first file followed by those of the second are put in the third file.

**e.** Write a C program to count the no. of characters present in the file.
### COMMAND LINE ARGUMENTS AND NUMERICAL METHODS

<table>
<thead>
<tr>
<th>Week-12</th>
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<tbody>
<tr>
<td>a.</td>
<td>Write a C program to read two numbers at the command line and perform arithmetic operations on it.</td>
</tr>
<tr>
<td>b.</td>
<td>Write a C program to read a file name at the command line and display its contents.</td>
</tr>
<tr>
<td>c.</td>
<td>Write a C program to solve numerical methods problems (root finding, numerical differentiation and numerical integration)</td>
</tr>
</tbody>
</table>

### Reference Books:


### Web References:

ENGINEERING PHYSICS LABORATORY

I Semester: AE / ECE / ME | II Semester: CSE / IT / CE / EEE

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<td>Tutorial Classes: Nil</td>
<td>Practical Classes: 36</td>
<td>Total Classes: 36</td>
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</table>

OBJECTIVES:
The course should enable the students to:
I. Upgrade practical knowledge in optics.
II. Analyze the behavior and characteristics of various materials for its optimum utilization.
III. Enrich the knowledge of electric and magnetic properties.

LIST OF EXPERIMENTS

Week-1 | INTRODUCTION TO PHYSICS LABORATORY
Do's and Don'ts in physics laboratory. Precautions to be taken in laboratory.

Week-2 | HALL EFFECT (LORENTZ FORCE)
Determination of charge carrier density.

Week-3 | MELDE’E EXPERIMENT
Determination of frequency of a given tuning fork.

Week-4 | STEWART GEE’S APPARATUS
Magnetic field along the axis of current carrying coil-Stewart and Gee’s method.

Week-5 | B-H CURVE WITH CRO
To determine the value of retentivity and coercivity of a given magnetic material.

Week-6 | ENERGY GAP OF A SEMICONDUCTOR DIODE
Determination of energy gap of a semiconductor diode.

Week-7 | PIN AND AVALANCHE DIODE
Studying V-I characteristics of PIN and Avalanche diode.

Week-8 | OPTICAL FIBER
Evaluation of numerical aperture of a given optical fiber.

Week-9 | WAVE LENGTH OF LASER LIGHT
Determination of wavelength of a given laser light using diffraction grating.
<table>
<thead>
<tr>
<th>Week-10</th>
<th>PLANK’S CONSTANT</th>
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<tbody>
<tr>
<td></td>
<td>Determination of Plank’s constant using LED.</td>
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</table>

<table>
<thead>
<tr>
<th>Week-11</th>
<th>LIGHT EMITTING DIODE</th>
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<tbody>
<tr>
<td></td>
<td>Studying V-I characteristics of LED</td>
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<table>
<thead>
<tr>
<th>Week-12</th>
<th>NEWTONS RINGS</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Determination of radius of curvature of a given plano-convex lens.</td>
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<thead>
<tr>
<th>Week-13</th>
<th>SINGLE SLIT DIFFRACTION</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Determination of width of a given single slit.</td>
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</table>

**Manuals:**


**Web Reference:**

http://www.iare.ac.in
## ELECTRICAL CIRCUITS LABORATORY

### II Semester: EEE

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Category</th>
<th>Hours / Week</th>
<th>Credits</th>
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<td>30 70 100</td>
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- Contact Classes: Nil
- Tutorial Classes: Nil
- Practical Classes: 36
- Total Classes: 36

### OBJECTIVES:
The course should enable the students to:

I. Understand the characteristics of basic electrical components
II. Perform the soldering of electrical and electronics components for smooth functioning.
III. Calculate and verify the electrical quantities in series RL, RC and RLC circuit.
IV. Measure the choke coil parameters and small transformer characteristics and electrical energy using single phase energy meter.
V. Measure impedance of series RL, RC and RLC circuits

### LIST OF EXPERIMENTS

<table>
<thead>
<tr>
<th>Expt.</th>
<th>STUDY OF ELECTRICAL AND ELECTRONIC COMPONENTS AND THEIR SPECIFICATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>To identify the electrical and electronic components and selection of these components based on their specifications.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Expt.</th>
<th>TYPES OF ELECTRICAL WIRING AND RESIDENTIAL HOUSE WIRING</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Study the staircase wiring, fluorescent lamp wiring and corridor wiring; To implement residential house wiring using switches, fuse, indicator and lamp.</td>
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</table>

<table>
<thead>
<tr>
<th>Expt.</th>
<th>SOLDERING PRACTICE</th>
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<tbody>
<tr>
<td></td>
<td>To practice soldering and de-soldering for the electronic circuit by assembling and disassembling the resistors and capacitor in the given Printed Circuit Board (PCB).</td>
</tr>
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<table>
<thead>
<tr>
<th>Expt.</th>
<th>MEASUREMENT OF POWER CONSUMED BY A FLUORESCENT LAMP</th>
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<tbody>
<tr>
<td></td>
<td>To obtain power consumed and power factor of a fluorescent lamp, operated at different voltages.</td>
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</table>

<table>
<thead>
<tr>
<th>Expt.</th>
<th>OHM’S LAW, KCL AND KVL</th>
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<tr>
<td></td>
<td>Verification of Ohm’s law, KCL and KVL.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Expt.</th>
<th>DESIGN OF CHOKE AND SMALL TRANSFORMER</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Study the design concepts and assembly of prototype choke and small transformer.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Expt.</th>
<th>DETERMINATION OF CIRCUIT IMPEDANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Calculation and verification of impedance and current of RL, RC and RLC series circuits.</td>
</tr>
<tr>
<td>Expt. 8</td>
<td>STUDY OF CONSTANT CURRENT SOURCE</td>
</tr>
<tr>
<td>--------</td>
<td>----------------------------------</td>
</tr>
<tr>
<td></td>
<td>To develop a circuit which provides substantially constant current using a low voltage input source.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Expt. 9</th>
<th>MEASUREMENT OF ELECTRICAL PARAMETERS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>To measure the electrical quantities like voltage, current, power and power factor in RLC series circuit.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Expt. 10</th>
<th>MEASUREMENT OF ELECTRICAL ENERGY</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>To measure the electrical energy using single phase and three phase energy meters</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Expt. 11</th>
<th>CHARACTERISTICS OF PERIODIC WAVEFORMS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Calculation of average value, RMS value, form factor, peak factor of sinusoidal and square waveform.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Expt. 12</th>
<th>IMPEDANCE OF SERIES RL, RC, RLC CIRCUIT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Examine the impedance of series RL, RC, RLC circuit.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Expt. 13</th>
<th>SERIES RESONANCE AND PARALLEL RESONANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Demonstrating resonance phenomena in series and parallel RLC circuits and measurements of resonance characteristics using hardware and digital simulation.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Expt. 14</th>
<th>MEASUREMENT OF EARTH RESISTANCE AND EARTH POTENTIAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Study of earthing and determination of earth resistance and earth potential.</td>
</tr>
</tbody>
</table>

**Reference Books:**


**Web References:**

1. https://www.ee.iitkgp.ac.in
2. https://www.citchennai.edu.in
3. https://www.iare.ac.in

**SOFTWARE AND HARDWARE REQUIREMENTS FOR A BATCH OF 24 STUDENTS:**

**SOFTWARE:** Microsoft Windows 7 and MATLAB – V 8.5

**HARDWARE:** 06 numbers of Intel Desktop Computers with 2 GB RAM
**WORKSHOP / MANUFACTURING PRACTICES LABORATORY**

**I Semester:** AERO / CSE / IT / MECH | **II Semester:** ECE / EEE / CE

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Category</th>
<th>Hours / Week</th>
<th>Credits</th>
<th>Maximum Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMEB01</td>
<td>Foundation</td>
<td>L T P C CIA SEE</td>
<td>0 0 3 1.5 30 70 100</td>
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**Contact Classes:** Nil | **Tutorial Classes:** Nil | **Practical Classes:** 36 | **Total Classes:** 36

**OBJECTIVES:**
The course should enable the students to:
I. Identify and use of tools, types of joints in carpentry, fitting, tin smithy and plumbing operations.
II. Understand of electrical wiring and components.
III. Observation of the function of lathe, shaper, drilling, boring, milling, grinding machines.

**LIST OF EXPERIMENTS**

<table>
<thead>
<tr>
<th>Week</th>
<th>MACHINE SHOP-Turning and other machines</th>
</tr>
</thead>
<tbody>
<tr>
<td>Batch I</td>
<td>Working on central lathe and shaping machine.</td>
</tr>
<tr>
<td>Batch II</td>
<td>Working on drilling, grinding machines.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Week</th>
<th>MACHINE SHOP-Milling and other machines</th>
</tr>
</thead>
<tbody>
<tr>
<td>Batch I</td>
<td>Working on milling machine.</td>
</tr>
<tr>
<td>Batch II</td>
<td>Working on milling and shaping machine.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Week</th>
<th>ADVANCED MACHINE SHOP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Batch I</td>
<td>Working on CNC Turning machines.</td>
</tr>
<tr>
<td>Batch II</td>
<td>Working on CNC Vertical Drill Tap Center.</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Week</th>
<th>FITTING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Batch I</td>
<td>Make a straight fit and straight fit for given dimensions.</td>
</tr>
<tr>
<td>Batch II</td>
<td>Make a square fit for straight fit for given sizes.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Week</th>
<th>CARPENTRY-I</th>
</tr>
</thead>
<tbody>
<tr>
<td>Batch I</td>
<td>Preparation of lap joint as per given dimensions.</td>
</tr>
<tr>
<td>Batch II</td>
<td>Preparation of dove tail joint as per given taper angle.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Week</th>
<th>CARPENTRY-II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Batch I</td>
<td>Preparation of dove tail joint as per given taper angle.</td>
</tr>
<tr>
<td>Batch II</td>
<td>Preparation of lap joint as per given dimensions.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Week</th>
<th>ELECTRICAL AND ELECTRONICS</th>
</tr>
</thead>
</table>
Batch I & II: Make an electrical connection to demonstrate domestic voltage and current sharing.  
Make an electrical connection to control one bulb with two switches-stair case connection.

<table>
<thead>
<tr>
<th>Week-8</th>
<th>WELDING</th>
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</thead>
</table>

Batch I: Arc welding & Gas Welding. 
Batch II: Gas welding & Arc Welding.

<table>
<thead>
<tr>
<th>Week-9</th>
<th>MOULD PREPARATION</th>
</tr>
</thead>
</table>

Batch I: Prepare a wheel flange mould using a given wooden pattern. 
Batch II: Prepare a bearing housing using an aluminum pattern.

<table>
<thead>
<tr>
<th>Week-10</th>
<th>MOULD PREPARATION</th>
</tr>
</thead>
</table>

Batch I: Prepare a bearing housing using an aluminum pattern. 
Batch II: Prepare a wheel flange mould using a given wooden pattern.

<table>
<thead>
<tr>
<th>Week-11</th>
<th>BLACKSMITHY- I, TINSMITHY- I,</th>
</tr>
</thead>
</table>

Batch I: Prepare S-bend & J-bend for given MS rod using open hearth furnace. 
Batch II: Prepare the development of a surface and make a rectangular tray and a round tin.

<table>
<thead>
<tr>
<th>Week-12</th>
<th>TINSMITHY- I, BLACKSMITHY- I</th>
</tr>
</thead>
</table>

Batch I: Prepare the development of a surface and make a rectangular tray and a round tin. 
Batch II: Prepare S-bend & J-bend of given MS rod using open hearth furnace.

<table>
<thead>
<tr>
<th>Week-13</th>
<th>PLASTIC MOULDING, INJECTION MOULDING, GLASS CUTTING</th>
</tr>
</thead>
</table>

Batch I: Plastic Moulding and Glass cutting. 
Batch II: Plastic Moulding and Glass cutting.

<table>
<thead>
<tr>
<th>Week-14</th>
<th>BLOW MOULDING</th>
</tr>
</thead>
</table>

Batch I& II: Blow Moulding.

Reference Books:


Web References:

http://www.iare.ac.in
# NETWORK ANALYSIS

## III Semester: EEE

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Category</th>
<th>Hours / Week</th>
<th>Credits</th>
<th>Maximum Marks</th>
</tr>
</thead>
<tbody>
<tr>
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<td>Core</td>
<td>L T P C CIA SEE Total</td>
<td>3 - - 3 30 70 100</td>
<td></td>
</tr>
</tbody>
</table>

| Contact Classes: 45 | Tutorial Classes: Nil | Practical Classes: Nil | Total Classes: 45 |

**OBJECTIVES:**

The course should enable the students to:

I. Analyze electrical circuits with the help of network theorems.
II. Understand the response of RL, RC and RLC circuits for DC and AC excitations.
III. Discuss the concept of network functions and calculate network parameters.
IV. Understand the design of various types of filters.

## MODULE-I NETWORK THEOREMS (DC AND AC)

Classes: 09

Network Theorems: Tellegen’s, superposition, reciprocity, Thevenin’s, Norton’s, maximum power transfer, Milliman’s and compensation theorems for DC and AC excitations, numerical problems.

## MODULE-II SOLUTION OF FIRST AND SECOND ORDER NETWORKS

Classes: 09

Transient response: Initial conditions, transient response of RL, RC and RLC series and parallel circuits with DC and AC excitations, differential equation and Laplace transform approach.

## MODULE-III LOCUS DIAGRAMS AND NETWORKS FUNCTIONS

Classes: 09

Locus diagrams: Locus diagrams of RL, RC, RLC circuits;

Network Functions: The concept of complex frequency, physical interpretation, transform impedance, series and parallel combination of elements, terminal ports, network functions for one port and two port networks, poles and zeros of network functions, significance of poles and zeros, properties of driving point functions and transfer functions, necessary conditions for driving point functions and transfer functions, time domain response from pole-zero plot.

## MODULE-IV TWO PORT NETWORK PARAMETERS

Classes: 09

Two port network parameters: Z, Y, ABCD, hybrid and inverse hybrid parameters, conditions for symmetry and reciprocity, inter relationships of different parameters, interconnection (series, parallel and cascade) of two port networks, image parameters.

## MODULE-V FILTERS

Classes: 09

Filters: Classification of filters, filter networks, classification of pass band and stop band, characteristic impedance in the pass and stop bands, constant-k low pass filter, high pass filter, m-derived T-section, band pass filter and band elimination filter.
<table>
<thead>
<tr>
<th>Text Books:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reference Books:</td>
</tr>
<tr>
<td>Web References:</td>
</tr>
<tr>
<td>1. <a href="https://www.igniteengineers.com">https://www.igniteengineers.com</a></td>
</tr>
<tr>
<td>3. <a href="https://www.ocw.nthu.edu.tw">https://www.ocw.nthu.edu.tw</a></td>
</tr>
<tr>
<td>4. <a href="https://www.uotechnology.edu.iq">https://www.uotechnology.edu.iq</a></td>
</tr>
<tr>
<td>5. <a href="https://www.iare.ac.in">https://www.iare.ac.in</a></td>
</tr>
<tr>
<td>E-Text Books:</td>
</tr>
<tr>
<td>2. <a href="https://www.jntubook.com">https://www.jntubook.com</a></td>
</tr>
<tr>
<td>3. <a href="https://www.allabouicircuits.com">https://www.allabouicircuits.com</a></td>
</tr>
</tbody>
</table>
# ELECTROMAGNETIC FIELDS

**III Semester: EEE**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Category</th>
<th>Hours / Week</th>
<th>Credits</th>
<th>Maximum Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>AEEB10</td>
<td>Core</td>
<td>L T P C CIA SEE Total</td>
<td>3 1 - 4 30 70 100</td>
<td></td>
</tr>
<tr>
<td>Contact Classes: 45</td>
<td>Tutorial Classes: 15</td>
<td>Practical Classes: Nil</td>
<td>Total Classes: 60</td>
<td></td>
</tr>
</tbody>
</table>

## OBJECTIVES:

The course should enable the students to:

I. Demonstrate the concept of electrostatic field intensity and electric potential.
II. Illustrate polarization of dielectrics and the behavior of conductors and dielectrics in electric field.
III. Understand the concept of magnetic field intensity and flux density.
IV. Discuss forces in magnetic fields and law of electromagnetic induction.
V. Analyze propagation of electro-magnetic waves.

### MODULE-I  VECTOR CALCULUS AND ELECTROSTATICS

- Introduction to Cartesian, cylindrical and spherical co-ordinates.
- Conversion of one type of co-ordinates to another;
- Electrostatic fields: Coulomb’s law, electric field intensity due to line and surface charges, work done in moving a point charge in an electrostatic field, electric potential, properties of potential function, potential gradient, Gauss’s law, application of Gauss’s law, Maxwell’s first law, Laplace’s and Poisson’s equations, solution of Laplace’s equation in one variable.

### MODULE-II  CONDUCTORS AND DIELECTRICS

- Electric dipole: Dipole moment, potential and electric field intensity due to an electric dipole, torque on an electric dipole in an electric field, behavior of conductors in an electric field, electric field inside a dielectric material, polarization, conductor and dielectric, dielectric boundary conditions, capacitance of parallel plate and spherical and coaxial capacitors with composite dielectrics, energy stored and energy density in a static electric field, current density, conduction and convection current densities, Ohm’s law in point form, equation of continuity.

### MODULE-III  MAGNETOSTATICS

- Static magnetic fields: Biot-Savart’s law, magnetic field intensity, magnetic field intensity due to a straight current carrying filament, magnetic field intensity due to circular, square and solenoid current carrying wire, relation between magnetic flux, magnetic flux density and magnetic field intensity, Maxwell’s second equation, \( \text{div}(B)=0 \)
- Ampere’s circuital law and it’s applications: Magnetic field intensity due to an infinite sheet of current and a long current carrying filament, point form of Ampere’s circuital law, Maxwell’s third equation, Curl \((H)=Jc\), field due to a circular loop, rectangular and square loops.

### MODULE-IV  FORCE IN MAGNETIC FIELD AND MAGNETIC POTENTIAL

- Magnetic force: Moving charges in a magnetic field, Lorentz force equation, force on a current element in a magnetic field, force on a straight and a long current carrying conductor in a magnetic field, force between two straight long and parallel current carrying conductors, magnetic dipole and dipole moment, a differential current loop as a magnetic dipole, torque on a current loop placed in a magnetic field; Scalar magnetic potential and its
limitations: Vector magnetic potential and its properties, vector magnetic potential due to simple configurations, Poisson’s equations, self and mutual inductance, Neumann’s formula, determination of self-inductance of a solenoid, toroid and determination of mutual inductance between a straight long wire and a square loop of wire in the same plane, energy stored and density in a magnetic field, characteristics and applications of permanent magnets.

<table>
<thead>
<tr>
<th>MODULE-V</th>
<th>TIME VARYING FIELDS AND FINITE ELEMENT METHOD</th>
<th>Classes: 09</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time varying fields: Faraday’s laws of electromagnetic induction, integral and point forms, Maxwell’s fourth equation, curl (E)=∂B/∂t, statically and dynamically induced EMFs, modification of Maxwell’s equations for time varying fields, displacement current; Derivation of Wave Equation, Uniform Plane Waves, Maxwell’s equation in phasor form, Wave equation in Phasor form, Plane waves in free space and in a homogenous material. Wave equation for a conducting medium, Plane waves in loss dielectrics, Propagation in good conductors, Skin effect. Poynting theorem.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Text Books:


Reference Books:


Web References:

3. https://www.nptel.ac.in/courses/108106073/
4. https://www.iare.ac.in

E-Text Books:

2. https://www.books.google.co.in/books/.../Fundamentals of Electromagnetic Fields
ANALOG ELECTRONICS

III Semester: EEE

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Category</th>
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<th>Credits</th>
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<td>4</td>
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</tbody>
</table>

Contact Classes: 45  Tutorial Classes: 15  Practical Classes: Nil  Total Classes: 60

OBJECTIVES:
The course should enable the students to:
I. Explain the components such as diodes, BJTs and FETs their switching characteristics, application
II. Learn the concepts of high frequency analysis of transistors.
III. Describe the various types of basic and feedback amplifier circuits such as small signal, cascaded, large signal and tuned amplifiers.
IV. Discuss the basic building blocks of linear integrated circuits.
V. Understand the concepts of waveform generation and introduce some special function ICs.

MODULE-I   DIODE CIRCUITS  Classes: 09
P-N junction diode, I-V characteristics of a diode; review of half-wave and full-wave rectifiers, clamping and clipping circuits. Input output characteristics of BJT in CB, CE, CC configurations, biasing circuits, Load line analysis, common emitter, common base and common collector amplifiers; Small signal equivalent circuits.

MODULE-II  MOSFET CIRCUITS  Classes: 09
MOSFET structure and I-V characteristics. MOSFET as a switch. small signal equivalent circuits - gain, input and output impedances, small-signal model and common-source, common-gate and common-drain amplifiers, trans conductance, high frequency equivalent circuit.

MODULE-III MULTI-STAGE AND POWER AMPLIFIERS  Classes: 09
Classification of Amplifiers, Distortion in amplifiers, Different coupling schemes used in amplifiers, Frequency response and Analysis of multistage amplifiers, Cascade amplifier, Darlington pair.

Transistor at High Frequency: Hybrid - model of Common Emitter transistor model, fα, β and unity gain bandwidth, Gain band width product. Differential Amplifiers, Power amplifiers - Class A, Class B, Class C, Class AB.

MODULE-IV  FEEDBACK AMPLIFIERS  Classes: 09
Concepts of feedback: Classification of feedback amplifiers, general characteristics of Negative feedback amplifiers, effect of feedback on amplifier characteristics, voltage series, voltage shunt, current series and current shunt feedback configurations, simple problems; Oscillators: Condition for Oscillations, RC type Oscillators RC phase shift and Wien-bridge Oscillators, LC type Oscillators, generalized analysis of LC Oscillators, Hartley and Colpitts oscillators.
# MODULE-V
## OPERATIONAL AMPLIFIERS

<table>
<thead>
<tr>
<th>Classes: 09</th>
</tr>
</thead>
</table>

Ideal op-amp, Output offset voltage, input bias current, input offset current, slew rate, gain bandwidth product, Inverting and non-inverting amplifier, Differentiator, integrator, Square-wave and triangular-wave generators

### Text Books:


### Reference Books:


### Web References:

3. [http://nptel.ac.in/courses/Webcourse-contents/IIT-ROORKEE/BASIC ELECTRONICS/home_page.htm](http://nptel.ac.in/courses/Webcourse-contents/IIT-ROORKEE/BASIC ELECTRONICS/home_page.htm)
4. [www.nptel.ac.in](http://www.nptel.ac.in)
5. [notes.specworld.in/pdc-pulse-and-digital-circuits](http://notes.specworld.in/pdc-pulse-and-digital-circuits)

### E-Text Books:

2. [http://nptel.ac.in/courses/122106025/](http://nptel.ac.in/courses/122106025/)
OBJECTIVES:
The course should enable the students to:
I. Demonstrate the concept of electrostatic field intensity and electric potential.
II. Illustrate polarization of dielectrics and the behavior of conductors and dielectrics in electric field.
III. Understand the concept of magnetic field intensity and flux density.
IV. Discuss forces in magnetic fields and law of electromagnetic induction.
V. Analyze propagation of electro-magnetic waves.

MODULE-I
FUNDAMENTALS OF DIGITAL SYSTEMS AND LOGIC FAMILIES
Classes: 09
Digital signals, digital circuits, AND, OR, NOT, NAND, NOR and Exclusive-OR operations, Boolean algebra, examples of IC gates, number systems-binary, signed binary, octal hexadecimal number, binary arithmetic, one’s and two’s complements arithmetic, codes, error detecting and correcting codes, characteristics of digital ICs, digital logic families, TTL, Schottky TTL and CMOS logic, interfacing CMOS and TTL, Tri-state logic.

MODULE-II
COMBINATIONAL DIGITAL CIRCUITS
Classes: 09
Standard representation for logic functions, K-map representation, and simplification of logic functions using Kmap, minimization of logical functions. Don’t care conditions, Multiplexer, Demultiplexer, Decoders, Adders, Subtractors, BCD arithmetic, carry look ahead adder, serial ladder, ALU, elementary ALU design, popular MSI chips, digital comparator, parity checker/generator, code converters, priority encoders, decoders, drivers for display devices, Q-M method of function realization.

MODULE-III
SEQUENTIAL CIRCUITS AND SYSTEMS
Classes: 09
1-bit memory, the circuit properties of Bi-stable latch, the clocked SR flip flop, J- K-T and D types flip flops, applications of flip flops, shift registers, applications of shift registers.
Serial to parallel converter: Parallel to serial converter, ring counter, sequence generator, ripple (Asynchronous) counters, synchronous counters, counters design using flip flops, special counter IC’s, asynchronous sequential counters, applications of counters.

MODULE-IV
A/D AND D/A CONVERTERS
Classes: 09
Digital to analog converters: weighted resistor, converter, R-2R Ladder D/A converter, specifications for D/A converters, examples of D/A converter ICs, sample and hold circuit, analog to digital converters: quantization and encoding, parallel comparator A/D converter, successive approximation A/D converter, counting A/D converter, dual slope A/D converter, A/D converter using voltage to frequency and voltage to time conversion, specifications of A/D converters, example of A/D converter ICs.
<table>
<thead>
<tr>
<th>MODULE-V</th>
<th>SEMICONDUCTOR MEMORIES AND PROGRAMMABLE LOGIC DEVICES</th>
<th>Classes: 09</th>
</tr>
</thead>
<tbody>
<tr>
<td>Memory organization and operation, expanding memory size, classification and characteristics of memories, sequential memory, read only memory (ROM), read and write memory (RAM), content addressable memory (CAM), charge de coupled device memory (CCD), commonly used memory chips, ROM as a PLD, Programmable logic array, Programmable array logic, complex Programmable logic devices (CPLDS), Field Programmable Gate Array (FPGA).</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Text Books:**


**Reference Books:**


**Web References:**

3. https://www.nptel.ac.in/courses/108106073/
4. https://www.iare.ac.in

**E-Text Books:**

2. https://www.books.google.co.in/books/.../Fundamentals of Electromagnetic Fields
III Semester: EEE

<table>
<thead>
<tr>
<th>Course Code</th>
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<tr>
<td>Contact Classes:</td>
<td></td>
<td>Tutorial Classes:</td>
<td></td>
<td>Practical Classes:</td>
</tr>
</tbody>
</table>

**OBJECTIVES:**
The course should enable the students to:

I. Understand the concepts of magnetic circuits and illustrate the theory of electromechanical energy conversion and the concept of co-energy.

II. Understand the operation of dc machines.

III. Analyse the differences in operation of different dc machine configurations.

IV. Analyse single phase and three phase transformers circuits.

**MODULE-I**  MAGNETIC FIELDS AND MAGNETIC CIRCUITS  Classes: 09

Review of magnetic circuits: MMF, flux, reluctance, inductance; Visualization of magnetic fields produced by a bar magnet and a current carrying coil through air and through a combination of iron and air, influence of highly permeable materials on the magnetic flux lines; Electromechanical energy conversion: Forces and torque in magnetic systems, energy balance, energy and force in a singly excited and multi excited magnetic field systems, determination of magnetic force, co-energy.

**MODULE-II**  DC GENERATORS  Classes: 09

DC generators: Principle of operation, construction, armature windings, lap and wave windings, simplex and multiplex windings, problems, use of laminated armature, commutator, EMF equation, types of DC generators, voltage buildup, critical field resistance and critical speed, causes for failure to self-excite and remedial measures; Armature reaction: Cross magnetization and demagnetization, ampere turns per pole, compensating winding, commutation, reactance voltage, methods of improving commutation; Characteristics: Open circuit characteristics, critical field resistance and critical speed. Load characteristics of shunt, series and compound generators; Parallel operation: Principle of parallel operation, load sharing, and use of equalizer bars, cross connection of field windings, problems.

**MODULE-III**  DC MOTORS AND TESTING  Classes: 09

DC motors: Principle of operation, back EMF, torque equation, condition for maximum power developed, types of DC motors, armature reaction and commutation, characteristics, methods of speed control, types of starters, numerical problems; Losses and efficiency: Types of losses, calculation of efficiency, condition for maximum efficiency.

Testing of DC machines: Swinburne’s test, brake test, regenerative testing, Hopkinson’s test, field’s test, retardation test and separation of stray losses, problems.

**MODULE-IV**  SINGLE PHASE TRANSFORMERS  Classes: 09

Single phase transformers: Principle of operation, construction, types of transformers, EMF equation, concept of leakage flux and leakage reactance, operation of transformer under no load and on load, phasor diagrams, equivalent circuit, efficiency, regulation and all day efficiency; Testing of transformers: objective of testing, polarity test, measurement of resistance, OC and SC tests, back to back test, heat run test, parallel operation, problems.
<table>
<thead>
<tr>
<th>MODULE-V</th>
<th>POLY PHASE TRANSFORMERS</th>
<th>Classes: 09</th>
</tr>
</thead>
<tbody>
<tr>
<td>Three phase transformer: Principle of operation, star to star, delta to delta, star to delta, delta to star, three phase to six phase, open delta connection, Scott connection; Auto transformers: Principles of operation, equivalent circuit, merits and demerits, no load and on load tap changers, harmonic reduction in phase voltages, cooling methods of transformers problems.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Text Books:**


**Reference Books:**


**Web References:**

3. https://www.ustudy.in
4. https://examsdaily.in

**E-Text Books:**

1. https://www.textbooksonline.tn.nic.in
2. https://www.freeengineeringbooks.com
3. https://www.eleccompengineering.files.wordpress.com
4. https://www.books.google.co.in
OBJECTIVES:
The course should enable the students to:
I. Apply network theorems to obtain the equivalent circuit of electrical networks.
II. Calculate two port network parameters of different electrical circuits.
III. Examine the circuit modeling in frequency domain.
IV. Understand the virtual instrumentation using LabVIEW.

LIST OF EXPERIMENTS

<table>
<thead>
<tr>
<th>Expt.</th>
<th>Experiment Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>MESH AND NODAL ANALYSIS</td>
</tr>
<tr>
<td></td>
<td>Verification of mesh and nodal analysis using hardware.</td>
</tr>
<tr>
<td>2</td>
<td>SUPERPOSITION AND RECIPROCITY THEOREMS</td>
</tr>
<tr>
<td></td>
<td>Verification of super position and reciprocity theorems using hardware.</td>
</tr>
<tr>
<td>3</td>
<td>MAXIMUM POWER TRANSFER THEOREM</td>
</tr>
<tr>
<td></td>
<td>Verification of maximum power transfer theorem using hardware.</td>
</tr>
<tr>
<td>4</td>
<td>THEVENIN’S AND NORTON’S THEOREMS</td>
</tr>
<tr>
<td></td>
<td>Verification of Thevenin’s and Norton’s theorems using hardware.</td>
</tr>
<tr>
<td>5</td>
<td>COMPENSATION AND MILLIMAN’S THEOREM</td>
</tr>
<tr>
<td></td>
<td>Verification of compensation and Milliman’s theorems using hardware.</td>
</tr>
<tr>
<td>6</td>
<td>IMPEDANCE (Z) AND ADMITTANCE (Y) PARAMETERS</td>
</tr>
<tr>
<td></td>
<td>To calculate and verify ‘Z’ parameters and ‘Y’ parameters of two-port network</td>
</tr>
<tr>
<td>7</td>
<td>TRANSMISSION (ABCD) AND HYBRID (H) PARAMETERS</td>
</tr>
<tr>
<td></td>
<td>To calculate and verify ‘ABCD’ parameters and ‘H’ parameters of two-port network.</td>
</tr>
<tr>
<td>Expt. 8</td>
<td>VIRTUAL INSTRUMENTS (VI) USING LABVIEW</td>
</tr>
<tr>
<td>---------</td>
<td>--------------------------------------</td>
</tr>
<tr>
<td></td>
<td>Editing and building a VI, creating a sub VI.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Expt. 9</th>
<th>GENERATION OF COMMON WAVE FORMS USING LABVIEW</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Signal generation of triangular wave; saw tooth, square wave and display of wave form, minimum and maximum values of wave form and modulation.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Expt.10</th>
<th>FREQUENCY MEASUREMENT USING LABVIEW</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Frequency measurement using Lissajous figures in Lab View.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Expt. 11</th>
<th>STRUCTURES USING LABVIEW</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Using FOR loop, WHILE loop, charts and arrays, graph and analysis VIs.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Expt. 12</th>
<th>SERIES, PARALLEL AND CASCADE CONNECTION OF TWO PORT NETWORK</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>To determine the equivalent parameters of series, parallel, cascade connection of two port network.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Expt. 13</th>
<th>SOURCE TRANSFORMATION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Analysis of given circuit using source transformation technique</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Expt. 14</th>
<th>MODELLING ELECTRICAL NETWORK IN FREQUENCY DOMAIN</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>To learn modelling of electrical network in frequency domain using digital simulation.</td>
</tr>
</tbody>
</table>

**Reference Books:**


**Web References:**

1. https://www.ee.iitkgp.ac.in
2. https://www.citchennai.edu.in
3. https://www.iare.ac.in

**SOFTWARE AND HARDWARE REQUIREMENTS FOR A BATCH OF 36 STUDENTS:**

**SOFTWARE:** MATLAB R2015a and LabVIEW

**HARDWARE:** Desktop Computers (04 no.s)
### III Semester: EEE

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Category</th>
<th>Hours /Week</th>
<th>Credits</th>
<th>Maximum Marks</th>
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<tr>
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<td>-</td>
<td>-</td>
<td>3</td>
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</tbody>
</table>

Contact Classes: Nil  
Tutorial Classes: Nil  
Practical Classes: 45  
Total Classes: 45

### OBJECTIVES:

The course should enable the students to:

I. Implement and study the characteristics of diodes and transistors.
II. Illustrate the concept of rectification using half wave and full wave rectifiers.
III. Design and construct different amplifier circuits.
IV. Build the concept of digital and binary system.
V. Design and analyze the combinational logic circuits.

### LIST OF EXPERIMENTS

<table>
<thead>
<tr>
<th>Expt.</th>
<th>Description</th>
</tr>
</thead>
</table>
| 1     | PN JUNCTION DIODE CHARACTERISTICS  
Verification of V-I characteristics of PN diode and calculate static and dynamic resistance using Hardware. |
| 2     | ZENER DIODE CHARACTERISTICS AND VOLTAGE REGULATOR  
Verification of V-I characteristics of Zener diode and perform Zener diode as a Voltage regulator using Hardware. |
| 3     | HALF WAVE AND FULL WAVE RECTIFIER  
Verification of Half wave rectifier and Full wave rectifier without and with filters using hardware. |
| 4     | TRANSISTOR CE CHARACTERISTICS  
Verification of Input and Output characteristics of CE configuration using hardware |
| 5     | TRANSISTOR CB CHARACTERISTICS  
Verification of Input and Output characteristics of CB configuration using hardware |
| 6     | FREQUENCY RESPONSE OF CE AMPLIFIER  
Determine the Gain and Bandwidth of CE amplifier using hardware. |
| 7     | BOOLEAN EXPRESSIONS USING GATES  
Realization of Boolean Expressions using Gates |
<table>
<thead>
<tr>
<th>Expt. 8</th>
<th>UNIVERSAL GATES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design and realization of logic gates using universal gates</td>
<td></td>
</tr>
<tr>
<td>Expt. 9</td>
<td>NAND / NOR GATES</td>
</tr>
<tr>
<td>Generation of clock using NAND / NOR gates</td>
<td></td>
</tr>
<tr>
<td>Expt. 10</td>
<td>ADDER/ SUBTRACTOR</td>
</tr>
<tr>
<td>Design a 4 – bit Adder / Subtractor</td>
<td></td>
</tr>
<tr>
<td>Expt. 11</td>
<td>BINARY TO GRAY CONVERTER</td>
</tr>
<tr>
<td>Design and realization of a 4 – bit gray to Binary and Binary to Gray Converter</td>
<td></td>
</tr>
<tr>
<td>Expt. 12</td>
<td>TRUTH TABLES AND EXCITATION TABLES</td>
</tr>
<tr>
<td>Verification of truth tables and excitation tables</td>
<td></td>
</tr>
<tr>
<td>Expt. 13</td>
<td>SHIFT REGISTER</td>
</tr>
<tr>
<td>Design and realization of an 8 bit parallel load and serial out shift register using flip-flops</td>
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</tr>
<tr>
<td>Expt. 14</td>
<td>MULTIPLEXER</td>
</tr>
<tr>
<td>Design and realization of 8x1 using 2x1 MUX</td>
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</tr>
<tr>
<td>Expt. 15</td>
<td>2 BIT COMPARATOR</td>
</tr>
<tr>
<td>Design and realization of 2 bit comparator</td>
<td></td>
</tr>
</tbody>
</table>

**Reference Books:**


**Web References:**

2. http://www.ee.iitkgp.ac.in
3. http://www.citchennai.edu.in
ELECTRICAL MACHINES LABORATORY - I

III Semester: EEE

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Category</th>
<th>Hours / Week</th>
<th>Credits</th>
<th>Maximum Marks</th>
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<tr>
<td>AEEB13</td>
<td>Core</td>
<td>L T P C CIA SEE Total</td>
<td>- - 3 1.5 30 70 100</td>
<td></td>
</tr>
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</table>

Contact Classes: NIL  Tutorial Classes: NIL  Practical Classes: 36  Total Classes: 36

OBJECTIVES:
The course should enable the students to:
I. Conduct various tests on DC identical series and shunt machines.
II. Develop procedure for speed control of DC machines.
III. Conduct various tests on DC shunt, series and compound machines.
IV. Simulate DC machine to study the characteristics by using digital simulation.

Expt.1  OPEN CIRCUIT CHARACTERISTICS OF DC SHUNT GENERATOR
Magnetization characteristics of DC shunt generator

Expt.2  LOAD TEST ON DC SHUNT GENERATOR
Determination of efficiency by load test in DC shunt generator

Expt.3  LOAD TEST ON DC SERIES GENERATOR
Determination of efficiency by load test on DC series generator.

Expt.4  LOAD TEST ON DC COMPOUND GENERATOR
Determination of efficiency by load test on DC compound generator.

Expt.5  HOPKINSON’S TEST
Study the performance characteristics of two identical DC shunts machines.

Expt.6  FIELD’S TEST
Study the performance characteristics of two identical DC series machines

Expt.7  SWINBURNE’S TEST AND SPEED CONTROL OF DC SHUNT MOTOR
Predetermine the efficiency and study the characteristics of DC shunt machine with different speed control techniques.

Expt.8  BRAKE TEST ON DC COMPOUND MOTOR
Study the performance characteristics of DC compound motor

Expt.9  BRAKE TEST ON DC SHUNT MOTOR
Study the performance characteristics of DC shunt motor by brake test
<table>
<thead>
<tr>
<th>Expt. 10</th>
<th>RETARDATION TEST</th>
</tr>
</thead>
<tbody>
<tr>
<td>Study the performance characteristics by using retardation test on DC shunt motor</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Expt. 11</th>
<th>SEPARATION OF LOSSES IN DC SHUNT MOTOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Study the method used for separation of losses in DC shunt motor</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Expt. 12</th>
<th>MAGNETIZATION CHARACTERISTICS OF DC SHUNT GENERATOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Study the magnetization characteristics of DC shunt generator using digital simulation.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Expt. 13</th>
<th>LOAD TEST ON DC SHUNT GENERATOR USING DIGITAL SIMULATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perform the load test on DC shunt generator using digital simulation</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Expt. 14</th>
<th>SPEED CONTROL OF DC SHUNT MOTOR USING DIGITAL SIMULATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Verify the speed control techniques of DC motor using digital simulation</td>
<td></td>
</tr>
</tbody>
</table>

**Reference Books:**


**Web References:**

1. https://www.ee.iitkgp.ac.in
2. https://www.citchennai.edu.in
3. https://www.iare.ac.in
IV Semester: EEE

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Category</th>
<th>Hours / Week</th>
<th>Credits</th>
<th>Maximum Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>AHSB06</td>
<td>Core</td>
<td>L  T  P  C  CIA  SEE  Total</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>3  -  -  3  30  70  100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contact Classes: 45</td>
<td>Tutorial Classes: Nil</td>
<td>Practical Classes: Nil</td>
<td>Total Classes: 45</td>
<td></td>
</tr>
</tbody>
</table>

OBJECTIVES:
The course should enable the students to:
I. Understand the basic theory of complex functions to express the power series.
II. Evaluate the contour integration using Cauchy residue theorem.
III. Enrich the knowledge of probability on single random variables and probability distributions.

MODULE-I  COMPLEX FUNCTIONS AND DIFFERENTIATION  Classes: 09

1. Complex functions differentiation and integration: Complex functions and its representation on argand plane, concepts of limit, continuity, differentiability, analyticity, Cauchy-Riemann conditions and harmonic functions; Milne-Thomson method; Bilinear Transformation.

MODULE-II  COMPLEX INTEGRATION  Classes: 09

1. Line integral: Evaluation along a path and by indefinite integration; Cauchy’s integral theorem; Cauchy’s integral formula; Generalized integral formula; Power series expansions of complex functions and contour Integration: Radius of convergence.

MODULE-III  POWER SERIES EXPANSION OF COMPLEX FUNCTION  Classes: 09

1. Expansion in Taylor’s series, Maclaurin’s series and Laurent series. Singular point; Isolated singular point; Pole of order m; Essential singularity; Residue: Cauchy Residue Theorem.

Evaluation of Residue by Laurent Series and Residue Theorem.
Evaluation of integrals of the type
\[
\begin{align*}
1. & \quad \int_0^{2\pi} f(\cos \theta, \sin \theta) \, d\theta \\
2. & \quad \int_{-\infty}^{\infty} f(x) \, dx
\end{align*}
\]

MODULE-IV  SINGLE RANDOM VARIABLES  Classes: 09

1. Random variables: Discrete and continuous, probability distributions, mass function-density function of a probability distribution. Mathematical expectation, moment about origin, central moments, moment generating function of probability distribution.

MODULE-V  PROBABILITY DISTRIBUTIONS  Classes: 09

1. Binomial, Poisson and normal distributions and their properties.

Text Books:
**Reference Books:**


**Web References:**


**E-Text Books:**

ELECTRICAL POWER GENERATION SYSTEMS

IV Semester: EEE

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Category</th>
<th>Hours / Week</th>
<th>Credits</th>
<th>Maximum Marks</th>
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</thead>
<tbody>
<tr>
<td>AEEB14</td>
<td>Core</td>
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<td>P</td>
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<tr>
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<td>1</td>
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<td>4</td>
<td>30</td>
</tr>
</tbody>
</table>

Contact Classes: 45  Tutorial Classes: 15  Practical Classes: Nil  Total Classes: 60

OBJECTIVES:
The course should enable the students to:
I. Demonstrate various conventional power generation systems including major subsystems.
II. Understand hydroelectric power generation systems along with pumped storage plants and hydraulic turbines.
III. Apply knowledge of solar and wind power generation systems in design and implementation to obtain clean energy.
IV. Illustrate the economic aspects of power generation and power tariff methods.

MODULE I  CONVENTIONAL POWER GENERATION SYSTEMS  Classes: 09

Thermal Power Stations: Evaluation of power systems, present day scenario, Line diagram of thermal power station (TPS) showing paths of coal, steam, water, air, ash and flue gasses; Brief description of TPS components: Economizers, boilers, super heaters, turbines, condensers, chimney and cooling towers. Nuclear power stations: Nuclear fission and chain reaction, nuclear fuels, principle of operation of nuclear reactor, reactor components, moderators, control rods, reflectors and coolants, radiation hazards, shielding and safety precautions, types of nuclear reactors and brief description of PWR, BWR and FBR; Gas power stations: Principle of operation and components (Block diagram approach only).

MODULE II  HYDROELECTRIC POWER STATIONS  Classes: 09

Hydroelectric Power Stations: Elements of hydro electric power station, types, concept of pumped storage plants, storage requirements, mass curve (explanation only), estimation of power developed from a given catchment area, heads and efficiencies; Hydraulic turbines: Classification of turbines, impulse and reaction turbines, Pelton wheel, Francis turbine and Kaplan turbine, working proportions, work done, efficiencies, hydraulic design, draft tube theory, functions and efficiency.

MODULE III  SOLAR ENERGY  Classes: 09

Solar radiation: Environmental impact of solar power, physics of the sun, solar constant, extraterrestrial and terrestrial solar radiation, solar radiation on tilted surface, instruments for measuring solar radiation, solar radiation data, solar concentrators, collectors, thermal applications, design of standalone solar systems, simple problems.

Photovoltaic systems: Photovoltaic effect, semiconducting materials, band gap theory, photo emission of electrons, cell configuration, types of solar cells, cell properties, device physics, electrostatic field across the depletion layer, voltage developed, I-V characteristics, module structure and fabrication, output power and efficiency, fill factor, maximum power point tracking (MPPT), solar grid connected inverters, simple problems.

MODULE IV  WIND ENERGY  Classes: 09

Wind energy: Sources and potential, power from wind, Betz criterion, components of wind energy conversion system, types of turbines, horizontal and vertical axis wind turbines, aerodynamics, momentum theory (actuator
disk concept), operational characteristics, blade element theory, types of generating systems for wind energy, permanent magnet generators, DC generators, induction generators, doubly fed induction generators, applications of wind energy, safety and environmental aspects, simple problems.

<table>
<thead>
<tr>
<th>MODULE-V</th>
<th>ECONOMIC ASPECTS OF POWER GENERATION</th>
<th>Classes: 09</th>
</tr>
</thead>
</table>

Terms commonly used in system operation, various factors affecting cost of generations; load curves, connected load, maximum demand, peak load, base load and peak load power plants, load factors, plant capacity factor, plant use factor, demand factors, diversity factor, cost of power plant, tariffs.

**Text Books:**


**Reference Books:**


**Web References:**

1. https://www.solarpowernotes.com
2. https://www.electrical4u.com/power-plants-types-of-power-plant
3. https://www.iare.ac.in

**E-Text Books:**

2. https://www.nitt.edu
3. https://www.textbooksonline.tn.nic.in
### ELECTRICAL MACHINES - II

**IV Semester: EEE**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Category</th>
<th>Hours / Week</th>
<th>Credits</th>
<th>Maximum Marks</th>
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<tr>
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<td>Core</td>
<td>L 1 T - P 4</td>
<td>CIA 30</td>
<td>SEE 70</td>
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</tbody>
</table>

Contact Classes: 45  
Tutorial Classes: 15  
Practical Classes: Nil  
Total Classes: 60

**OBJECTIVES:**
The course should enable the students to:
I. Explain the concepts of rotating magnetic fields.
II. Understand the operation of ac machines.
III. Analyse performance characteristics of ac machines.

<table>
<thead>
<tr>
<th>MODULE-I</th>
<th>PULSATING AND REVOLVING MAGNETIC FIELDS</th>
<th>Classes: 09</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant magnetic field, pulsating magnetic field, alternating current in windings with spatial displacement, Magnetic field produced by a single winding, fixed current and alternating current. Pulsating fields produced by spatially displaced windings, windings spatially shifted by 90 degrees. Addition of pulsating magnetic fields. Three windings spatially shifted by 120 degrees (carrying three-phase balanced currents), revolving magnetic field.</td>
<td></td>
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</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MODULE-II</th>
<th>INDUCTION MACHINES</th>
<th>Classes: 09</th>
</tr>
</thead>
<tbody>
<tr>
<td>Three phase induction motors: Introduction, construction, types of induction motors, slip and frequency of rotor currents, rotor MMF and production of torque, equivalent circuit, power across air gap, torque and power output, torque slip characteristics, generating and braking modes, maximum (breakdown) torque, starting torque, maximum power output, problems. Equivalent circuit model: No load test and blocked rotor test, circuit model, starting methods, speed control of induction motors, induction generator, principle of operation, isolated induction generator, Doubly-Fed Induction Machines, circle diagram, determination of induction motor parameters from circle diagram, problem.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MODULE-III</th>
<th>ALTERNATORS</th>
<th>Classes: 09</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>MODULE-IV</th>
<th>SYNCHRONOUS MOTORS</th>
<th>Classes: 09</th>
</tr>
</thead>
<tbody>
<tr>
<td>Synchronous motors: Principle of operation, power developed, synchronous motor with different excitations, effect of increased load with constant excitation, effect of change in excitation with constant load, effect of excitation on armature current and power factor, construction of “V” and inverted “V” curves, power and excitation circles, starting methods, salient pole synchronous motor, phasor diagrams and analysis, synchronous condenser.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### MODULE-V
**SINGLE-PHASE INDUCTION MOTORS**

<table>
<thead>
<tr>
<th>Classes: 09</th>
</tr>
</thead>
</table>

Single phase induction motor: Principle of operation, two reaction theory, equivalent circuit analysis, split phase motor, construction, principle of operation, capacitor start, capacitor run, capacitor start - capacitor run motor, shaded pole motor, torque speed characteristics.

### Text Books:


### Reference Books:


### Web References:

1. https://www.electrical4u.com
2. https://auto.howstuffworks.com
3. https://www.studyelectrical.com

### E-Text Books:

1. https://www.freeengineeringbooks.com
2. https://bookboon.com
3. https://www.jntubook.com
CONTROL SYSTEMS

IV Semester: ECE, EEE

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Category</th>
<th>Hours / Week</th>
<th>Credits</th>
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</tr>
</tbody>
</table>

Contact Classes: 45  Tutorial Classes: 15  Practical Classes: Nil  Total Classes: 60

OBJECTIVES:
The course should enable the students to:
I. Organize modeling and analysis of electrical and mechanical systems.
II. Analyse control systems by block diagrams and signal flow graph technique.
III. Demonstrate the analytical and graphical techniques to study the stability.
IV. Illustrate the frequency domain and state space analysis.

MODULE-I  INTRODUCTION AND MODELING OF PHYSICAL SYSTEMS  Classes: 08

Control systems: Introduction, open loop and closed loop systems, examples, comparison, mathematical modeling and differential equations of physical systems, concept of transfer function, translational and rotational mechanical systems, electrical systems, force, voltage and current analogy.

MODULE-II  BLOCK DIAGRAM REDUCTION AND TIME RESPONSE ANALYSIS  Classes: 10

Block Diagrams: Block diagram representation of various systems, block diagram algebra, characteristics of feedback systems, AC servomotor, signal flow graph, Mason’s gain formula; Time response analysis: Standard test signals, shifted unit step, shifting theorem, convolution integral, impulse response, unit step response of first and second order systems, time response specifications, steady state errors and error constants, dynamic error coefficients method, effects of proportional, derivative and proportional derivative, proportional integral and PID controllers.

MODULE-III  CONCEPT OF STABILITY AND ROOT LOCUS TECHNIQUE  Classes: 09

Concept of stability: Necessary and sufficient conditions for stability, Routh’s and Routh Hurwitz stability criterions and limitations.

Root locus technique: Introduction, root locus concept, construction of root loci, graphical determination of ‘k’ for specified damping ratio, relative stability, effect of adding zeros and poles on stability.

MODULE-IV  FREQUENCY DOMAIN ANALYSIS  Classes: 10

Frequency domain analysis: Introduction, frequency domain specifications, stability analysis from Bode plot, Nyquist plot, calculation of gain margin and phase margin, determination of transfer function, correlation between time and frequency responses.

MODULE-V  STATE SPACE ANALYSIS AND COMPENSATORS  Classes: 08

State Space Analysis: Concept 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 properties, concept of controllability and observability; Compensators: Lag, lead, lead - lag networks.
### Text Books:


### Reference Books:


### Web References:

2. https://www.aar.faculty.asu.edu/classes
3. https://www.facstaff.bucknell.edu/
4. https://www.electrical4u.com
5. https://www.iare.ac.in

### E-Text Books:

1. https://www.jntubook.com/
2. https://www.freeengineeringbooks.com
DATA STRUCTURES

III Semester: ME / CSE / IT / ECE / CE | IV Semester AE / EEE

<table>
<thead>
<tr>
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<th>Category</th>
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Contact Classes: 45 Tutorial Classes: Nil Practical Classes: Nil Total Classes: 45

OBJECTIVES:
The course should enable the students to:
I. Learn the basic techniques of algorithm analysis.
II. Demonstrate searching and sorting algorithms and analyze their time complexities.
III. Implement linear data structures viz. stack, queue and linked list.
IV. Demonstrate non-linear data structures viz. tree and graph traversal algorithms.
V. Study and choose appropriate data structure to solve problems in real world.

MODULE – I INTRODUCTION TO DATA STRUCTURES, SEARCHING AND SORTING Classes: 09
Basic concepts: Introduction to data structures, classification of data structures, operations on data structures; Searching techniques: Linear search and Binary search; Sorting techniques: Bubble sort, selection sort, insertion sort and comparison of sorting algorithms.

MODULE - II LINEAR DATA STRUCTURES Classes: 09
Stacks: Primitive operations, implementation of stacks using arrays, applications of stacks arithmetic expression conversion and evaluation; Queues: Primitive operations; Implementation of queues using Arrays, applications of linear queue, circular queue and double ended queue (deque).

MODULE - III LINKED LISTS Classes: 09
Linked lists: Introduction, singly linked list, representation of a linked list in memory, operations on a single linked list; Applications of linked lists: Polynomial representation and sparse matrix manipulation.
Types of linked lists: Circular linked lists, doubly linked lists; Linked list representation and operations of Stack and Queue.

MODULE - IV NON-LINEAR DATA STRUCTURES Classes: 09
Trees: Basic concept, binary tree, binary tree representation, array and linked representations, binary tree traversal, binary tree variants, application of trees; Graphs: Basic concept, graph terminology, graph implementation, graph traversals, Application of graphs.

MODULE - V BINARY TREES AND HASHING Classes: 09
Binary search trees: Binary search trees, properties and operations; Balanced search trees: AVL trees; Introduction to M-Way search trees, B trees; Hashing and collision: Introduction, hash tables, hash functions, collisions, applications of hashing.
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<thead>
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<th><strong>Text Books:</strong></th>
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<th><strong>Reference Books:</strong></th>
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<th><strong>Web References:</strong></th>
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ELECTRICAL MACHINES LABORATORY - II

IV Semester: EEE

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<td>- - 3 1.5 30 70 100</td>
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</table>

Contact Classes: Nil  Tutorial Classes: Nil  Practical Classes: 36  Total Classes: 36

OBJECTIVES:
The course should enable the students to:
I. Evaluate losses and determine the efficiency of single phase and three phase electrical machines.
II. Determine the voltage regulation, efficiency and temperature rise in various transformers.
III. Apply PLC and digital simulation software to gain practical knowledge.

LIST OF EXPERIMENTS

Expt. 1  OC AND SC TEST ON SINGLE PHASE TRANSFORMER
Determine the equivalent circuit parameters; predetermine the efficiency and regulation by open circuit and short circuit test on a single phase transformer.

Expt. 2  SUMPNER’S TEST
Predetermine the efficiency and regulation of two identical single phase transformers.

Expt. 3  LOAD TEST ON SINGLE PHASE TRANSFORMERS
Determination of efficiency by load test on a single phase transformer.

Expt. 4  SCOTT CONNECTION OF TRANSFORMERS
Conversion of three phase to two phase using single phase transformers.

Expt. 5  SEPARATION OF CORE LOSSES IN SINGLE PHASE TRANSFORMER
Find out the eddy current and hysteresis losses in single phase transformer.

Expt. 6  HEAT RUN TEST ON SINGLE PHASE TRANSFORMERS
Determine the temperature rise in three single phase transformers set.

Expt. 7  BRAKE TEST ON THREE PHASE SQUIRREL CAGE INDUCTION MOTOR
Plot the performance characteristics of three phase induction motor.

Expt. 8  CIRCLE DIAGRAM OF THREE PHASE SQUIRREL CAGE INDUCTION MOTOR
Plot the circle diagram and predetermine the efficiency and losses of three phase squirrel cage induction motor.
<table>
<thead>
<tr>
<th>Expt.</th>
<th>Description</th>
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<tbody>
<tr>
<td>9</td>
<td>REGULATION OF ALTERNATOR BY EMF METHOD</td>
</tr>
<tr>
<td>10</td>
<td>REGULATION OF ALTERNATOR BY MMF METHOD</td>
</tr>
<tr>
<td>11</td>
<td>SLIP TEST ON THREE PHASE SALIENT POLE SYNCHRONOUS MOTOR</td>
</tr>
<tr>
<td>12</td>
<td>V’ AND INVERTED ‘V’ CURVES OF SYNCHRONOUS MOTOR</td>
</tr>
<tr>
<td>13</td>
<td>EQUIVALENT CIRCUIT PARAMETERS OF SINGLE PHASE INDUCTION MOTOR</td>
</tr>
<tr>
<td>14</td>
<td>STARTING AND SPEED CONTROL OF INDUCTION MOTOR USING PLC</td>
</tr>
</tbody>
</table>

**Reference Books:**


**Web References:**

1. https://www.ee.iitkgp.ac.in
2. https://www.citchennai.edu.in
3. https://www.iare.ac.in
CONTROL SYSTEMS LABORATORY

IV Semester: EEE

<table>
<thead>
<tr>
<th>Course Code</th>
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<th>Maximum Marks</th>
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Contact Classes: Nil  Tutorial Classes: Nil  Practical Classes: 24  Total Classes: 24

OBJECTIVES:
The course should enable the students to:
I. Understand mathematical models of electrical and mechanical systems.
II. Analysis of control system stability using digital simulation.
III. Demonstrate the time domain and frequency domain analysis for linear time invariant systems.
IV. Apply programmable logic controllers to demonstrate industrial controls in the laboratory.

LIST OF EXPERIMENTS

Expt. 1  TIME RESPONSE OF SECOND ORDER SYSTEM
To obtain the time response of a given second order system with time domain specifications.

Expt. 2  TRANSFER FUNCTION OF DC MOTOR
Determine the transfer function, time response of DC motor and verification with digital simulation.

Expt. 3  AC SERVO MOTOR
Study of AC servomotor and plot its torque speed characteristics.

Expt. 4  EFFECT OF VARIOUS CONTROLLERS ON SECOND ORDER SYSTEM
Study the effect of P, PD, PI and PID controller on closed loop second order systems.

Expt. 5  COMPENSATOR
Study lead-lag compensator and obtain its magnitude, phase plots.

Expt. 6  TEMPERATURE CONTROLLER
Study the performance of PID controller used to control the temperature of an oven.

Expt. 7  DESIGN AND VERIFICATION OF OP-AMP BASED PID CONTROLLER
Implementation of PID controller using Op-Amps and verification using MATLAB.

Expt. 8  STABILITY ANALYSIS USING DIGITAL SIMULATION

Expt. 9  STATE SPACE MODEL USING DIGITAL SIMULATION
Verification of state space model from transfer function and transfer function from state space model using digital simulation.
<table>
<thead>
<tr>
<th>Expt. 10</th>
<th>LADDER DIAGRAMS USING PLC</th>
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<tbody>
<tr>
<td>Input output connection, simple programming, ladder diagrams, uploading, running the program and debugging in programmable logic controller.</td>
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</table>

<table>
<thead>
<tr>
<th>Expt. 11</th>
<th>TRUTH TABLES USING PLC</th>
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<tbody>
<tr>
<td>Study and verification of truth tables of logic gates, simple boolean expressions and application to speed control of DC motor using programmable logic controller.</td>
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<thead>
<tr>
<th>Expt. 12</th>
<th>IMPLEMENTATION OF COUNTER</th>
</tr>
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<tbody>
<tr>
<td>Implementation of counting number of objects and taking action using PLC.</td>
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<table>
<thead>
<tr>
<th>Expt. 13</th>
<th>BLINKING LIGHTS USING PLC</th>
</tr>
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<tbody>
<tr>
<td>Implementation of blinking lights with programmable logic controller.</td>
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<thead>
<tr>
<th>Expt. 14</th>
<th>WATER LEVEL CONTROL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control of maximum and minimum level of water in a tank using PLC.</td>
<td></td>
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</tbody>
</table>

**Reference Books:**


**Web References:**

1. https://www.ee.iitkgp.ac.in
3. https://www.iare.ac.in

**SOFTWARE AND HARDWARE REQUIREMENTS FOR A BATCH OF 36 STUDENTS:**

**SOFTWARE:** MATLAB, WPL soft Software

**HARDWARE:** Desktop Computers (04 nos)
III Semester: ME / CSE / IT / ECE / CE | IV Semester AE / EEE

<table>
<thead>
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<td>0 0 3 1.5 30 70 100</td>
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</tbody>
</table>

Contact Classes: Nil Tutorial Classes: Nil Practical Classes: 36 Total Classes: 36

COURSE OBJECTIVES:
The course should enable the students to:
I. Understand various data representation techniques in the real world.
II. Implement linear and non-linear data structures.
III. Analyze various algorithms based on their time and space complexity.
IV. Develop real-time applications using suitable data structure.
V. Identify suitable data structure to solve various computing problems.

LIST OF EXPERIMENTS

WEEK-1 BASICS OF PYTHON
Write Python programs for the following:
a. To find the biggest of given n numbers using control statements and lists
b. To print the Fibonacci series using functions
c. To find GCD of two numbers

WEEK-2 SEARCHING TECHNIQUES
Write Python programs for implementing the following searching techniques to arrange a list of integers in ascending order.
a. Linear search
b. Binary search

WEEK-3 SORTING TECHNIQUES
Write Python programs for implementing the following sorting techniques to arrange a list of integers in ascending order.
a. Bubble sort
b. Insertion sort
c. Selection sort

WEEK-4 IMPLEMENTATION OF STACK AND QUEUE
Write Python programs to for the following:
a. Design and implement Stack and its operations using List.
b. Design and implement Queue and its operations using List.

WEEK-5 APPLICATIONS OF STACK
Write Python programs for the following:
a. Uses Stack operations to convert infix expression into postfix expression.
b. Uses Stack operations for evaluating the postfix expression.
<table>
<thead>
<tr>
<th>WEEK6</th>
<th>IMPLEMENTATION OF SINGLE LINKED LIST</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write Python programs for the following operations on Single Linked List.</td>
<td></td>
</tr>
<tr>
<td>(i) Creation (ii) insertion (iii) deletion (iv) traversal</td>
<td></td>
</tr>
</tbody>
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<tr>
<th>WEEK-7</th>
<th>IMPLEMENTATION OF CIRCULAR SINGLE LINKED LIST</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write Python programs for the following operations on Circular Linked List.</td>
<td></td>
</tr>
<tr>
<td>(i) Creation (ii) insertion (iii) deletion (iv) traversal</td>
<td></td>
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<table>
<thead>
<tr>
<th>WEEK-8</th>
<th>IMPLEMENTATION OF DOUBLE LINKED LIST</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write Python programs for the following operations on Double Linked List.</td>
<td></td>
</tr>
<tr>
<td>(i) Creation (ii) insertion (iii) deletion (iv) traversal in both ways.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>WEEK-9</th>
<th>IMPLEMENTATION OF STACK USING LINKED LIST</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write a Python program to implement Stack using linked list.</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>WEEK-10</th>
<th>IMPLEMENTATION OF QUEUE USING LINKED LIST</th>
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<tbody>
<tr>
<td>Write a Python program to implement Linear Queue using linked list.</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>WEEK-11</th>
<th>GRAPH TRAVERSAL TECHNIQUES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write Python programs to implement the following graph traversal algorithms:</td>
<td></td>
</tr>
<tr>
<td>a. Depth first search.</td>
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<tr>
<td>b. Breadth first search.</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>WEEK-12</th>
<th>IMPLEMENTATION OF BINARY SEARCH TREE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write a Python program to perform the following:</td>
<td></td>
</tr>
<tr>
<td>a. Create a binary search tree.</td>
<td></td>
</tr>
<tr>
<td>b. Traverse the above binary search tree recursively in pre-order, post-order and in-order.</td>
<td></td>
</tr>
<tr>
<td>c. Count the number of nodes in the binary search tree.</td>
<td></td>
</tr>
</tbody>
</table>

**LIST OF REFERENCE BOOKS:**

**WEB REFERENCES:**
1. https://docs.python.org/3/tutorial/datastructures.html
ELECTRICAL POWER TRANSMISSION SYSTEMS

V Semester: EEE

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Category</th>
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Contact Classes: 30  Tutorial Classes: 15  Practical Classes: Nil  Total Classes: 45

OBJECTIVES:
The course should enable the students to:

I. Evaluate the voltage regulation and efficiency of different transmission lines.
II. Understand performance of short, medium and long transmission lines.
III. Illustrate power systems transients and sag of transmission lines.
IV. Design insulators for overhead lines, cables for power transmission and overview of HVDC and EHVAC transmission systems.

MODULE-I  TRANSMISSION LINE PARAMETERS  Classes: 09

Transmission line parameters: Types of conductors, calculation of resistance for solid conductors, description and effect on resistance of solid conductors, calculation of inductance for single phase and three phase, single and double circuit lines, concept of GMR, GMD, symmetrical and asymmetrical conductor configuration with and without transposition, Skin and Proximity effect; Numerical Problems: Calculation of capacitance for 2 wire and 3 wire systems, effect of ground on capacitance, capacitance calculations for symmetrical and asymmetrical single and three phase, single and double circuit lines, numerical problems.

MODULE-II  MECHANICAL DESIGN OF TRANSMISSION LINES  Classes: 08

Overhead line insulators: Types of insulators, string efficiency and methods for improvement, numerical problems, voltage distribution, calculation of string efficiency, capacitance grading and static shielding, testing of insulators; Sag and tension calculations: Sag and tension calculations with equal and unequal heights of towers, effect of wind and ICE on weight of conductor, numerical problems, stringing chart and sag template and its applications; mechanical design of typical towers and conductors for 400KV, 220KV and 132KV operations.

MODULE-III  PERFORMANCE OF TRANSMISSION LINES  Classes: 10

Performance of short and medium length transmission lines: Classification of transmission lines, short, medium and long line and their model representations, nominal-T, nominal-Pie and a, b, c, d constants for symmetrical and asymmetrical networks, numerical problems, mathematical solutions to estimate regulation and efficiency of all types of lines, numerical problems.

Performance of long transmission lines: Long transmission line, rigorous solution, evaluation of a, b, c, d constants, representation of long lines, equivalent-T and equivalent Pie network models (numerical problems); Ferranti effect, charging current, effect on regulation of the transmission line, urge impedance and SIL of long lines, wave length and velocity of propagation of waves.
### MODULE-IV
**POWER SYSTEM TRANSIENTS AND FACTORS GOVERNING PERFORMANCE OF TRANSMISSION LINES**  
**Classes: 09**

Power systems transients: Incident reflected and refracted waves, Types of system transients, travelling or propagation of surges, attenuation, distortion, reflection and refraction coefficients, termination of lines with different types of conditions, open circuited line, short circuited line, T-junction, lumped reactive junctions (numerical problems), Bewley’s lattice diagrams (for all the cases mentioned with numerical examples); Corona, description of the phenomenon, factors affecting corona, critical voltages and power loss, radio interference, Electrostatic and electromagnetic interference with communication lines.

### MODULE-V
**UNDERGROUND CABLES, EHV TRANSMISSION AND HVDC TRANSMISSION**  
**Classes: 09**

Underground cables: Types of cables, construction, types of insulating materials, calculation of insulation resistance and stress in insulation, numerical problems, capacitance of single and 3core belted cables, numerical problems, grading of cables, capacitance grading, numerical problems, description of inter-sheath grading HV cables. Need of EHV transmission systems, types of DC links, comparison of AC and DC transmission, advantage of DC transmission, HVDC systems in India.

#### Text Books:

#### Reference Books:

#### Web References:

#### E-Text Books:
POWER ELECTRONICS

V Semester: EEE

<table>
<thead>
<tr>
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<td>70</td>
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Contact Classes: 30  
Tutorial Classes: 15  
Practical Classes: Nil  
Total Classes: 45

OBJECTIVES:
The course should enable the students to:
I. Understand the differences between signal level and power level devices.
II. Analyze controlled rectifier circuits and the operation of DC-DC choppers.
III. Analyze the operation of voltage source inverters.

MODULE-I  POWER SWITCHING DEVICES  Classes: 09

Diode, Thyristor, MOSFET, IGBT: I-V Characteristics; R, RC and UJT firing circuit for thyristor; Gate drive circuits for MOSFET and IGBT. Series and parallel operation, ratings, protection against dv/dt and di/dt, design of Snubber circuit, forced commutation circuits, other devices in thyristor family: TRIAC, GTO and their characteristics, numerical problems.

MODULE-II  PHASE CONTROLLED RECTIFIERS  Classes: 09

Single phase half wave and single phase full bridge thyristor rectifier with R-load and highly inductive load; derivation of average load voltage and current, effect of freewheeling diode, effect of source inductance, Three phase full bridge thyristor rectifier with R-load and highly inductive load; Dual converters, circulating and non-circulating current modes of operation of single phase and three phase dual converters with R-Load, numerical problems.

MODULE-III  CHOPPERS  Classes: 09

Basic chopper operation, control strategies, step up chopper, derivation of load voltage and load currents with R and RL loads, chopper configurations.

Power circuit of a buck, boost and buck-boost converters: Analysis and waveforms at steady state.

MODULE-IV  AC VOLTAGE CONTROLLER AND CYCLO CONVERTERS  Classes: 09

Single phase AC voltage controllers - two SCRs in anti-parallel with R and RL loads, derivation of rms load voltage and load current, numerical problems, Cyclo converters - single phase midpoint and bridge type (step-up and step-down operations) with R and RL loads.

MODULE-V  INVERTERS  Classes: 09

Single phase inverters: Basic operation, voltage source inverters, basic series and parallel inverters, current source inverter, modified Mc Murray and Mc Murray-Bedford half bridge inverters (operation and waveforms), voltage control by pulse width modulation techniques (single pulse, multiple pulse and sinusoidal), numerical problems. Three phase bridge Inverters - 180° and 120° conduction modes of operation.
### Text Books:


### Reference Books:


### Web References:

2. https://www.nptel.iitm.ac.in
3. https://www.iare.ac.in

### E-Text Books:

1. https://www.freebookcentre.net
2. https://www.amazon.in/POWER-ELECTRONICS-HANDBOOK
3. https://www.circuitstoday.com
## MICROPROCESSORS AND MICROCONTROLLERS

**VI Semester: ECE | V Semester: EEE**

<table>
<thead>
<tr>
<th>Course Code</th>
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<tr>
<td>Contact Classes: 30</td>
<td>Tutorial Classes: 15</td>
<td>Practical Classes: Nil</td>
<td>Total Classes: 45</td>
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</table>

**OBJECTIVES:**
The course should enable the students to:
I. Imbibe sound knowledge about architecture, instruction set and concepts of 8086 and 8051.
II. Demonstrate the ability to develop programmes for different applications using assembly language of 8086 and 8051.
III. Impart knowledge of different types of external peripherals like 8255, 8259, 8279, 8251, 8257.
IV. Proficient in Memory and I/O interfacing with 8086 and 8051.

### MODULE -I  8086 MICROPROCESSORS

Register organization of 8086, Architecture, signal description of 8086, physical memory organization, general bus operation, I/O addressing capability, special purpose activities, Minimum mode, maximum mode of 8086 system and timings, machine language instruction formats, addressing mode of 8086, instruction set off 8086, assembler directives and operators.

### MODULE -II  PROGRAMMING WITH 8086 MICROPROCESSOR

Machine level programs, programming with an assembler, Assembly language programs, introduction to stack, stack structure of 8086/8088, interrupts and interrupt service routines. Interrupt cycle of 8086, non-mask able interrupt and mask able interrupts, interrupt programming.

### MODULE -III  INTERFACING WITH 8086/88

Semiconductor memory interfacing, dynamic RAM interfacing, interfacing i/o ports, PIO 8255 modes of operation of 8255, interfacing to D/A and A/D converters, stepper motor interfacing, control of high power devices using 8255.

Programmable interrupt controller 8259A, the keyboard /display controller8279, programmable communication interface 8251 USART, DMA Controller 8257.

### MODULE -IV  8051 MICROCONTROLLER

8051 Microcontroller – Internal architecture and pin configuration, 8051 addressing modes, instruction set, Bit addressable features. I/O Port structures, assembly language programming using data transfer, arithmetic, logical and branch instructions.

### MODULE -V  SYSTEM DESIGN USING MICROCONTROLLER

8051 Timers/Counters, Serial data communication and its programming, 8051 interrupts, Interrupt vector table, Interrupt programming. Real world interfacing of 8051 with external memory, expansion of I/O ports, LCD, ADC, DAC, stepper motor interfacing.

**Text Books:**

**Reference Books**


**Web References:**

1. http://www.nptel.ac.in/downloads/106108100/
2. http://www.the8051microcontroller.com/web-references
3. http://www.iare.ac.in

**E-Text Book:**

1. https://books.google.co.in/books
BUSINESS ECONOMICS AND FINANCIAL ANALYSIS

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Category</th>
<th>Hours / Week</th>
<th>Credits</th>
<th>Maximum Marks</th>
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<td>Contact Classes: 45</td>
<td>Tutorial Classes: Nil</td>
<td>Practical Classes: Nil</td>
<td>Total Classes: 45</td>
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</table>

OBJECTIVES:
The course should enable the students to:
I. Understand the market dynamics namely demand elasticity of demand and pricing in different market structures.
II. Analyze how capital budgeting decisions are carried out for selecting the best investment proposal.
III. Learn how organizations make important investment and financing decisions.
IV. Analyze a company’s financial statements and come to a reasoned conclusion about the financial situation of the company.
V. Acquire the basics of how to analyze and interpret the financial statements through ratio analysis.

MODULE – I INTRODUCTION AND DEMAND ANALYSIS  Classes: 07
Definition, nature and scope of business economics; Demand analysis; Demand determinants, law of demand and its exceptions; Elasticity of demand: Definition, types, measurement and significance of elasticity of demand, demand forecasting, factors governing demand forecasting.

MODULE – II PRODUCTION AND COST ANALYSIS  Classes: 10
Production function; Isoquants and isocosts, MRTS, least cost combination of inputs, Cobb-Douglas production function, internal and external economies of scale, cost analysis; Cost concepts: Break even analysis (BEA), determination of break-even point (simple problems), managerial significance.

MODULE – III MARKETS AND NEW ECONOMIC ENVIRONMENT  Classes: 08
Types of competition and markets, features of perfect competition, monopoly and monopolistic competition, price-output determination in case of perfect competition and monopoly business.
Features and evaluation of different forms of business organizations: Sole proprietorship, partnership, joint stock company, public enterprises and their types.

MODULE – IV CAPITAL BUDGETING  Classes: 10
Capital and its significance, types of capital, estimation of fixed and working capital requirements, methods and sources of raising capital, capital budgeting: features of capital budgeting proposals; Methods of capital budgeting: Payback period, accounting rate of return(ARR), net present value method and internal rate of return method (simple problems).

MODULE – V INTRODUCTION TO FINANCIAL ACCOUNTING AND FINANCIAL ANALYSIS  Classes: 10
Financial accounting objectives, functions, importance; Accounting concepts and accounting conventions - double-entry book keeping, journal, ledger, trial balance; Final accounts: Trading account, profit and loss account and balance sheet with simple adjustments; Financial analysis: Analysis and interpretation of liquidity ratios, activity ratios, capital structure ratios and profitability ratios (simple problems), Du Pont chart.
### Text Books:


### Reference Books:


### Web References:

4. https://www.gvpce.ac.in/syllabi/Managerial Economics and financial analysis

### E-Text Book:

1. https://books.google.co.in/books/about/Managerial economics and financial analysis.html
4. http://books.google.com/books/about/Managerial economics and financial analysis.html
POWER ELECTRONICS LABORATORY

V Semester: EEE

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Category</th>
<th>Hours / Week</th>
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<th>Maximum Marks</th>
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<tr>
<td>2 2 1 30 70 100</td>
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</table>

Contact Classes: Nil  Tutorial Classes: Nil  Practical Classes: 24  Total Classes: 24

OBJECTIVES:
The course should enable the students to:
I. Examine the characteristics of various devices and application of firing circuits used in power electronics.
II. Outline the performance characteristics of AC voltage regulators, choppers, inverters, rectifiers and cycloconverters.
III. Demonstrate the working principle of various power electronic devices and circuits using simulation.
IV. Design the circuit of switched mode power supplies through simulation.

LIST OF EXPERIMENTS

<table>
<thead>
<tr>
<th>Expt. 1</th>
<th>SCR, MOSFET AND IGBT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Study the characteristics of SCR, MOSFET and IGBT.</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Expt. 2</th>
<th>GATE FIRING CIRCUITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Study the operation of gate firing circuits of SCR.</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Expt. 3</th>
<th>HALF CONTROLLED CONVERTER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Study the performance characteristics of single phase half controlled converter with R and RL loads.</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Expt. 4</th>
<th>FORCED COMMUTATION CIRCUITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plot the characteristics of forced commutation circuits (Class A, Class B, Class C, Class D and Class E).</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Expt. 5</th>
<th>FULLY CONTROLLED BRIDGE CONVERTER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Study the characteristics of single phase fully controlled bridge converter with R and RL loads.</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Expt. 6</th>
<th>SERIES INVERTER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Study the characteristics of single phase series inverter with different loads.</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Expt. 7</th>
<th>PARALLEL INVERTER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Study the characteristics of single phase parallel inverter with different loads.</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Expt. 8</th>
<th>VOLTAGE CONTROLLER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plot the characteristics of single phase AC voltage controller with R and RL loads.</td>
<td></td>
</tr>
<tr>
<td>Expt. 9</td>
<td>DUAL CONVERTER</td>
</tr>
<tr>
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</tr>
<tr>
<td>Study the characteristics of single phase dual converter with R and RL loads.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Expt. 10</th>
<th>CYCLOCONVERTER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Study the characteristics of single phase cycloconverter with R and RL loads.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Expt. 11</th>
<th>THREE PHASE SEMI CONVERTER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plot the characteristics of three phase half converter with R and RL loads.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Expt. 12</th>
<th>MOSFET BASED CHOPPERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Study the principle of operation of step down chopper using MOSFET.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Expt. 13</th>
<th>SIMULATION OF THREE PHASE FULL CONVERTER AND PWM INVERTER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simulation of three phase full converter and PWM inverter with R and RL loads by using MATLAB.</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Expt. 14</th>
<th>SIMULATION OF DC CONVERTERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simulation of boost, buck, buck - boost converter with R and RL loads by using MATLAB.</td>
<td></td>
</tr>
</tbody>
</table>

**Reference Books:**


**Web References:**

1. https://www.ee.iitkgp.ac.in
2. https://www.citchennai.edu.in
3. https://www.iare.ac.in

**Course Home Page:**

**SOFTWARE AND HARDWARE REQUIREMENTS FOR A BATCH OF 36 STUDENTS:**

**SOFTWARE:** MATLAB R2015a

**HARDWARE:** Desktop Computers (04 No.s)
OBJECTIVES:
The course should enable the students to:
I. Develop assembly level programs and providing the basics of the microprocessors.
II. Understanding the interfacing of external devices to the processor and controller for various applications.
III. Learn assemble language programming using 8051 microcontroller.
IV. Develop ability in programming using microprocessor and microcontroller.

LIST OF EXPERIMENTS

WEEK - 1 DESIGN A PROGRAM USING WIN862
Design and develop an Assembly language program using 8086 microprocessor and to show the following aspects.
   a) Programming
   b) Execution
   c) Debugging
To Demonstrate the win 862 software and Trainer kit for 8086 Microprocessor

WEEK - 2 16 BIT ARITHMETIC AND LOGICAL OPERATIONS
Write an ALP program to perform 16 Bit arithmetic and logical operations using WIN862 software

WEEK - 3 MULTIBYTE ADDITION AND SUBTRACTION
a) Write an ALP program to perform multi byte addition and subtraction
b) Write an ALP program to perform 3*3 matrix multiplication and addition

WEEK - 4 PROGRAMS TO SORT NUMBERS
a) Write an ALP program to perform ascending order using 8086
b) Write an ALP program to perform descending order using 8086

WEEK - 5 PROGRAMS FOR STRING MANIPULATIONS OPERATIONS
a) Write an ALP program to insert or delete a byte in the given string
b) Write an ALP program to search a number/character in a given string
c) Write an ALP program to move a block of data from one memory location to the other
d) Write an ALP program for reverse of a given string.

WEEK - 6 CODE CONVERSIONS
a) Write an ALP program to convert packed BCD to Unpacked BCD
b) Write an ALP program to convert packed BCD to ASCII
c) Write an ALP program to convert hexadecimal to ASCII
## WEEK - 7
INTERFACING STEPPER MOTOR

a) Write an ALP program to rotate stepper motor in clockwise direction  
b) Write an ALP program to rotate stepper motor in anti clockwise direction

## WEEK - 8
INTERFACING ADC & DAC DEVICES

a) Write an ALP program to convert analog to digital using 8086  
b) Write an ALP program to convert digital to analog using 8086

## WEEK - 9
INTERFACING KEYBOARD TO 806

Write an ALP program to interface keyboard to 806

## WEEK - 10
SERIAL AND PARALLEL COMMUNICATION

a) Parallel communication between two microprocessors using 8255  
b) Serial communication between two microprocessor kits using 8251

## WEEK - 11
INTERFACING TRAFFIC LIGHT CONTROLLER AND TONE GENERATOR

a) Write a program to interface traffic light controller  
b) Write an ALP program to interface tone generator

## WEEK - 12
ARITHMETIC AND LOGICAL OPERATIONS USING 8051

Write an ALP program to perform 16 Bit arithmetic and logical operations using 8051 microcontroller

## WEEK - 13
TIMER/COUNTER

Write an ALP Program and verify Timer/Counter using 8051

## WEEK - 14
INTERFACING KEYBOARD TO 8051

Write an ALP program to interface keyboard to 8051

### Reference Books:


### Web References:

1. http://www.nptel.ac.in/downloads/106108100/  
2. http://www.the8051microcontroller.com/web-references  
3. http://www.iare.ac.in

### Course Home Page:

**HARDWARE AND SOFTWARE REQUIRED FOR A BATCH OF 24 STUDENTS**

**HARDWARE:** Desktop Computer Systems 24 nos  
**SOFTWARE:** win 862
POWER SYSTEM ANALYSIS

VI Semester: EEE

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Category</th>
<th>Hours / Week</th>
<th>Credits</th>
<th>Maximum Marks</th>
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<td>2 1 - 3</td>
<td>30 70 100</td>
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</table>

Contact Classes: 30  Tutorial Classes: 15  Practical Classes: Nil  Total Classes: 45

OBJECTIVES:
The course should enable the students to:
I. Determine the bus impedance and admittance matrices for power system network.
II. Calculate various parameters at different buses using load flow studies and numerical methods.
III. Discuss the symmetrical component theory, sequence networks, short circuit calculations and per-unit representation power system.
IV. Understand the steady state stability of power system and suggest improvements.
V. Analyze the transient stability of power system and check methods to improve the stability.

MODULE-I  POWER SYSTEM NETWORK MATRICES  Classes: 09

Graph Theory: Definitions, bus incidence matrix, Y bus formation by direct and singular transformation methods, numerical problems; Formation of Z Bus: Partial network, algorithm for the modification of Z bus matrix for addition of an element from a new bus to reference bus, addition of element from a new bus to an old bus, addition of element between an old bus to reference bus and addition of element between two old busses (Derivations and Numerical Problems), modification of Z bus for the changes in network, numerical problems.

MODULE-II  LOAD FLOWS STUDIES  Classes: 09

Load flows studies: Necessity of power flow studies, data for power flow studies, derivation of static load flow equations; Load flow solutions using Gauss Seidel method: Acceleration factor, load flow solution with and without PV buses, algorithm and flowchart; Numerical load flow solution for simple power systems (Max. 3 buses): Determination of bus voltages, injected active and reactive powers (Sample one iteration only) and finding line flows / losses for the given bus voltages; Newton Raphson method in rectangular and polar coordinates form: Load flow solution with or without PV busses derivation of Jacobian elements, algorithm and flowchart, decoupled and fast decoupled methods, comparison of different methods, DC load flow study.

MODULE-III  PER UNIT SYSTEM OF REPRESENTATION, SHORT CIRCUIT ANALYSIS  Classes: 10

Per unit system: Equivalent reactance network of a three phase power system, numerical problems; Symmetrical Fault Analysis: Introduction, transient on a transmission line, short circuit of a synchronous machine (on no load), short circuit of a synchronous machine (on load), Symmetrical Component: Introduction, symmetrical component transformation, phase shift in star delta transformer, sequence impedance of transmission line, sequence impedance and sequence network of power system, sequence impedance and sequence network of synchronous machine, sequence impedance of transmission line and network of transformer, construction of sequence network of a power system.

Unsymmetrical Fault Analysis: Introduction, symmetrical component analysis of unsymmetrical faults, single line to ground (LG) fault, line to line (LL) fault, double line to ground (LLG) fault, open conductor fault bus impedance matrix method for analysis of unsymmetrical shunt fault.
### MODULE-IV  STEADY STATE STABILITY ANALYSIS  
**Classes: 08**

Steady state stability: Elementary concepts of steady state, dynamic and transient stabilities, description of steady state stability power limit, transfer reactance, synchronizing power coefficient, power angle curve and determination of steady state stability and methods to improve steady state stability.

### MODULE-V  TRANSIENT STATE STABILITY ANALYSIS  
**Classes: 09**

Swing equation: Derivation of swing equation, determination of transient stability by equal area criterion, application of equal area criterion, critical clearing angle calculation, solution of swing equation, point by point method, methods to improve stability, application of auto reclosing and fast operating circuit breakers.

### Text Books:


### Reference Books:


### Web References:

2. [https://www.sjbit.edu.in/.../COMPUTER%20%20TECHNIQUES%20IN%20POWER%20%20SYS.](https://www.sjbit.edu.in/.../COMPUTER%20%20TECHNIQUES%20IN%20POWER%20%20SYS.)
3. [https://www.books.google.com › Technology & Engineering › Electrical](https://www.books.google.com › Technology & Engineering › Electrical)
4. [https://www.nptel.ac.in/courses/108105067/](https://www.nptel.ac.in/courses/108105067/)
5. [https://www.jntusyllabus.blogspot.com/2012/01/computer-methods-power-systems-syllabus.html](https://www.jntusyllabus.blogspot.com/2012/01/computer-methods-power-systems-syllabus.html)

### E-Text Books:

2. [https://www.academia.edu/8352160/Computer_Methods_and_Power_System_Analysis_Stagg](https://www.academia.edu/8352160/Computer_Methods_and_Power_System_Analysis_Stagg)
3. [https://www.uploady.com/#!/download/ddC9obmVTiv/NwO1AnQrlmogeJjs](https://www.uploady.com/#!/download/ddC9obmVTiv/NwO1AnQrlmogeJjs)
5. [https://www.ee.iitm.ac.in/2015/07/ee5253/](https://www.ee.iitm.ac.in/2015/07/ee5253/)
ELECTRIC DRIVES AND STATIC CONTROL

VI Semester: EEE

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Category</th>
<th>Hours / Week</th>
<th>Credits</th>
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<td>2    1    -  3    30   70   100</td>
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</table>

Contact Classes: 30  Tutorial Classes: 15  Practical Classes: Nil  Total Classes: 45

OBJECTIVES:
The course should enable the students to:
I. Demonstrate DC drives through phase controlled rectifiers and choppers.
II. Analyze operating principle of four quadrant DC drives.
III. Illustrate the speed control of induction motors through various parameters.
IV. Outline the separate and self control of synchronous motors.

MODULE-I  ELECTRIC DRIVES  Classes: 09
Concept and classification, four quadrant operation, dynamics of electric drives, types of loads, torque characteristics of load, characteristics of motor load combination, dynamics of motor load combination, steady state and transient stability of electric drive; Characteristics of electric drives: modified speed-torque characteristics of dc shunt motors, dc series motor and induction motors.

MODULE-II  STARTING AND BRAKING OF ELECTRIC MOTORS  Classes: 09
Methods of Starting electric motors, acceleration time, energy relation during starting, dc shunt and series motor and Induction motors, methods to reduce the energy loss during starting; Types of braking: regenerative braking, dynamic braking and plugging, braking of dc shunt motor, dc series motor and three phase Induction motor, energy relation and dynamics of braking, effect of load inertia and load equalization.

MODULE-III  DC MOTOR CONTROL  Classes: 09
Single phase controlled rectifier and chopper circuit arrangement for continuous armature current operation.
Dual converter control, circulating current and non circulating current modes of operation, principles of closed loop control for dc drives.

MODULE-IV  INDUCTION MOTOR CONTROL  Classes: 09
Speed control of three phase induction motor with ac voltage regulators, Voltage source inverters and Cyclo-converters, static rotor resistance control, slip power recovery schemes: Static Krammer drive and Scherbius drive.

MODULE-V  SYNCHRONOUS MOTOR CONTROL  Classes: 09
Self controlled and Separately controlled synchronous motors, Brushless dc motors, switched reluctance motors.
<table>
<thead>
<tr>
<th>Text Books:</th>
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<table>
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<tr>
<th>Reference Book</th>
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<table>
<thead>
<tr>
<th>Web References:</th>
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<tbody>
<tr>
<td>5.  <a href="https://www.iare.ac.in">https://www.iare.ac.in</a>.</td>
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</table>
ELECTRICAL MEASUREMENTS AND INSTRUMENTATION

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Category</th>
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<th>Credits</th>
<th>Maximum Marks</th>
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<tbody>
<tr>
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<td>Core</td>
<td>L T P C CIA SEE Total</td>
<td>3 - - 3 30 70 100</td>
<td></td>
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</tbody>
</table>

Contact Classes: 45 Tutorial Classes: Nil Practical Classes: NIL Total Classes: 45

OBJECTIVES:
The course should enable the students to:
I. Demonstrate the construction, working and characteristics of electrical measurement instruments.
II. Illustrate the principles of energy measurement in electrical loads.
III. Outline the use of cathode ray oscilloscope.
IV. Evaluate various transducers for electrical measurements.

MODULE-I INTRODUCTION TO MEASURING INSTRUMENTS Classes:09

Introduction: Classification of measuring instruments, deflecting, damping and control torques, types of errors, ammeter and voltmeter: PMMC, MI instruments, expression for deflection and control torque, errors and compensation, extension of range using shunts and series resistances; Electro static voltmeter: attracted type, disc type, extension of range of voltmeters, electro dynamic type voltmeters.

MODULE-II POTENTIOMETERS AND INSTRUMENT TRANSFORMERS Classes:09

DC Potentiometers: Principle and operation of Crompton potentiometer, standardization, measurement of unknown resistance, current, voltage; AC potentiometers: polar and coordinate type, standardization, applications; Instrument transformers: CT and PT, ratio and phase angle error.

MODULE-III MEASUREMENT OF POWER AND ENERGY Classes:09

Measurement of Power: Single phase dynamometer type wattmeter, LPF and UPF, double elements and three elements dynamometer wattmeter; Expression for deflection and control torque, extension of range of wattmeter by using instrument transformers, measurement of active and reactive power for balanced and unbalanced Systems.

Measurement of Energy: Single phase induction type energy meter, driving and braking torques, errors and compensations, testing by phantom loading using RSS meter, three phase energy meter, introduction to net energy metering (web ref: 4 and 5), maximum demand meters.

MODULE-IV DC AND AC BRIDGES Classes:09

Measurement of Resistance: Methods of measuring low, medium, high resistance, Wheatstone bridge, carry foster, Kelvin’s double bridge, loss of charge method; Measurement of Inductance: Maxwell’s bridge, Hay’s bridge, Anderson’s bridge, Owen’s bridge; Measurement of Capacitance: Desauty’s bridge, Wein’s bridge, Schering bridge.
### MODULE-V

**TRANSDUCERS AND OSCILLOSCOPES**

<table>
<thead>
<tr>
<th>Classes:09</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transducers: Definition of transducers, classification of transducers, advantages of electrical transducers, characteristics and choice of transducers, principle of operation of LVDT and capacitor transducers, LVDT applications, strain gauge and its principle of operation, gauge factor, thermistors, thermocouples, synchros, piezo-electric transducers, photovoltaic, photo conductive cells, photo diodes; Cathode ray oscilloscope: Cathode ray tube, time base generator, horizontal and vertical amplifiers, CRO probes, applications of CRO, measurement of phase and frequency. Lissajous patterns, sampling oscilloscope, analog oscilloscope, tubeless oscilloscopes, digital storage oscilloscope (web ref: 6).</td>
</tr>
</tbody>
</table>

**Text Books:**


**Reference Books:**


**Web References:**

2. https://www.aar.faculty.asu.edu/classes/
3. https://www.electrical4u.com
6. https://www.iare.ac.in

**E-Text Books:**

1. https://www.jntubook.com
2. https://www.freeengineeringbooks.com

**Course Home Page:**
### OBJECTIVES:

The course should enable the students to:

I. Understand various measurement techniques used in electrical engineering.

II. Analyze waveforms using LabVIEW to measure various parameters.

III. Demonstrate the use of sensors and transducers in electrical and nonelectrical measurements.

IV. Apply knowledge of virtual instruments in measurement of analysis of electrical parameters.

### LIST OF EXPERIMENTS

<table>
<thead>
<tr>
<th>Expt.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>SENSING OF TEMPERATURE AND SPEED</td>
</tr>
<tr>
<td></td>
<td>Measurement of temperature using transducers like thermocouple, thermistors and resistance temperature detector with signal conditioning; speed measurement using proximity sensor.</td>
</tr>
<tr>
<td>2</td>
<td>MEASUREMENT OF RESISTANCE</td>
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<tr>
<td></td>
<td>Measurement of low resistance using Kelvin’s double bridge</td>
</tr>
<tr>
<td>3</td>
<td>MEASUREMENT OF STRAIN AND PRESSURE</td>
</tr>
<tr>
<td></td>
<td>Measurement of strain using strain gauge and measurement of pressure using differential pressure transducer.</td>
</tr>
<tr>
<td>4</td>
<td>MEASUREMENT OF POSITION AND LEVEL</td>
</tr>
<tr>
<td></td>
<td>Measurement of position using encoders and measurement of level using capacitive transducer.</td>
</tr>
<tr>
<td>5</td>
<td>PHANTOM LOADING ON LPF WATTMETER</td>
</tr>
<tr>
<td></td>
<td>Calibration of electrodynamometer type LPF wattmeter using phantom loading</td>
</tr>
<tr>
<td>6</td>
<td>CALIBRATION OF SINGLE PHASE ENERGY METER AND POWER FACTOR METER</td>
</tr>
<tr>
<td></td>
<td>Calibration of single phase energy meter using resistive load and dynamometer power factor meter.</td>
</tr>
<tr>
<td>7</td>
<td>MEASUREMENT OF TURNS RATIO AND APPLICATIONS OF CTs</td>
</tr>
<tr>
<td></td>
<td>Measurement of turns ratio using AC bridge; the extension of range of wattmeter to measure three phase power using two CTs and one single phase wattmeter.</td>
</tr>
<tr>
<td>Expt. 8</td>
<td>MEASUREMENT OF REACTIVE POWER</td>
</tr>
<tr>
<td>---------</td>
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</tr>
<tr>
<td></td>
<td>Measurement of reactive power using one single phase wattmeter.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Expt. 9</th>
<th>CT TESTING USING MUTUAL INDUCTOR MEASUREMENT OF % RATIO ERROR AND PHASE ANGLE OF GIVEN CT BY NULL METHOD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Measurement of % ratio error and phase angle of given ct by null method.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Expt. 10</th>
<th>CROMPTON DC POTENTIOMETER</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Calibration of PMMC ammeter and PMMC voltmeter.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Expt. 11</th>
<th>ANALYSIS OF WAVE FORMS, FREQUENCY AND THD USING DIGITAL SIMULATION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Measurement and display of voltage, current wave forms, frequency Lissajous patterns and THD using LabVIEW.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Expt. 12</th>
<th>MEASUREMENT OF THREE PHASE POWER</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Measurement of three phase power with single wattmeter and two numbers of current transformer.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Expt. 13</th>
<th>WORKING OF STATIC ENERGY METER USING DIGITAL SIMULATION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Measurement of energy using static energy meter and verification with LabVIEW.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Expt. 14</th>
<th>MEASUREMENT OF PASSIVE PARAMETERS USING DIGITAL SIMULATION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Inductance measurement using Anderson bridge and capacitance measurement using Schering bridge and verification with LabVIEW.</td>
</tr>
</tbody>
</table>

**Reference Books:**

2. https://www.books.google.co.in › Technology & Engineering › Sensors

**Web References:**


**Course Home Page:**

**SOFTWARE AND HARDWARE REQUIREMENTS FOR A BATCH OF 36 STUDENTS:**

**SOFTWARE:** MATLAB R2015a and LabVIEW

**HARDWARE:** Desktop Computers (04 nos)
PLC AND INDUSTRIAL AUTOMATION LABORATORY

VII Semester: EEE

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Category</th>
<th>Hours / Week</th>
<th>Credits</th>
<th>Maximum Marks</th>
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<td></td>
<td></td>
<td>- - 2 1 30 70 100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Contact Classes: Nil  Tutorial Classes: Nil  Practical Classes: 24  Total Classes: 24

OBJECTIVES:
The course should enable the students to:
I. Illustrate the functioning of programmable logic controllers and implementation in automation of industry.
II. Analyze working of hardware related to programmable logic controllers.
III. Demonstrate control system applications in industry using programmable logic controllers.
IV. Apply sequential logic to industrial applications and control systems.

LIST OF EXPERIMENTS

Expt. 1  STAR - DELTA STARTER
Star-delta starter for three phase squirrel cage induction motor using programmable logic controller.

Expt. 2  AUTOMATIC FORWARD AND REVERSE CONTROL
Automatic forward and reverse control of three phase squirrel cage induction motor for milling operation using programmable logic controller.

Expt. 3  FAULT ANNUNCIATION SYSTEM
Fault annunciation system using programmable logic controller

Expt. 4  TEMPERATURE CONTROL SYSTEM
Temperature control system using programmable logic controllers and PT100 using programmable logic controller

Expt. 5  PLUGGING
Starting, stopping, reversing and braking by plugging of a squirrel cage induction motor using programmable logic controller

Expt. 6  CONTROL OF LIFT
Control of lift using programmable logic controller.

Expt. 7  TRAFFIC SIGNAL CONTROL
Traffic signal control using programmable logic controller.
<table>
<thead>
<tr>
<th>Expt. 8</th>
<th>IMPLEMENTATION OF TIMERS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Implementation of ON - delay and OFF - delay timers using PLC.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Expt. 9</th>
<th>SOLAR TRACKING</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Solar tracking using programmable logic controller.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Expt. 10</th>
<th>DIRECT ONLINE STARTER</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Direct online starter for AC motor implementation using programmable logic controller.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Expt. 11</th>
<th>UP DOWN COUNTER</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Implementation of up down counter to count the objects in a store using programmable logic controller.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Expt. 12</th>
<th>DIGITAL CLOCK</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Implementation of 24 hour digital clock using programmable logic controller.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Expt. 13</th>
<th>TIMERS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Implementation of on delay, off delay and retentive timer using programmable logic controller.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Expt. 14</th>
<th>SEQUENTIAL CONTROL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sequential control of three motors to start one after the other with a time delay using programmable logic controller.</td>
</tr>
</tbody>
</table>

**Reference Books:**


**Web References:**

1. https://www.igniteengineers.com
2. https://www.ocw.nthu.edu.tw
3. https://www.uotechnology.edu.iq
4. https://www.iare.ac.in

**Course Home Page:**

**LIST OF EQUIPMENT REQUIRED FOR A BATCH OF 24 STUDENTS:**

**SOFTWARE:** WPL soft programmable logic controller software

**HARDWARE:** Desktop Computers (24 nos)
POWER SYSTEM PROTECTION

VII Semester: EEE

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Category</th>
<th>Hours / Week</th>
<th>Credits</th>
<th>Maximum Marks</th>
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<td>Core</td>
<td>L T P C CIA SEE Total</td>
<td>3 - - 3 30 70 100</td>
<td></td>
</tr>
</tbody>
</table>

Contact Classes: 45  Tutorial Classes: Nil  Practical Classes: Nil  Total Classes: 45

OBJECTIVES:
The course should enable the students to:
I. Understand types of various circuit breakers
II. Classify relays into various types such as of electromagnetic, static and numerical relays
III. Evaluate the performance of protection schemes of generator and transformer
IV. Analyze the performance of feeder and bus-bar protection
V. Discuss the protection schemes against over voltages

MODULE-I  CIRCUIT BREAKERS  Classes: 08

Circuit Breakers: Elementary principles of arc interruption, restriking and recovery voltages, restriking phenomenon, average, maximum and rate of rise of restriking voltage, current chopping and resistance switching, circuit breaker ratings and specifications, auto reclosures, description and operation of various types of circuit breakers, minimum oil circuit breakers, air blast circuit breakers, vacuum and SF6 circuit breakers, numerical problems.

MODULE-II  ELECTROMAGNETIC, STATIC AND NUMERICAL RELAYS  Classes: 14

Electromagnetic relays: Principle of operation and construction of attracted armature, balanced beam, induction disc and induction cup relays; Relays classification: instantaneous, definite minimum time and inverse definite minimum time relays over current / under voltage relays, direction relays, differential relays and percentage differential relays, universal torque equation; Distance relays: Impedance, reactance, mho and offset mho relays, characteristics of distance relays; Static relays: Overview of static relay, block diagram, operating principle and comparison, static relays versus electromagnetic relays; Numerical relays: Introduction, block diagram of numerical relay, sampling theorem, anti aliasing filter, block diagram of phasor measurement unit and intelligent electronic device, data acquisition systems and numerical relaying algorithms, applications and numerical problems.

MODULE-III  SUBSTATIONS AND PROTECTION OF FEEDER / BUS BAR  Classes: 07

Indoor and outdoor substations: Substations layout, bus bar arrangements like single, sectionalized, main and transfer bus bar system with relevant diagrams; Gas insulated substations (GIS): Types, single line diagram, constructional aspects of GIS, Installation, maintenance, advantages, comparison of GIS with air insulated substations.

Protection of lines: Over current, carrier current and three zone distance relay protection using impedance relays, translay relay; Protection of bus bars: Differential protection, grounded and ungrounded neutral systems, effect of ungrounded neutral on system performance, methods of neutral grounding, solid, resistance, reactance arcing grounds and grounding practices, application of numerical relays.
MODULE-IV  GENERATOR AND TRANSFORMER PROTECTION  Classes: 08

Generator protection: Protection of generators against stator faults, rotor faults, and abnormal conditions, restricted earth fault and inter turn fault protection, numerical problems on percentage winding unprotected; Transformer protection: Percentage differential protections, numerical problem on design of current transformers ratio, Buchholz protection.

MODULE-V  PROTECTION AGAINST OVER VOLTAGES  Classes: 08

Over voltages in power systems: Generation of over voltages in power systems, protection against lightning over voltages, valve type and zinc oxide lighting arresters, insulation coordination, basic insulation level, impulse ratio, standard impulse test wave, volt time characteristics.

Text Books:


Reference Books:


Web References:

1. https://www.eiseverywhere.com/file_uploads/aaf42a76a5588f69c7a1348d6f77fe0f_Introduction_to_System_Protection_Protection_Basics.pdf

E-Text Books:

POWER SYSTEM OPERATION AND CONTROL

VII Semester: EEE

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Category</th>
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<th>Credits</th>
<th>Maximum Marks</th>
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</tr>
</tbody>
</table>

| Contact Classes: 45 | Tutorial Classes: Nil | Practical Classes: Nil | Total Classes: 45 |

OBJECTIVES:
The course should enable the students to:
I. Demonstrate economic operation of power systems, hydrothermal scheduling.
II. Illustrate modeling of turbines, generators and automatic controllers.
III. Discuss single area and two area load frequency control.
IV. Analyze reactive power control and load modeling.

MODULE-I ECONOMIC OPERATION OF POWER SYSTEMS Classes: 12
Optimal scheduling of thermal power system: Optimal operation of generators in thermal power stations, heat rate curve, cost curve, incremental fuel and production costs, input output characteristics, optimum generation allocation without and with transmission line losses coefficients, general transmission line loss formula, unit commitment; Optimal scheduling of hydrothermal system: Hydro electric power plant models, scheduling problems, short term hydro thermal scheduling problem.

MODULE-II MODELING OF GOVERNOR, TURBINE AND EXCITATION SYSTEMS Classes: 09
Modeling of governor: Mathematical modeling of speed governing system, derivation of small signal transfer function; Modeling of turbine: First order turbine model, block diagram representation of steam turbines and approximate linear models; Modeling of excitation system: Fundamental characteristics of an excitation system, transfer function, block diagram representation of IEEE type-1 model.

MODULE-III SINGLE AREA AND TWO AREA LOAD FREQUENCY CONTROL Classes: 09
Load frequency control of single area system: Necessity of keeping frequency constant, definitions of control area, single area control, block diagram representation of an isolated power system, steady state analysis, dynamic response, uncontrolled case.
Load frequency control of two area system: Uncontrolled case and controlled case, tie line bias control; Load frequency controllers: Proportional plus integral control of single area and its block diagram representation, steady state response, load frequency control and economic dispatch.

MODULE-IV COMPENSATION FOR POWER FACTOR IMPROVEMENT AND REACTIVE POWER CONTROL Classes: 09
Voltage control: Equipment for voltage control, effect of series capacitors, line drop compensation, effect of AVR, power factor control using different types of power capacitors, shunt and series capacitors, effect of shunt capacitors (fixed and switched), power factor correction, capacitor allocation, economic justification, procedure to determine the best capacitor location; Reactive power control: Reactive power compensation in transmission systems, advantages and disadvantages of different types of compensating equipment for transmission systems; Uncompensated and compensated transmission lines: Shunt and series compensation.
# Module-V Load Compensation

| Load Compensation: characteristics of loads, factors associated with loads, relation between the load factor and loss factor; specifications of load compensator; Classification of loads: Residential, commercial, agricultural and industrial loads and characteristics. |

## Text Books:


## Reference Books:


## Web References:

2. https://www.freevideolectures.com
3. https://www.ustudy.in › Electrical Machines

## E-Text Books:

1. https://www.textbooksonline.tn.nic.in
2. https://www.freeengineeringbooks.com
3. https://www.eleccompengineering.files.wordpress.com
4. https://www.books.google.co.in
# ELECTRICAL POWER SYSTEMS LABORATORY

## VII Semester: EEE

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Category</th>
<th>Hours / Week</th>
<th>Credit</th>
<th>Maximum Marks</th>
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</tbody>
</table>

| Contact Classes: Nil | Tutorial Classes: Nil | Practical Classes: 36 | Total Classes: 36 |

### OBJECTIVES:

The course should enable the students to:

I. Determine the parameters, surge impedance loading and reactive power compensation of transmission lines.

II. Understand the concept of various transmission line protection schemes.

III. Simulate and study feeder protection circuits.

### LIST OF EXPERIMENTS

<table>
<thead>
<tr>
<th>Expt.</th>
<th>Title</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CHARACTERISTICS OF AN MCB</td>
<td>Plotting the Characteristics of Miniature Circuit Breaker (MCB).</td>
</tr>
<tr>
<td>2</td>
<td>CHARACTERISTICS OF FUSE AND THERMAL OVERLOAD PROTECTION</td>
<td>Study of characteristics of High Rupturing Capacity (HRC) fuse and tripping of bimetallic thermal overload protection and its characteristics.</td>
</tr>
<tr>
<td>3</td>
<td>ABCD PARAMETERS OF TRANSMISSION LINE</td>
<td>Measurement of ABCD parameters of a transmission line.</td>
</tr>
<tr>
<td>4</td>
<td>FERRANTI EFFECT IN A TRANSMISSION LINE</td>
<td>Study of Ferranti effect in a transmission line.</td>
</tr>
<tr>
<td>5</td>
<td>SURGE IMPEDANCE LOADING</td>
<td>Study of Surge Impedance Loading (SIL) of a transmission line.</td>
</tr>
<tr>
<td>6</td>
<td>EFFECT OF SHUNT COMPENSATION</td>
<td>Determine shunt compensation to counteract the voltage rise on no load and zero regulation at different loads in a transmission line.</td>
</tr>
<tr>
<td>7</td>
<td>VOLTAGE PROFILE IMPROVEMENT USING TAP CHANGING TRANSFORMER</td>
<td>Study of voltage improvement by reactive power control using tap changing transformer.</td>
</tr>
<tr>
<td>Expt. 8</td>
<td>EFFICIENCY AND REGULATION OF A TRANSMISSION LINE</td>
<td></td>
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<td>---------</td>
<td>-----------------------------------------------</td>
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</tr>
<tr>
<td></td>
<td>Determine the performance of a transmission line by calculating its efficiency and regulation.</td>
<td></td>
</tr>
<tr>
<td>Expt. 9</td>
<td>PERFORMANCE OF IMPEDANCE RELAY</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Study the working principle of impedance relay and its effect during faults in a transmission line.</td>
<td></td>
</tr>
<tr>
<td>Expt. 10</td>
<td>PERFORMANCE OF OVER CURRENT RELAY</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Study the working principle of over current relay and its effect during faults in a transmission line.</td>
<td></td>
</tr>
<tr>
<td>Expt. 11</td>
<td>EARTH FAULT PROTECTION</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Study of earth fault detection methods and various earth fault protection schemes.</td>
<td></td>
</tr>
<tr>
<td>Expt. 12</td>
<td>FEEDER PROTECTION</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Study the various protection schemes in radial feeder under various fault conditions.</td>
<td></td>
</tr>
<tr>
<td>Expt. 13</td>
<td>MEASUREMENT OF SEQUENCE IMPEDANCES OF SYNCHRONOUS MACHINE</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Measurement of positive, negative and zero sequence impedances of synchronous machine by using direct method and fault analysis method.</td>
<td></td>
</tr>
<tr>
<td>Expt. 14</td>
<td>STRING EFFICIENCY OF INSULATORS</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Determination of string efficiency in a string of insulators.</td>
<td></td>
</tr>
</tbody>
</table>

**Reference Books:**


**Web References:**

1. https://www.ee.iitkgp.ac.in
2. https://www.citchennai.edu.in
3. https://www.iare.ac.in
### LIST OF EQUIPMENT REQUIRED FOR A BATCH OF 36 STUDENTS:

<table>
<thead>
<tr>
<th>S No</th>
<th>Name of the Equipment</th>
<th>No.s / Range</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Miniature Circuit Breaker (MCB)</td>
<td>01</td>
</tr>
<tr>
<td>2</td>
<td>HRC Fuse</td>
<td>01</td>
</tr>
<tr>
<td>3</td>
<td>Impedance Relay</td>
<td>01</td>
</tr>
<tr>
<td>4</td>
<td>Over Current Relay</td>
<td>01</td>
</tr>
<tr>
<td>5</td>
<td>Earth Fault Relay</td>
<td>01</td>
</tr>
<tr>
<td>6</td>
<td>Radial Feeder Protection Unit</td>
<td>01</td>
</tr>
<tr>
<td>7</td>
<td>Transmission Line Simulating Unit</td>
<td>01</td>
</tr>
<tr>
<td>8</td>
<td>Three Phase Alternator</td>
<td>01</td>
</tr>
<tr>
<td>9</td>
<td>Capacitors / String Insulators</td>
<td>05</td>
</tr>
</tbody>
</table>
POWER SYSTEM SIMULATION LABORATORY

VII Semester: EEE

<table>
<thead>
<tr>
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<th>Category</th>
<th>Hours / Week</th>
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<th>Maximum Marks</th>
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<td>3</td>
</tr>
</tbody>
</table>

Contact Classes: Nil  Tutorial Classes: Nil  Practical Classes: 36  Total Classes: 36

OBJECTIVES:
The course should enable the students to:
I. Simulate transmission lines using PSCAD software to analyze faults in transmission systems.
II. Demonstrate load flow studies using static load flow methods using MATLAB.
III. Analyze transient state stability in power systems.

LIST OF EXPERIMENTS

Expt. 1   FORMATION OF BUS ADMITTANCE AND IMPEDANCE MATRICES
Formation of bus admittance matrices by adding one element at a time and also write a program for Zbus building algorithm using MATLAB.

Expt. 2   LOAD FLOW SOLUTION USING GAUSS SEIDEL METHOD
Write a MATLAB program for load flow studies without and with generator buses using Gauss Seidel Method.

Expt. 3   LOAD FLOW SOLUTION USING NEWTON RAPHSON AND FDLF METHOD
Write a MATLAB program for load flow studies using Newton Raphson and Fast decoupled load flow (FDLF) method.

Expt. 4   POWER SYSTEM FAULT ANALYSIS
Analysis of symmetrical and unsymmetrical faults using symmetrical components using MATLAB.

Expt. 5   POINT BY POINT METHOD
Development of MATLAB program for transient stability analysis of single machine, infinite bus and multi machine system by point by point method.

Expt. 6   TRANSIENT RESPONSE OF RLC CIRCUIT
Obtain transient response of RLC circuit using PSCAD.

Expt. 7   THREE PHASE SHORT CIRCUIT ANALYSIS IN A SYNCHRONOUS MACHINE
Analyze symmetrical faults and short circuit studies in a given synchronous machine using PSCAD.
<table>
<thead>
<tr>
<th>Expt. 8</th>
<th>STUDY OF TRANSMISSION SYSTEM AND SHORT CIRCUIT ANALYSIS OF 9 BUS SYSTEM</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Study of simple transmission system and also Perform short circuit analysis on IEEE 9 bus system using PSCAD.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Expt. 9</th>
<th>TRANSFORMER INRUSH CURRENT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Determination of transformer inrush current under unbalanced three phase parameters using PSCAD.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Expt. 10</th>
<th>SMALL SIGNAL STABILITY ANALYSIS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Development of PSCAD model for stability analysis of single machine - infinite bus with STATCOM.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Expt. 11</th>
<th>TRANSMISSION LINE PARAMETERS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Obtaining parameters of a typical transmission line and modelling it in PSCAD.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Expt. 12</th>
<th>LOAD FREQUENCY CONTROL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Obtain the frequency response of single and two area power system using PSCAD.</td>
</tr>
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</table>

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<thead>
<tr>
<th>Expt. 13</th>
<th>POWER QUALITY</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Familiarization with PSCAD and understanding of reactive power and power factor correction in AC circuits, current harmonics drawn by power electronics interface.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Expt. 14</th>
<th>DISTANCE PROTECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Development of PSCAD model to study the distance protection scheme in long transmission line.</td>
</tr>
</tbody>
</table>

**Reference Books:**


**Web References:**

1. https://www.ee.iitkgp.ac.in
2. https://www.iare.ac.in

**LIST OF EQUIPMENT REQUIRED FOR A BATCH OF 36 STUDENTS:**

**SOFTWARE:** Power System Computer Aided Design (PSCAD) software and MATLAB

**HARDWARE:** 36 No. of Desktop Computers
### PROJECT WORK - I

**VII Semester: Common for all branches**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Category</th>
<th>Hours / Week</th>
<th>Credits</th>
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Contact Classes: Nil  
Tutorial Classes: Nil  
Practical Classes: 150  
Total Classes: 150

The object of Project Work I is to enable the student to take up investigative study in the broad field of Electronics & Communication Engineering, either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department on an individual basis or two/three students in a group, under the guidance of a Supervisor. This is expected to provide a good initiation for the student(s) in R&D work. The assignment to normally include:

1. Survey and study of published literature on the assigned topic;
2. Working out a preliminary Approach to the Problem relating to the assigned topic;
3. Conducting preliminary Analysis / Modelling / Simulation/Experiment/Design/Feasibility;
4. Preparing a Written Report on the Study conducted for presentation to the Department;
5. Final Seminar, as oral Presentation before a departmental committee.

### PROJECT WORK - II

**VIII Semester: Common for all branches**

<table>
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<tr>
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Contact Classes: Nil  
Tutorial Classes: Nil  
Practical Classes: 180  
Total Classes: 180

The object of Project Work II & Dissertation is to enable the student to extend further the investigative study taken up under EC P1, either fully theoretical/practical or involving both theoretical and practical work, under the guidance of a Supervisor from the Department alone or jointly with a Supervisor drawn from R&D laboratory/Industry. This is expected to provide a good training for the student(s) in R&D work and technical leadership. The assignment to normally include:

1. In depth study of the topic assigned in the light of the Report prepared under EEP1;
2. Review and finalization of the Approach to the Problem relating to the assigned topic;
3. Preparing an Action Plan for conducting the investigation, including team work;
4. Detailed Analysis / Modelling / Simulation / Design / Problem Solving / Experiment as needed;
5. Final development of product/process, testing, results, conclusions and future directions;
6. Preparing a paper for Conference presentation/Publication in Journals, if possible;
7. Preparing a Dissertation in the standard format for being evaluated by the Department.
8. Final Seminar Presentation before a Departmental Committee.
# ELECTRICAL MACHINE DESIGN

## PE – I

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Category</th>
<th>Hours / Week</th>
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</tbody>
</table>

Contact Classes: 45  
Tutorial Classes: Nil  
Practical Classes: NIL  
Total Classes: 45

### OBJECTIVES:

The course should enable the students to:

I. Understand the construction and performance characteristics of electrical machines.

II. Discuss various factors which influence the design of electrical, magnetic and thermal loading of electrical machines.

III. Explain principles of electrical machine design and carry out a basic design of an ac machine.

IV. Use software tools to do machine design calculations.

### MODULE-I  
**INTRODUCTION**  
Classes: 09

Major considerations in electrical machine design, electrical engineering materials, space factor, choice of specific electrical and magnetic loadings, thermal considerations, heat flow, temperature rise, rating of machines.

### MODULE-II  
**DESIGN OF TRANSFORMERS**  
Classes: 09

Sizing of a transformer, main dimensions, kVA output for single- and three-phase transformers, window space factor, overall dimensions, operating characteristics, regulation, no load current, temperature rise in transformers, design of cooling tank, methods for cooling of transformers.

### MODULE-III  
**DESIGN OF INDUCTION MOTOR**  
Classes: 09

Sizing of an induction motor, Dimensions, length of air gap, rules for selecting rotor slots of squirrel cage machines, design of rotor bars & slots, design of end rings, design of wound rotor, magnetic leakage calculations, leakage reactance of poly phase machines, magnetizing current, short circuit current, circle diagram, operating characteristics.

### MODULE-IV  
**DESIGN OF SYNCHRONOUS MACHINE**  
Classes: 09

Sizing of a synchronous machine, main dimensions, design of salient pole machines, short circuit ratio, shape of pole face, armature design, armature parameters, estimation of air gap length, design of rotor, design of damper winding, determination of full load field mmf, design of field winding design of turbo alternators, rotor design.

### MODULE-V  
**COMPUTER AIDED DESIGN**  
Classes: 09

Limitations (assumptions) of traditional designs, need for CAD analysis, synthesis and hybrid methods, design optimization methods, variables, constraints and objective function, problem formulation. Introduction to FEM based machine design. Introduction to complex structures of modern machines-PMSMs, BLDCs, SRM and claw-pole machines.

### Text Books:

**Reference Books:**

<table>
<thead>
<tr>
<th>Reference</th>
<th>Details</th>
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**Web References:**

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<tr>
<th>Web Reference</th>
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<tr>
<td>2.</td>
<td><a href="https://www.sanfoundry.com/1000-design-electrical-machines-questions-answers/">https://www.sanfoundry.com/1000-design-electrical-machines-questions-answers/</a></td>
</tr>
<tr>
<td>3.</td>
<td><a href="https://nptel.ac.in/courses/108106023/">https://nptel.ac.in/courses/108106023/</a></td>
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**E-Text Books:**

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**Course Home Page:**
COMPUTATIONAL ELECTROMAGNETICS

PE – I

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Contact Classes: 45 Tutorial Classes: Nil Practical Classes: Nil Total Classes: 45

OBJECTIVES:
This course should enable the students to:
I. Understand conventional design methodology to study electromagnetic fields.
II. Apply various methods to solve electromagnetic field related problems.
III. Use numerical methods to study accuracy and stability.
IV. Discuss numerical methods for efficient finite element computation.
V. Compute the electrostatic and magnetics fields using various computing methods.

MODULE-I INTRODUCTION TO COMPUTATIONAL METHODS Classes: 09
Conventional design methodology, Computer aided design aspects, advantages. Review of basic fundamentals of electrostatics and electromagnetics, development of Helmholtz equation, energy transformer vectors- Poynting and Slepian, magnetic diffusion-transients and time-harmonic.

MODULE-II ANALYTICAL METHODS Classes:10
Analytical methods of solving field equations, method of separation of variables, Roth’s method, integral methods- Green’s function, method of images.

MODULE-III FINITE DIFFERENCE METHOD Classes:08
Finite difference schemes, treatment of irregular boundaries, accuracy and stability of FD solutions;
Finite Difference Time-Domain (FDTD) method- Uniqueness and convergence.

MODULE-IV FINITE ELEMENT METHOD Classes:09
Overview of FEM, Variational and Galerkin Methods, shape functions, lower and higher order elements, vector elements, 2D and 3D finite elements, efficient finite element computations.

MODULE-V OTHER COMPUTATIONAL TECHNIQUES Classes:09
Background of experimental methods-electrolytic tank, R-C network solution, Field plotting (graphical method)), hybrid methods, coupled circuit, field computations, electromagnetic – thermal and electromagnetic, structural coupled computations, solution of equations, method of moments, Poisson’s fields.

Text Books:
<table>
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<thead>
<tr>
<th>Web References:</th>
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<tbody>
<tr>
<td>1. Power Electronic Web Course by NPTEL, IIT Kharagpur, <a href="http://www.nptel.iitm.ac.in">www.nptel.iitm.ac.in</a></td>
</tr>
<tr>
<td>2. Lecture notes from iare website <a href="http://www.iare.ac.in">http://www.iare.ac.in</a></td>
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<tr>
<td>1. <a href="https://www.freebookcentre.net">https://www.freebookcentre.net</a></td>
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<tr>
<td>2. <a href="https://www.amazon.in/power-electronics-handbook">https://www.amazon.in/power-electronics-handbook</a></td>
</tr>
<tr>
<td>3. <a href="https://www.circuitstoday.com">https://www.circuitstoday.com</a></td>
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### SPECIAL ELECTRICAL MACHINES

**PE – I**

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Contact Classes: 45  
Tutorial Classes: Nil  
Practical Classes: Nil  
Total Classes: 45

**OBJECTIVES:**

The course should enable the students to:

I. Outline construction, principle of operation and performance of synchronous reluctance motors.
II. Discuss configuration, control and performance of stepper motors.
III. Analyze the performance of power converters for switched reluctance motors.
IV. Design power converters and their controllers for permanent magnet brushless DC motors.

**MODULE-I  SYNCHRONOUS RELUCTANCE MOTORS**

<table>
<thead>
<tr>
<th>Classes: 08</th>
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</thead>
<tbody>
<tr>
<td>Reluctance motors: Constructional features, types, axial and radial flux motors, operating principles, variable reluctance motors, voltage and torque equations, phasor diagram, performance characteristics, applications.</td>
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</table>

**MODULE-II  STEPPER MOTORS**

<table>
<thead>
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<th>Classes: 08</th>
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<tbody>
<tr>
<td>Stepper motors: Constructional features, principle of operation, variable reluctance motor, hybrid motor, single and multi stack configurations, torque equations, modes of excitation, characteristics, drive circuits, microprocessor control of stepper motors, closed loop control, concept of lead angle, applications.</td>
</tr>
</tbody>
</table>

**MODULE-III  SWITCHED RELUCTANCE MOTORS (SRM)**

<table>
<thead>
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<th>Classes: 10</th>
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</thead>
<tbody>
<tr>
<td>Switched reluctance motors: Constructional features: rotary and linear SRM, principle of operation, torque production, steady state performance prediction, analytical method, power converters and their controllers. Methods of rotor position sensing: sensor less operation, characteristics and closed loop control, applications.</td>
</tr>
</tbody>
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**MODULE-IV  PERMANENT MAGNET BRUSHLESS D.C. MOTORS**

<table>
<thead>
<tr>
<th>Classes: 09</th>
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<tbody>
<tr>
<td>BLDC motors: Permanent magnet materials, minor hysteresis loop and recoil line, magnetic characteristics, permeance, coefficient, principle of operation, types, magnetic circuit analysis, EMF and torque equations, commutation, power converter circuits and their controllers, motor characteristics and control, applications.</td>
</tr>
</tbody>
</table>

**MODULE-V  PERMANENT MAGNET SYNCHRONOUS MOTORS (PMSM)**

<table>
<thead>
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<th>Classes: 10</th>
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</thead>
<tbody>
<tr>
<td>PM Synchronous motors: Principle of operation, ideal PMSM, EMF and torque equations, armature MMF, synchronous reactance, sine wave motor with practical windings, phasor diagram, torque speed characteristics, power controllers, converter volt ampere requirements, applications.</td>
</tr>
</tbody>
</table>

**Text Books:**

**Reference Books:**


**Web References:**

3. https://www.freeengineeringbooks.com

**E-Text Books:**

2. https://www.textbooksonline.tn.nic.in/
ELECTRICAL ENERGY CONSERVATION AND AUDITING

PE – I

<table>
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</table>

Contact Classes: 45  Tutorial Classes: Nil  Practical Classes: Nil  Total Classes: 45

OBJECTIVES:
The course should enable the students to:
I. Explain the current energy scenario and importance of energy conservation.
II. Understand the concepts of energy management.
III. Discuss the methods of improving energy efficiency in different electrical systems.
IV. Understand the concepts of different energy efficient devices.

MODULE-I  ENERGY SCENARIO  Classes: 06

Commercial and Non-commercial energy: Primary energy resources, commercial energy production, final energy consumption, energy needs of growing economy, long, medium and short term energy scenarios, energy pricing, energy sector reforms, energy and environment, energy security, conservation and its importance, restructuring of the energy supply sector, energy strategy for the future, air pollution, climate change. Energy Conservation Act-2001 and its features.

MODULE-II  ENERGY MANAGEMENT AND AUDIT  Classes: 06

Energy audit: Need, types, approach understanding energy costs, benchmarking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel & energy substitution, energy audit instruments. Material and Energy balance: Facility as an energy system, methods for preparing process flow, material and energy balance diagrams.

MODULE-III  ENERGY EFFICIENCY IN ELECTRICAL SYSTEMS  Classes: 07

Thermal Basics–fuels, thermal energy contents of fuel, temperature & pressure, heat capacity, sensible and latent heat, evaporation, condensation, steam, moist air and humidity and heat transfer, units and conversion; Electrical system: Electricity billing, electrical load management and maximum demand control, power factor improvement and its benefit, selection and location of capacitors, performance assessment of PF capacitors, distribution and transformer losses.

Electric motors: Types, efficiency, factors of performance, losses in induction motors, rewinding and motor replacement issues, energy saving opportunities with energy efficient motors.

MODULE-IV  ENERGY EFFICIENCY IN INDUSTRIAL SYSTEMS  Classes: 08

Compressed air system: Types of air compressors, efficiency, efficient compressor operation, compressed air system components, capacity assessment, leakage test, factors of performance and savings opportunities in HVAC; Fans and blowers: Types, performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities; Pumps and pumping system: Types, performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities; Cooling tower: Types and performance evaluation, efficient system operation, flow control strategies and energy saving opportunities, assessment of cooling towers.
### MODULE-V

**ENERGY EFFICIENT TECHNOLOGIES IN ELECTRICAL SYSTEMS**

<table>
<thead>
<tr>
<th>Classes: 08</th>
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</thead>
</table>

Maximum demand controllers: Automatic power factor controllers, energy efficient motors, soft starters with energy saver, variable speed drives, energy efficient transformers, electronic ballast, occupancy sensors, energy efficient lighting controls, energy saving potential of each technology.

### Text Books:


### Reference Books:


### Web References:

3. [https://beeindia.gov.in/sites/default/files/1Ch3.pdf](https://beeindia.gov.in/sites/default/files/1Ch3.pdf)
4. [https://www.slideshare.net/rayvarun/energy-conservation-ppt-by-vp-singh](https://www.slideshare.net/rayvarun/energy-conservation-ppt-by-vp-singh)
5. [http://elion.co.in/elion-energy-audit-conservation/](http://elion.co.in/elion-energy-audit-conservation/)

### E-Text Books:

1. [https://www.amazon.in/Energy-conservation-audit-b-patil-ebook/ dp/B07 hmvx5yv](https://www.amazon.in/Energy-conservation-audit-b-patil-ebook/ dp/B07 hmvx5yv)
DIGITAL CONTROL SYSTEMS

**OBJECTIVES:**
The course should enable the students to:
I. Understand analog to digital and digital to analog conversion techniques.
II. Illustrate Z transform techniques for solving difference equations.
III. Apply state space analysis to determine the stability of digital control systems.
IV. Design discrete time control system based on frequency response method.

**MODULE-I**  **SAMPLING AND RECONSTRUCTION**  **Classes: 08**
Introduction, examples of data control systems, digital to analog conversion and analog to digital conversion, sample and hold operations.

**MODULE-II**  **SYSTEM RESPONSE**  **Classes: 10**
The z-transforms: Introduction, linear difference equations, pulse response, z-transforms, theorems of z-transforms, the inverse z-transforms, modified z-transforms; Z-plane analysis of discrete time control system: Z-Transform method for solving difference equations, pulse transforms function, block diagram analysis of sampled data systems, mapping between s-plane and z-plane.

**MODULE-III**  **STATE SPACE ANALYSIS**  **Classes: 09**
State space representation of discrete time systems, pulse transfer function matrix solving discrete time state space equations, state transition matrix, properties, methods for computation of state transition matrix, discretization of continuous time state space equations.
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.

**MODULE-IV**  **STABILITY ANALYSIS**  **Classes: 10**
Mapping between the s-plane and 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 stability test, stability analysis by the use of the bilinear transformation and Routh stability criterion.

**MODULE-V**  **DESIGN OF DISCRETE TIME CONTROL SYSTEM**  **Classes: 08**
Design of discrete time control system by conventional methods: Transient and steady state response analysis, design based on the frequency response method, bilinear transformation and design procedure in the w-plane, lead, lag and lead lag compensators and digital PID controllers; 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:


### Reference Books:


### Web References:

1. https://www.nptel.ac.in/syllabus/108103008/

### E-Text Books:

1. https://www.nptel.ac.in/courses/108103008/
2. https://www.freeengineeringbooks.com
3. https://www.engr.mun.ca/~hinch/6951/TEXT/DORF.PDF
PRINCIPLES OF SIGNALS AND SYSTEMS

PE: II

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Contact Classes: 45  Tutorial Classes: Nil  Practical Classes: Nil  Total Classes: 45

OBJECTIVES:
The course should enable the students to:
I. Study about signals and systems.
II. Analysis of signals & systems (continuous and discrete) using time domain & frequency domain methods.
III. Understand the stability of systems through the concept of ROC.
IV. Know various transform techniques in the analysis of signals and systems.

MODULE - I  SIGNAL ANALYSIS  Classes: 09
Signal Analysis: Analogy between Vectors and Signals, Orthogonal Signal Space, Signal approximation using Orthogonal functions, Mean Square Error, Closed or complete set of Orthogonal functions, Orthogonally in Complex functions, Exponential and Sinusoidal signals, Concepts of Impulse function, Unit Step function, Signum function.

MODULE - II  FOURIER TRANSFORM  Classes: 09
Deriving Fourier Transform from Fourier series, Fourier Transform of arbitrary signal, Fourier Transform of standard signals, Fourier Transform of Periodic Signals, Properties of Fourier Transform

MODULE - III  SIGNAL TRANSMISSION THROUGH LINEAR SYSTEMS  Classes: 12
Linear System, Impulse response, Response of a Linear System, Linear Time Invariant (LTI) System, 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 characteristics

Convolution and Correlation of Signals: Concept of convolution in Time domain and Frequency domain, Graphical representation of Convolution, Convolution property of Fourier Transforms, Cross Correlation and Auto Correlation of functions, Properties of Correlation function, Relation between Convolution and Correlation,

MODULE - IV  INTRODUCTION TO DIGITAL SIGNAL PROCESSING  Classes: 09
Discrete Time Signals & Sequences, conversion of continuous to discrete signal, Normalized Frequency, Linear Shift Invariant Systems, Stability, and Causality, linear differential equation to difference equation, Linear Constant Coefficient Difference Equations, Frequency Domain Representation of Discrete Time Signals and Systems

MODULE - V  FAST FOURIER TRANSFORMS  Classes: 06
Fast Fourier transforms (FFT) - Radix-2 decimation-in-time and decimation-in-frequency FPT Algorithms, Inverse FFT and FFT with general Radix-N
**Text Books:**


**Reference Books:**


**Web References:**

1. https://www.edx.org/course/discrete-time-signal-processing-mitx-6-341x-1

**E-Text Books:**

2. http://www.freebookcentre.net/SpecialCat/Free-Signal-Processing-Boo
CONTROL SYSTEMS DESIGN

PE: II

<table>
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Contact Classes: 45 Tutorial Classes: Nil Practical Classes: Nil Total Classes: 45

OBJECTIVES:
The course should enable the students to:
I. Understand the time and frequency domain design problem specifications.
II. Analyze the design aspects of classical control systems in frequency-domain
III. Design controllers to satisfy the desired design specifications using simple controller structures such as P, PI, PID, compensators
IV. Identify the performance of the systems by design them in state-space and study the effects of nonlinearities on various systems performance.

MODULE-I DESIGN SPECIFICATIONS Classes: 09
Introduction to design problem and philosophy. Introduction to time domain and frequency domain design specification and its physical relevance. Effect of gain on transient and steady state response. Effect of addition of pole on system performance. Effect of addition of zero on system response.

MODULE-II DESIGN OF CLASSICAL CONTROL SYSTEM IN THE TIME DOMAIN Classes: 09

MODULE-III DESIGN OF CLASSICAL CONTROL SYSTEM IN FREQUENCY DOMAIN Classes: 09
Compensator design in frequency domain to improve steady state and transient response. Feedback and Feed forward compensator design using bode diagram.

Design of PID Controllers: Design of P, PI, PD and PID controllers in time domain and frequency domain for first, second and third order systems. Control loop with auxiliary feedback – Feed forward control.

MODULE-IV CONTROL SYSTEM DESIGN IN STATE SPACE Classes: 09
Review of state space representation, concept of controllability and observability, effect of pole zero cancellation on the controllability and observability of the system, pole placement design through state feedback, Ackerman’s formula for feedback gain design, design of observer, reduced order observer, separation principle.

MODULE-V NONLINEARITIES AND ITS EFFECT ON SYSTEM PERFORMANCE Classes: 09
Introduction to nonlinear systems, types of non-linearities, Effect of various non-linearities on system performance, introduction to phase plane analysis, singular points, phase plane analysis of nonlinear control systems.
### Text Books:


### Reference Books:


### Web References:

2. https://www.aar.faculty.asu.edu/classes
3. https://www.facstaff.bucknell.edu/
4. https://www.electrical4u.com
5. https://www.iare.ac.in

### E-Text Books:

1. https://www.jntubook.com/
2. https://www.freeengineeringbooks.com
### LINEAR SYSTEM ANALYSIS

<table>
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<tr>
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</table>

**Contact Classes: 45**  **Tutorial Classes: Nil**  **Practical Classes: Nil**  **Total Classes: 45**

#### OBJECTIVES:

The course should enable the students to:

I. Analyze linear systems and signals
II. Develop critical understanding of mathematical methods to analyze linear systems and signals.
III. Use mathematical modelling tools to represent linear systems

#### MODULE-I  STATE VARIABLE ANALYSIS
Classes: 09


#### MODULE-II  FOURIER SERIES AND FOURIER TRANSFORM REPRESENTATION
Classes: 09


#### MODULE-III  LAPLACE TRANSFORM APPLICATIONS
Classes: 09


Network Synthesis: Network synthesis: Synthesis of one port LC networks-Foster and Cauer methods-Synthesis of RL and RC one port networks-Foster and Cauer methods

#### MODULE-IV  SAMPLING
Classes: 09

Sampling theorem – Graphical and Analytical proof for Band Limited Signal impulse sampling, natural and Flat top Sampling, Reconstruction of signal from its samples, effect of under sampling – Aliasing, introduction to Band Pass sampling, Cross correlation and auto correlation of functions, properties of correlation function, Energy density spectrum, Power density spectrum, Relation between auto correlation function and Energy / Power spectral density function.
### MODULE-V  Z-TRANSFORMS

<table>
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<tr>
<th>Classes: 09</th>
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</table>

Fundamental difference between continuous and discrete time signals, discrete time complex, exponential and sinusoidal signals, periodicity of discrete time complex exponential, concept of Z Transform of a discrete sequence. Distinction between Laplace, Fourier, and Z-Transforms. Region of convergence in Z-Transforms, constraints on ROC for various classes of signals, Inverse Z-Transform properties of Z-Transforms.

### Text Books:


### Reference Books:


### Web References:


### E-Text Books:

1. https://www.freebookcentre.net
POWER SYSTEM STABILITY

<table>
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<td></td>
</tr>
</tbody>
</table>

Contact Classes: 45  
Tutorial Classes: Nil  
Practical Classes: Nil  
Total Classes: 45

OBJECTIVES:
The course should enable the students to:
I. Demonstrate various power system stability problems using single machine infinite bus configuration.
II. Apply and explain different methods for analyzing power system stability.
III. Create mathematical models for studying dynamic and stability of a power system.
IV. Illustrate different power system controls, and their impact on the system stability.

MODULE I  INTRODUCTION TO POWER SYSTEM STABILITY PROBLEMS  Classes: 08


MODULE II  MODELING OF POWER SYSTEM COMPONENTS FOR STABILITY ANALYSIS  Classes: 10

Synchronous machine modeling: Sub transient model, two axis model, one axis (flux decay) model, classical model; Excitation systems modeling: DC excitation, AC excitation and static excitation, prime mover and energy supply systems modeling, transmission line modeling, load modeling, methods of representing synchronous machines in stability analysis.

MODULE III  SMALL SIGNAL STABILITY  Classes: 09

Fundamental concepts, state space representation, modal analysis: Eigen properties, participation factors, stability assessment, effects of excitation system on stability.

Power system stabilizer and its design, angle and voltage stability of multi machine power systems and phenomenon of sub synchronous resonance.

MODULE IV  TRANSIENT STABILITY  Classes: 10


MODULE V  VOLTAGE STABILITY  Classes: 08

Classification of voltage stability, modeling requirements, voltage stability analysis, static and dynamic, sensitivity analysis, modal analysis, voltage collapse.
<table>
<thead>
<tr>
<th>Text Books:</th>
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<tr>
<th>Reference Books:</th>
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<table>
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<tr>
<th>Web References:</th>
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</thead>
<tbody>
<tr>
<td>2. <a href="https://www.aar.faculty.asu.edu/classes">https://www.aar.faculty.asu.edu/classes</a></td>
</tr>
<tr>
<td>3. <a href="https://www.facstaff.bucknell.edu/">https://www.facstaff.bucknell.edu/</a></td>
</tr>
<tr>
<td>4. <a href="https://www.electrical4u.com">https://www.electrical4u.com</a></td>
</tr>
<tr>
<td>5. <a href="https://www.iare.ac.in">https://www.iare.ac.in</a></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>E-Text Books:</th>
</tr>
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<tbody>
<tr>
<td>1. <a href="https://www.jntubook.com/">https://www.jntubook.com/</a></td>
</tr>
<tr>
<td>2. <a href="https://www.freeengineeringbooks.com">https://www.freeengineeringbooks.com</a></td>
</tr>
</tbody>
</table>
# POWER SYSTEM DYNAMICS AND CONTROL

**PE: III**

<table>
<thead>
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<th>Hours / Week</th>
<th>Credits</th>
<th>Maximum Marks</th>
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**Contact Classes:** 45  
**Tutorial Classes:** Nil  
**Practical Classes:** Nil  
**Total Classes:** 45

**OBJECTIVES:**  
This course should enable the students to:  
I. Remember the dynamic characteristics of power system equipment,  
II. Recognize dynamic performance of power systems  
III. Illustrate the system stability and controls.

## MODULE-I  
**BASIC CONCEPTS**  
Classes: 09  
Power system stability states of operation and system security, system dynamics, problems system model analysis of steady, state stability and transient stability, simplified representation of excitation control.

## MODULE-II  
**MODELING OF SYNCHRONOUS MACHINE**  
Classes: 10  
Synchronous machine, park’s Transformation-analysis of steady state performance, per – unit quantities, equivalent circuits of synchronous machine, determination of parameters of equivalent circuits.

## MODULE-III  
**EXCITATION SYSTEM**  
Classes: 08  
Excitation system modeling, excitation systems, block diagram, system representation by state equations, dynamics of a synchronous generator connected to infinite bus, system model.

Synchronous machine model, stator equations rotor equations, synchronous machine model with field circuit, one equivalent damper winding on q axis (model 1.1), calculation of Initial conditions.

## MODULE-IV  
**ANALYSIS OF SINGLE MACHINE SYSTEM**  
Classes: 09  
Small signal analysis with block diagram, representation characteristic equation and application of Routh Hurwitz criterion, synchronizing and damping torque analysis, small signal model, state equations.

## MODULE-V  
**APPLICATION OF POWER SYSTEM STABILIZERS**  
Classes: 09  
Basic concepts in applying PSS, control signals, structure and tuning of PSS, Washout circuit, dynamic compensator analysis of single machine, infinite bus system with and without PSS.

**Text Books:**

**Reference Books:**
**Web References:**

2. https://www.onlinecourses.nptel.ac.in/noc19_ee14/preview

**E-Text Books:**

ELECTRICAL DISTRIBUTION SYSTEMS

PE: III

<table>
<thead>
<tr>
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</table>

Contact Classes: 45  Tutorial Classes: Nil  Practical Classes: Nil  Total Classes: 45

OBJECTIVES:
This course should enable the students to:
I. Distinguish between transmission and distribution systems.
II. Understand design considerations of feeders.
III. Compute voltage drop and power loss in feeders.
IV. Understand protection of distribution systems.
V. Examine the power factor improvement and voltage control.

MODULE-I  GENERAL CONCEPTS  Classes: 09

Introduction to distribution system, Distribution system planning, Factors effecting the Distribution system planning, load modelling and characteristics, coincidence factor, contribution factor, loss factor relationship between the load factor and loss factor, load growth, classification of loads (residential, commercial, Agricultural and Industrial) and their characteristics; Distribution Feeders: Design considerations of distribution feeders, radial, loop and network types of primary feeders, introduction to low voltage distribution systems (LVDS) and High voltage distribution systems (HVDS), voltage levels, factors effecting the feeder voltage level, feeder loading, Application of general circuit constants (A,B,C,D) to radial feeders, basic design practice of the secondary distribution system, secondary banking, secondary network types, secondary mains.

MODULE-II  SUBSTATIONS  Classes:10

Overview of Gauss-Siedel, Newton-Raphson load flow methods, fast decoupled method, convergence properties, sparsity techniques, handling Qmax violations in constant matrix, inclusion in frequency effects, AVR in load flow, handling of discrete variable in load flow; System analysis: Voltage drop and power-loss calculations: Derivation for voltage drop and power loss in lines, manual methods of solution for radial networks, three phase balanced primary lines, analysis of non-three phase systems, method to analyze the distribution feeder cost.

MODULE-III  PROTECTION  Classes:08


Coordination: Coordination of protective devices, objectives of protection co-ordination, general coordination procedure, types of protection coordination: fuse to fuse, Auto-Recloser to fuse, circuit breaker to fuse, circuit breaker to auto-recloser.
### MODULE-IV | COMPENSATION FOR POWER FACTOR IMPROVEMENT

<table>
<thead>
<tr>
<th>Classes:09</th>
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</thead>
</table>

Compensation for power factor Improvement capacitive compensation for power-factor control, different types of power capacitors, shunt and series capacitors, effect of shunt capacitors (Fixed and switched), effect of series capacitors, difference between shunt and series capacitors, calculation of power factor correction, capacitor allocation, economic justification of capacitors, procedure to determine the best capacitor location.

### MODULE-V | VOLTAGE CONTROL

<table>
<thead>
<tr>
<th>Classes:09</th>
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</thead>
</table>

Voltage control voltage control: importance of voltage control, methods of voltage control, equipment for voltage control, effect of shunt capacitors, effect of series capacitors, effect of AVB/AVR on voltage control, line drop compensation, voltage fluctuations.

### Text Books:


### Reference Books:


### Web References:

1. Power Electronic Web Course by NPTEL, IIT Kharagpur, www.nptel.iitm.ac.in
2. Lecture notes from iare website: http://www.iare.ac.in

### E-Text Books:

1. https://www.freebookcentre.net
2. https://www.amazon.in/power-electronics-handbook
3. https://www.circuitstoday.com
REAL TIME CONTROL OF POWER SYSTEMS

PE : III

<table>
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<tr>
<th>Course Code</th>
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Contact Classes: 45 Tutorial Classes: Nil Practical Classes: Nil Total Classes: 45

OBJECTIVES:
The course should enable the students to:
I. Classify state estimation into different types.
II. Analyze and monitor security and contingency evaluation.
III. Justify the need of automation in power systems.
IV. Recognize the importance of voltage stability and voltage stability indices.
V. Apply artificial intelligence and artificial neural networks to power system analysis.

MODULE-I STATE ESTIMATION Classes: 09

Introduction: Different types of state estimation, theory of WLS state estimation, sequential and non sequential methods to process measurements, bad data observability, bad data detection, identification and elimination.

MODULE-II SECURITY AND CONTINGENCY EVALUATION Classes: 09

Evaluations: Security concept, security Analysis and monitoring, contingency analysis for generator and line outages by iterative linear power flow method, fast decoupled model, and network sensitivity methods.

MODULE-III COMPUTER CONTROL OF POWER SYSTEMS AND SCADA Classes: 09

Computer control: Need for real time and computer control of power systems, operating states of a power system.

SCADA: Supervisory control and data acquisition systems implementation considerations, energy control centres, software requirements for implementing the above functions.

MODULE-IV VOLTAGE STABILITY Classes: 09

Analysis of voltage stability: What is voltage stability, voltage collapse, and voltage security, relation of voltage stability to rotor angle stability, voltage stability analysis, introduction to voltage stability analysis, ‘P-V’ curves and ‘Q-V’ curves, voltage stability in mature power systems, long term voltage stability, power flow analysis for voltage stability, voltage stability static indices and research areas.

MODULE-V APPLICATION OF AI AND ANN IN POWER SYSTEM Classes: 09

Use of AI and ANN in power system: Basic concepts and definitions, algorithms for load flow, short term load forecasting, fault diagnosis and state estimation.
# Text Books:


# Reference Books:


# Web References:

1. [https://www.certs.lbl.gov/sites/all/files/rt-security-monitoring_0](https://www.certs.lbl.gov/sites/all/files/rt-security-monitoring_0)
2. [https://www.researchgate.net/.../2993799](https://www.researchgate.net/.../2993799)

# E-Text Books:

1. [https://www.calvin.edu/.../Power%20Systems%20Interim 2. 2.](https://www.calvin.edu/.../Power%20Systems%20Interim 2. 2.)
3. [https://www.selixc.com/api/download/248](https://www.selixc.com/api/download/248)
4. [https://www.cdn.intechopen.com/pdfs/37991.pdf](https://www.cdn.intechopen.com/pdfs/37991.pdf)

# Course Home Page:
HVDC TRANSMISSION

**OBJECTIVES:**
The course should enable the students to:
I. Understand the advantages of DC transmission over AC transmission.
II. Describe the operation of Line Commutated Converters and Voltage Source Converters.
III. Analyze the control strategies used in HVDC transmission system.
IV. Explain the improvement of power system stability using an HVDC system.

**MODULE-I**  
**DC TRANSMISSION TECHNOLOGY**  
Classes: 09
Introduction to HVDC transmission systems: Comparison of AC and DC transmission (economics, technical performance and reliability), components of a HVDC system, types of HVDC links, application of DC transmission, Line Commutated Converter and Voltage Source Converter based systems.

**MODULE-II**  
**ANALYSIS OF LINE COMMUTATED AND VOLTAGE SOURCE CONVERTERS**  
Classes: 09
Line Commutated Converters (LCCs): Six pulse converter, analysis neglecting commutation overlap, harmonics, twelve pulse converters: Inverter operation, effect of commutation overlap, expressions for average DC voltage, AC current and reactive power absorbed by the converters, Effect of commutation failure, misfire and current extinction in LCC links; Voltage Source Converters (VSCs): two and three-level VSCs. PWM schemes: selective harmonic elimination, sinusoidal pulse width modulation, analysis of a six pulse converter, equations in the rotating frame, real and reactive power control using a VSC.

**MODULE-III**  
**CONTROL OF HVDC CONVERTERS**  
Classes: 09
HVDC system control: Principles of link control in a LCC HVDC system, control hierarchy, firing angle controls: phase-locked loop, current and extinction angle control, starting and stopping of a link, higher level controllers power control, frequency control, stability controllers, reactive power control, principles of link control in a VSC HVDC system: power flow and DC voltage control, reactive power control, AC voltage regulation.
Components of HVDC systems: Smoothing reactors, reactive power sources and filters in LCC HVDC systems DC line, corona effects, insulators, transient over-voltages, DC line faults in LCC systems, DC line faults in VSC systems, DC breakers, monopolar operation, ground electrodes.

**MODULE-IV**  
**STABILITY ENHANCEMENT USING HVDC CONTROL**  
Classes: 09
Basic Concepts of stability enhancement: Power system angular, voltage and frequency stability, power modulation, basic principles, synchronous and asynchronous links, voltage stability problem in AC, DC systems.
<table>
<thead>
<tr>
<th>MODULE-V</th>
<th>MTDC LINKS</th>
<th>Classes: 09</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction to MTDC links: Multi-terminal and multi in-feed Systems, series and parallel MTDC systems using LCCs, MTDC systems using VSCs, modern trends in HVDC Technology and introduction to modular multi level converters.</td>
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</tbody>
</table>

**Text Books:**


**Reference Books:**


**Web References:**


**E- Text Books:**

EHV AC TRANSMISSION

<table>
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</tbody>
</table>

Contact Classes: 45  Tutorial Classes: Nil  Practical Classes: Nil  Total Classes: 45

OBJECTIVES:
The course should enable the students to:
I. Illustrate basic concepts of extra high voltage AC transmission and understand the need for it.
II. Outline the line and ground reactive parameters and voltage gradients of conductors.
III. Describe effects of corona and methods of associated measurement.
IV. Associate the knowledge of electrostatic field theory and traveling wave theory.
V. Select voltage control methods for extra high voltage AC transmission system.

MODULE-I  PRELIMINARIES  Classes: 09
Necessity of EHV AC transmission: Advantages and problems, power handling capacity and line losses, mechanical considerations, resistance of conductors, properties of bundled conductors, bundle spacing and bundle radius, examples.

MODULE-II  LINE AND GROUND REACTIVE PARAMETERS AND VOLTAGE GRADIENTS OF CONDUCTORS  Classes: 09
Reactive parameters: Line inductance and capacitances, sequence inductances and capacitances, modes of propagation, ground return, examples, electrostatics, field of sphere gap, field of line changes and properties, charge, potential relations for multi conductors; Voltage gradient: Surface voltage gradient on conductors, distribution of voltage gradient on sub conductors of bundle, examples.

MODULE-III  CORONA EFFECTS  Classes: 09
Corona effect I: Power loss and audible noise (AN), corona loss formulae, charge voltage diagram, generation, characteristics, limits and measurements of AN, relation between 1-phase and 3-phase AN levels, examples.
Corona effect II: Radio interference (RI), corona pulses generation, properties, limits, frequency spectrum, modes of propagation, excitation function, measurement of RI, RIV and excitation functions, examples.

MODULE-IV  ELECTRO STATIC FIELD AND TRAVELING WAVE THEORY  Classes: 09
Electrostatic field: Calculation of electrostatic field of EHV / AC lines, effect on humans, animals and plants; Electrostastic induction in un-energised circuit of double, circuit line, electromagnetic interference, examples; Travelling wave theory: Traveling wave expression and solution, source of excitation, terminal conditions, open circuited and short circuited end reflection and refraction coefficients, lumped parameters of distributed.
<table>
<thead>
<tr>
<th>MODULE-V</th>
<th>VOLTAGe CONTROL</th>
<th>Classes: 09</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage control: Power circle diagram and its use, voltage control using synchronous condensers; Compensation: Cascade connection of shunt and series compensation, sub synchronous resonance in series capacitor, compensated lines, static VAR compensating system.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Text Books:**


**Reference Books:**


**Web References:**

3. https://www.nptel.ac.in/syllabus/108108033/

**E-Text Books:**

2. https://www.archive.org/stream/extrahighvoltage00meht/extrahighvoltage00meht_djvu.txt
**POWER ELECTRONICS IN RENEWABLE ENERGY SYSTEMS**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Category</th>
<th>Hours / Week</th>
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</table>

**OBJECTIVES:**
The course should enable the students to:
I. Understand the stand alone and grid connected renewable energy systems
II. Learn required skills to derive the criteria for the design of power converters for renewable energy applications.
III. AnalyZe and comprehend the various operating modes of wind electrical generators and solar energy systems.
IV. Design different power converters namely AC to DC, DC to DC and AC to AC converters for renewable energy systems and develop maximum power point tracking algorithms.

**MODULE-I**
**INTRODUCTION**
Classes: 09
Environmental aspects of electric energy conversion: impacts of renewable energy generation on environment (cost-GHG Emission), qualitative study of different renewable energy resources ocean, biomass; Hydrogen energy systems: operating principles and characteristics of: Solar PV, fuel cells, wind electrical systems control strategy, operating area.

**MODULE-II**
**ELECTRICAL MACHINES FOR RENEWABLE ENERGY CONVERSION**
Classes: 09
Review of reference theory fundamentals principle of operation and analysis: IG, PMSG, SCIG and DFIG.

**MODULE-III**
**POWER CONVERTERS**
Classes: 09
AC-DC converters: Uncontrolled rectifiers, PWM Inverters, Grid Interactive Inverters-matrix converters.

**MODULE-IV**
**ANALYSIS OF WIND AND PV SYSTEMS**
Classes: 09
Stand alone operation of fixed and variable speed wind energy conversion systems and solar system, grid connection issues, grid integrated PMSG and SCIG Based WECS-Grid integrated solar system.

**MODULE-V**
**HYBRID RENEWABLE ENERGY SYSTEMS**
Classes: 09
Need for Hybrid Systems: Range and type of hybrid systems, case studies of wind-PV maximum power point tracking (MPPT).
### Text Books:


### Reference Books:


### Web References:

2. [https://www.academia.edu/3409546/Power_Electronics_Application_in_Renewable_Energy_System](https://www.academia.edu/3409546/Power_Electronics_Application_in_Renewable_Energy_System).

### E-Text Books:

2. [https://www.nitgoa.ac.in/News_files/STC.pdf](https://www.nitgoa.ac.in/News_files/STC.pdf).
# WIND AND SOLAR ENERGY SYSTEMS

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</table>

**COURSE OUTCOMES:**
The course should enable the students to:
I. Gain advanced knowledge on role of power electronics for renewable energy.
II. Analyze the power conditioning schemes for grid connected systems.
III. Develop skills in designing wind, solar systems and their integration.

## MODULE-I  
**DESIGN AND OPERATION OF WIND POWER SYSTEM**  
Classes: 09

Wind Power System: Components, turbine rating, electrical load matching, variable-speed operation, system design features, maximum power operation, system control requirements, speed control, rate control and environmental aspects, wind energy conversion systems and their classification.

## MODULE-II  
**DESIGN AND OPERATION OF PV SYSTEM**  
Classes: 09


## MODULE-III  
**POWER CONDITIONING SCHEMES FOR SOLAR ENERGY SYSTEMS**  
Classes: 09

Switching devices for solar energy conversion: DC power conditioning converters, maximum power point tracking algorithms.  
AC Power conditioners, Line commutated inverters, synchronized operation with grid supply, Harmonic reduction.

## MODULE-IV  
**WIND ENERGY CONVERSION SYSTEMS**  
Classes: 09

Wind energy Conversion system (WECS): Performance of Induction generators for WECS, Self-excited induction generator (SEIG) for isolated power generators. Controllable DC power from SEIGs, system performance, Grid related problems, generator control, AC voltage controllers, Harmonic reduction and Power factor improvement.

## MODULE-V  
**POWER QUALITY ISSUES IN INTEGRATION OF RENEWABLE ENERGY RESOURCES**  
Classes: 09

Stand alone and Grid connected systems, Power Quality issues, Impact of power quality problems on DG, Mitigation of power quality problems, Role of custom power devices in Distributed Generation.
### Text Books:


### Reference Books:


### Web References:


### E-Text Books:

2. https://www.freebookcentre.net
PE: V

<table>
<thead>
<tr>
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Contact Classes: 45  Tutorial Classes: Nil  Practical Classes: NIL  Total Classes: 45

OBJECTIVES:
The course should enable the students to:
I. Understand the various types of over voltages in power system and protection methods.
II. Demonstrate generation of higher voltages and currents in laboratories for testing purposes.
III. Measure over voltages using various advanced techniques.
IV. Analyze nature of breakdown mechanism in solid, liquid and gaseous dielectrics.
V. Design and test the power apparatus and insulation coordination.

MODULE-I  OVER VOLTAGES IN ELECTRICAL POWER SYSTEMS  Classes: 09
Origin of over voltages: Causes of over voltages and their effects on power system, lightning, switching surges and temporary over voltages, corona and its effects, reflection and refraction of travelling waves, protection against over voltages, charge formation in clouds, stepped leader, dart leader, lightning surges, switching over voltages, protection against over voltages, surge diverters, surge modifiers.

MODULE-II  DIELECTRIC BREAKDOWN  Classes: 09
Breakdown of dielectrics: Gaseous breakdown in uniform and non uniform fields, corona discharges, breakdown of vacuum, conduction and breakdown in pure and commercial liquids, maintenance of oil quality, breakdown mechanisms in solid and composite dielectrics.

MODULE-III  GENERATION OF HIGH VOLTAGES AND HIGH CURRENTS  Classes: 09
High AC, DC voltages and currents: Generation of high DC, AC and impulse voltages and currents.
Triggering: Triggering and control of impulse generators.

MODULE-IV  MEASUREMENT OF HIGH VOLTAGES AND HIGH CURRENTS  Classes: 09
High voltage and current measurement: High resistance with series ammeter, dividers, resistance, capacitance and mixed dividers, peak voltmeter, generating voltmeters, capacitance voltage transformers, electrostatic voltmeters, sphere gaps, high current shunts, digital techniques in high voltage measurement.

MODULE-V  HIGH VOLTAGE TESTING AND INSULATION COORDINATION  Classes: 09
Testing: High voltage testing of electrical power apparatus as per international and Indian standards, power frequency, impulse voltage and dc testing of insulators, circuit breakers, bushings, isolators and transformers, insulation coordination.

Text Books:

### Reference Books:


### Web References:

1. https://www.nptel.ac.in/courses/108104048/
2. https://www.hve.iisc.ernet.in/
3. https://www.ee.iisc.ac.in/research-hve.php
5. https://www.annauniv.edu/HighVoltage/

### E-Text Books:

1. https://www.docs.google.com/file/d/0B5vXY4-Kg5GeQi1LcEU2UnJNbE0/edit
2. https://www.7see.blogspot.in/2015/04/high-voltage-engineering-by-wadhwa-free.html
# ENERGY STORAGE SYSTEMS

**PE: V**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Category</th>
<th>Hours / Week</th>
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**Contact Classes: 45**  
**Tutorial Classes: Nil**  
**Practical Classes: Nil**  
**Total Classes: 45**

## OBJECTIVES:

The course should enable the students to:

I. Enable the student to understand the need for energy storage, devices and technologies available and their applications.

II. Analyze the characteristics of energy from various sources and need for storage.

III. Classify various types of energy storage and various devices used for the purpose.

IV. Identify various real time applications.

## MODULE - 1  
**ELECTRICAL ENERGY STORAGE TECHNOLOGIES**

Classes: 08

Characteristics of electricity, Electricity and the roles of EES, High generation cost during peak-demand periods, Need for continuous and flexible supply, Long distance between generation and consumption, Congestion in power grids, Transmission by cable.

## MODULE – 1I  
**NEEDS FOR ELECTRICAL ENERGY STORAGE**

Classes: 08

Emerging needs for EES, More renewable energy, less fossil fuel, Smart Grid uses, The roles of electrical energy storage technologies, The roles from the viewpoint of a utility, The roles from the viewpoint of consumers, The roles from the viewpoint of generators of renewable energy.

## MODULE – 1II  
**FEATURES OF ENERGY STORAGE SYSTEMS**

Classes: 10

Classification of EES systems, Mechanical storage systems, Pumped hydro storage (PHS), Compressed air energy storage (CAES), Flywheel energy storage (FES); Electrochemical storage systems, Secondary batteries, Flow batteries, Chemical energy storage, Hydrogen (H2), Synthetic natural gas (SNG).

## MODULE – 1V  
**TYPES OF ELECTRICAL ENERGY STORAGE SYSTEMS**

Classes: 09

Electrical storage systems, Double-layer capacitors (DLC), Superconducting magnetic energy storage (SMES), Thermal storage systems, Standards for EES, Technical comparison of EES technologies.

## MODULE - V  
**APPLICATIONS**

Classes: 10

Present status of applications, Utility use (conventional power generation, grid operation & service), Consumer use (uninterruptable power supply for large consumers), New trends in applications, Renewable energy generation, Smart Grid, Smart Micro grid, Smart House, Electric vehicles, Management and control hierarchy of storage systems, Internal configuration of battery storage systems, External connection of EES systems, Aggregating EES systems and distributed generation (Virtual Power Plant), Battery SCADA – aggregation of many dispersed batteries.
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<th>Text Books:</th>
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<th>Reference Books:</th>
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<tr>
<td>3. <a href="https://www.freeengineeringbooks.com">https://www.freeengineeringbooks.com</a></td>
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<th>E-Text Books:</th>
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<td>2. <a href="https://www.textbooksonline.tn.nic.in/">https://www.textbooksonline.tn.nic.in/</a></td>
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POWER QUALITY AND FACTS

PE: V

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Contact Classes: 45 Tutorial Classes: Nil Practical Classes: Nil Total Classes: 45

OBJECTIVES:
The course should enable the students to:
I. Gain knowledge on various sources of power quality disturbances, power quality issues.
II. Standards, measuring equipment and power quality enhancement devices.
III. Analyze the voltage sag, harmonic distortion due to commercial and industrial loads.
IV. Design a suitable harmonic filter for industrial application.
V. Apply suitable custom power devices for enhancement of power quality.

MODULE-I  POWER QUALITY ISSUES IN DISTRIBUTION SYSTEMS  Classes: 09

Power Quality problems in distribution systems: Transient and Steady state variations in voltage and frequency, unbalance, sags, swells, interruptions, wave-form distortions: harmonics, noise, notching, dc offsets, fluctuations, flicker and its measurement, Tolerance of Equipment: CBEMA curve.

MODULE-II  CUSTOM POWER DEVICES  Classes: 09

Dynamic Voltage Restorer: Working Principle and control strategies, harmonics and unbalance mitigation in distribution systems using DSTATCOM and shunt active filters, unified power quality conditioner (UPQC), working principle, capabilities and control strategies.

MODULE-III  FACTS CONCEPTS  Classes: 09

Basics of AC transmission, principles of conventional reactive power compensators.
Introduction to FACTS, flow of power in AC parallel paths, meshed systems, basic types of FACTS controllers, definitions of FACTS controllers, brief description of FACTS controllers.

MODULE-IV  STATIC SHUNT AND SERIES COMPENSATORS  Classes: 09

Shunt compensation - objectives of shunt compensation, methods of controllable VAR generation, static VAR compensators- SVC, STATCOM, SVC and STATCOM comparison. Series compensation, objectives of series compensation, thyristor switched series capacitors (TCSC), static series synchronous compensator (SSSC), power angle characteristics, basic operating control schemes.

MODULE-V  APPLICATION OF FACTS DEVICES  Classes: 09

Application of FACTS devices for power-flow control and stability improvement. Simulation example of power swing damping in a single-machine infinite bus system using a TCSC. Simulation example of voltage regulation of transmission mid-point voltage using a STATCOM.
### Text Books:


### Reference Books:


### Web References:

3. [https://www.aar.faculty.asu.edu/classes](https://www.aar.faculty.asu.edu/classes).

### E-Text Books:

2. [https://www.freebookcentre.net](https://www.freebookcentre.net).
SWITCH MODE POWER SUPPLIES

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Contact Classes: 45  Tutorial Classes: Nil  Practical Classes: Nil  Total Classes: 45

OBJECTIVES:
The course should enable the students to:
I. Understand the concept of switched mode power supply with both D.C. and A.C. outputs.
II. Elaborately study the working of switched mode topologies including resonant power suppliers.
III. have the knowledge of their importance and applications in various fields.

MODULE-I  SWITCHED MODE POWER CONVERSION  Classes: 09

Introduction to Switched Mode Power Supply, Linear DC to DC Power converters, Non- Idealities in reactive elements, Design of Inductors, Design of Transformers- Copper loss, Power factor, Non-isolated topologies, Isolated topologies, Quasi-resonant zero-current/zero-voltage switch Operating principle of Non Isolated DC to DC power Converters (Buck, Boost, Buck-Boost, and Cuk) Equivalent circuit model of the non-isolated DC-DC converters. Isolated converters (forward, Flyback).

MODULE-II MULTIPLE OUTPUT FLYBACK SWITCH MODE POWER SUPPLIES  Classes: 09

Introduction, operating Modes, operating principles, Direct off line Flyback Switch Mode Power Supplies, Flyback converter, snubber network, Problems.

MODULE-III USING POWER SEMICONDUCTORS IN SWITCHED MODE TOPOLOGIES  Classes: 09


MODULE-IV RECTIFICATION  Classes: 09

Explanation, Advantages and disadvantages, SMPS and linear power supply comparison, Theory of operation , Input rectifier stage, Inverter stage, Voltage converter and output rectifier, Regulation, An Introduction to Synchronous Rectifier Circuits using Power MOS Transistors.

MODULE-V SWITCH MODE VARIABLE POWER SUPPLIES  Classes: 09

### Text Books:


### Reference Books:


### Web References:


### E-Text Books:

UTILIZATION OF ELECTRIC POWER

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<td>Practical Classes: Nil</td>
<td>Total Classes: 45</td>
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**OBJECTIVES:**
This course should enable the students to:

II. Understand the performance and applications of electric drives.
III. Discuss the methods of electrical heating.
IV. Explain electrical welding and differentiate between AC and DC welding.
V. Understand the laws of illumination and the different types of illumination techniques.
VI. Illustrate the power electronic technology in electric traction systems

**MODULE I**

**ELECTRIC DRIVES**

Classes: 09

Electric Drives: Type of electric drives, choice of motor, starting and running characteristics, speed control, temperature rise, particular applications of electric drives, types of industrial loads, continuous, intermittent and variable loads, load equalization.

**MODULE II**

**ELECTRIC HEATING AND WELDING**

Classes:10

Electric Heating and Welding: Electric heating: Advantages and methods of electric heating, resistance heating, induction heating and dielectric heating: Electric welding: resistance and arc welding, electric welding equipment, comparison between AC and Welding.

**MODULE III**

**ILLUMINATION**

Classes:08

Illumination: Introduction, terms used in illumination, laws of illumination, polar curves, photometry, integrating sphere.
Sources of light: Discharge lamps, MV and SV lamps, comparison between tungsten filament lamps and fluorescent tubes, basic principles of light control, types and design of lighting and flood lighting.

**MODULE IV**

**TRAIN MECHANICS**

Classes:09

Train mechanics: System of electric traction and track electrification, review of existing electric traction systems in India, special features of traction motor, methods of electric braking-plugging, rheostat braking and regenerative braking, mechanics of train movement, speed-time curves for different service: Trapezoidal and quadrilateral speed time curves.

**MODULE V**

**ELECTRIC TRACTION**

Classes:09

Electric traction: 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:


### Reference Books:


### Web References:

1. https://lecturenotes.in/subject/386/utilization-of-electric-energy-uee

### E-Text Books:

1. https://www.freebookcentre.net
3. https://plus.google.com/+GoogleforgeniusBlogspot1/posts/MuFTRDqJ3iJ
INDUSTRIAL ELECTRICAL SYSTEMS

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Contact Classes: 45  Tutorial Classes: Nil  Practical Classes: Nil  Total Classes: 45

OBJECTIVES:
The course should enable the students to:
I. Analyze and select the proper size of various electrical system components.
II. Understand the electrical wiring systems for residential, commercial and industrial.
III. To know the basic quantities of light, definitions and relationships kinds of lamps, characteristics and Lighting calculations and illumination technology
IV. Remember various components of industrial electrical systems with automation.

MODULE - I  ELECTRICAL SYSTEM COMPONENTS  Classes: 08

Electrical System Components: Introduction to LT and HT system, Contactor, Isolator, Relays, metering system, Tariff structure, inverse current characteristics, components symbol, single line diagram (SLD) of a wiring system. Protection components: Fuse, MCB, MCCB, ELCB, MPCB.

MODULE - II  RESIDENTIAL AND COMMERCIAL ELECTRICAL SYSTEMS  Classes: 09

Residential and Commercial Electrical Systems: electric supply system, three phase four wire distribution system, protection of electric installation against over load, short circuit and earth fault, earthing, guide lines for installation of fittings, general requirements of electrical installations, testing of installations.

MODULE - III  ILLUMINATION SYSTEMS  Classes: 10

Illumination Systems: Production of light, Laws of illumination, lighting calculation, Interior and exterior illumination systems, lighting schemes, design on lighting scheme;

Electrical lamps, factory lighting, flood lighting, gaseous discharge lamps, high pressure and low pressure neon lamps, high frequency, low pressure discharge tubes, induction lamps, LED lamps. Simple problems.

MODULE - IV  INDUSTRIAL ELECTRICAL SYSTEMS  Classes: 9

Industrial Electrical Systems: Indian electricity rules, neutral and earth wire, types of loads, systems of wiring, service connections, service mains, sub-circuits, location of outlets; location of control switches, location of main board and distribution board, load assessment, permissible voltage drops and sizes of wires, estimating and costing of electric installations. Types of DG systems and UPS system, battery selection, types of battery and battery bank.

MODULE - V  INDUSTRIAL ELECTRICAL AUTOMATION SYSTEMS  Classes: 09

Industrial Electrical Automation Systems: introduction to basic PLC, Role of in automation, advantages of process automation, PLC based control system design, Panel Metering and Introduction to SCADA system for distribution automation.
**Text Books:**


**Reference Books:**


**Web References:**

3. https://nptel.ac.in/courses/Webcourse

**E-Text Books:**

SMART GRID TECHNOLOGY

PE: VI

<table>
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Contact Classes: 45  Tutorial Classes: Nil  Practical Classes: Nil  Total Classes: 45

OBJECTIVES:
The course should enable the students to:
I. Explain the concepts, architecture and design of smart grids.
II. Describe the communication and measurement technologies employed in smart grid.
III. Demonstrate the tools for the performance analysis and stability analysis of smart grid.
IV. Discuss the renewable energy resources and storages integrated with smart grid.

MODULE-I  SMART GRID ARCHITECTURAL DESIGNS  Classes: 08
Concept of smart grid: Introduction, comparison of power grid with smart grid, power system enhancement, communication and standards, general view of the smart grid market drivers, stakeholder roles and function, measures representative architecture, functions of smart grid components, wholesale energy market in smart grid, smart vehicles in smart grid.

MODULE-II  SMART GRID COMMUNICATIONS AND MEASUREMENT TECHNOLOGY  Classes: 10
Smart grid communications: Communication and measurement, monitoring, phasor measurement unit, smart meters, wide area monitoring systems, advanced metering infrastructure and google mapping tools.

MODULE-III  PERFORMANCE ANALYSIS TOOLS FOR SMART GRID DESIGN  Classes: 09
Performance analysis: Introduction to load flow studies, challenges to load flow in smart grid and weaknesses of the present load flow methods, load flow state of the art, classical, extended formulations, and algorithms.
Load flow studies: Load flow for smart grid design, contingencies studies for smart grid.

MODULE-IV  STABILITY ANALYSIS TOOLS FOR SMART GRID  Classes: 10

MODULE-V  RENEWABLE ENERGY AND STORAGE  Classes: 08
Renewable energy resources: Sustainable energy options for the smart grid, penetration and variability issues associated with sustainable energy technology, demand response issues, electric vehicles and plug in hybrids, plug in hybrid electric vehicles (PHEV), technology environmental implications, storage technologies, grid integration issues of renewable energy sources.
### Text Books:


### Reference Books:


### Web References:

2. https://www.aar.faculty.asu.edu/classes
3. https://www.facstaff.bucknell.edu/
4. https://www.electrical4u.com
5. https://www.iare.ac.in

### E-Text Books:

1. https://www.jntubook.com/
2. https://www.freeengineeringbooks.com
ELECTRICAL AND HYBRID VEHICLES

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<th>Course Code</th>
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OBJECTIVES:
The course should enable the students to:
I. Interpret the social and environmental importance of hybrid and electrical vehicles.
II. Discuss the concept of hybrid traction and electric traction with the help of hybrid drive train and electric drive train topologies
III. Explain the electric propulsion unit of hybrid electric vehicles.
IV. Understand the configuration and control of different types of electric drives.
V. Demonstrate the concepts of energy storage and energy management in hybrid electric vehicles.

MODULE-I  INTRODUCTION  Classes: 08
Introduction to Hybrid Electric Vehicles: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies; Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics, and mathematical models to describe vehicle performance.

MODULE-II  HYBRID ELECTRIC DRIVE TRAINS  Classes: 10
Hybrid Electric Drive trains: Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive train topologies, fuel efficiency analysis; Electric Drive trains: Basic concept of electric traction, introduction to various electric drive train topologies, power flow control in electric drive train topologies, fuel efficiency analysis.

MODULE-III  ELECTRIC MOTORS FOR HYBRID ELECTRIC VEHICLES  Classes: 10
Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles, configuration and control of DC motor drives, configuration and control of Induction Motor drives.
Configuration and control of permanent magnet motor drives, configuration and control of switch reluctance motor drives, drive system efficiency.

MODULE-IV  ENERGY STORAGE  Classes: 08
Energy Storage: Introduction to energy storage requirements in hybrid and electric vehicles, Battery based energy storage and its analysis, fuel cell based energy storage and its analysis, super capacitor based energy storage and its analysis, flywheel based energy storage and its analysis, hybridization of different energy storage devices; sizing the drive system: matching the electric machine and the internal combustion engine (ICE), sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, communications, supporting subsystems.
## MODULE-V
### ENERGY MANAGEMENT STRATEGIES

Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies. Case Studies: design of a hybrid electric vehicle (HEV), design of a battery electric vehicle (BEV).

### Text Books:

### Reference Books:

### Web References:

### E-Text Books:
COMPUTER ARCHITECTURE

OE – I

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Contact Classes: 45  Tutorial Classes: Nil  Practical Classes: Nil  Total Classes: 45

OBJECTIVES:
The course should enable the students to:
I. Understand the organization and architecture of computer systems and electronic computers.
II. Study the assembly language program execution, instruction format and instruction cycle.
III. Design a simple computer using hardwired and micro programmed control methods.
IV. Study the basic components of computer systems besides the computer arithmetic.
V. Understand input-output organization, memory organization and management, and pipelining.

MODULE - I  INTRODUCTION TO COMPUTER ORGANIZATION  Classes: 09
Basic computer organization, CPU organization, memory subsystem organization and interfacing, input or output subsystem organization and interfacing, a simple computer levels of programming languages, assembly language instructions, a simple instruction set architecture.

MODULE - II  ORGANIZATION OF A COMPUTER  Classes: 09
Register transfer: Register transfer language, register transfer, bus and memory transfers, arithmetic micro operations, logic micro operations, shift micro operations; Control memory.

MODULE - III  CPU AND COMPUTER ARITHMETIC  Classes: 09
CPU design: Instruction cycle, data representation, memory reference instructions, input-output, and interrupt, addressing modes, data transfer and manipulation, program control.
Computer arithmetic: Addition and subtraction, floating point arithmetic operations, decimal arithmetic unit.

MODULE - IV  INPUT-OUTPUT ORGANIZATION  Classes: 09
Input or output organization: Input or output Interface, asynchronous data transfer, modes of transfer, priority interrupt, direct memory access.

MODULE - V  MEMORY ORGANIZATION  Classes: 09
Memory organization: Memory hierarchy, main memory, auxiliary memory, associative memory, cache memory, virtual memory; Pipeline: Parallel processing, Instruction pipeline;

Text Books:
### Reference Books:


### Web References:

1. https://www.tutorialspoint.com/computer_logical_organization/
2. https://www.courseera.org/learn/comarch

### E-Text Books:

# ANALYSIS OF ALGORITHMS AND DESIGN

## OE - 1

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Contact Classes: 45  Tutorial Classes: Nil  Practical Classes: Nil  Total Classes: 45

## OBJECTIVES:
The course should enable the students to:

I. Assess how the choice of data structures and algorithm design methods impacts the performance of programs.

II. Solve problems using data structures such as binary search trees, and graphs.

III. Choose the appropriate data structure and algorithm design method for a specified application.

IV. Solve problems using algorithm design methods such as the divide and conquer, greedy method, dynamic programming, branch and bound, backtracking.

### MODULE - I  INTRODUCTION

Algorithm: Pseudo code for expressing algorithms; Performance analysis: Space complexity, time complexity; Amortized Complexity, Asymptotic notations: Big O notation, omega notation, theta notation and little o notation.

Classes: 09

### MODULE - II  DIVIDE AND CONQUER

Divide and Conquer: General method, applications: Binary search, quick sort, merge sort, Strassen’s matrix multiplication.

Classes: 09

### MODULE - III  TRAVERSAL TECHNIQUES AND GREEDY METHOD

Efficient non recursive binary tree traversal algorithms, spanning trees; Graph traversals: Breadth first search, depth first search, connected components, biconnected components.

Greedy method: The general method, job sequencing with deadlines, knapsack problem, single source shortest paths.

Classes: 09

### MODULE - IV  DYNAMIC PROGRAMMING

Dynamic programming: The general method, matrix chain multiplication, optimal binary search trees, 0/1 knapsack problem, all pairs shortest paths problem.

Classes: 09

### MODULE - V  BRANCH AND BOUND, BACKTRACKING

Branch and bound: The general method, travelling salesperson problem; Backtracking: The general method, the 8 queens problem, graph coloring.

Classes: 09

## Text Books:

### Reference Books:


### Web References:


### E-Text Books:

1. http://ebook/com/item/introduction_to_the_design_and_analysis_of_algorithms_3rd_editionananylevitin/
2. https://drive.google.com/file/d/0B_Y1VbyboEDBTDVxVXpVbnk4TVE/edit?pref=2&pli=1

### MOOC Course:

1. https://www.coursera.org/learn/algorithm-design-analysis
3. https://www.onlinecourses.nptel.ac.in/noc16_cs04/preview
RELATIONAL DATABASE MANAGEMENT SYSTEMS

OE – I

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Contact Classes: 45  Tutorial Classes: Nil  Practical Classes: Nil  Total Classes: 45

OBJECTIVES:
The course should enable the students to:
I. Understand the role of database management system in an organization and learn the database concepts.
II. Design databases using data modeling and Logical database design techniques.
III. Construct database queries using relational algebra and calculus and SQL.
IV. Understand the concept of a database transaction and related concurrent, recovery facilities.
V. Learn how to evaluate a set of queries in query processing.

MODULE -I  CONCEPTUAL MODELING INTRODUCTION  Classes: 09
Introduction to Databases and Database Management System - Database system Applications Advantages of DBMS over File System - Data Models – Instances and schema - View of Data - Database Languages - DDL-DML - Database Users and Administrator - Database System Structure.

MODULE -II  RELATIONAL APPROACH  Classes: 09

MODULE -III  SQL QUERY - BASICS, RDBMS - NORMALIZATION  Classes: 09
Introduction to the Relational Model – Structure of RDBMS - Integrity Constraints over Relations – Enforcing Integrity Constraints – Querying Relational Data - Relational Algebra and Calculus.
Introduction to SQL- Data Definition commands, Data Manipulation Commands, Basic Structure, Set operations Aggregate Operations - Join operations - Sub queries and correlated queries, SQL functions, views, Triggers, Embedded SQL.

MODULE -IV  TRANSACTION MANAGEMENT  Classes: 09

MODULE -V  DATA STORAGE AND QUERY PROCESSING  Classes: 09
### Text Books:


### Reference Books:


### Web References:

1. https://www.youtube.com/results?search_query=DBMS+onluine+classes
2. http://www.w3schools.in/dbms/

### E-Text Books:

3. https://docs.google.com/file/d/0B9aJA_iV4kHYM2dieHZhMHhyRVE/edit

### MOOC Course

1. https://onlinecourses.nptel.ac.in/noc18_cs15/preview
ADVANCED DATA STRUCTURES

OE - I

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Contact Classes: 45  Tutorial Classes: Nil  Practical Classes: Nil  Total Classes: 45

OBJECTIVES:
The course should enable the students to:
I. Understand the basic data structures and techniques of algorithm analysis.
II. Understand dictionaries, hashing mechanisms and skip lists for faster data retrieval.
III. Comprehension of heaps, priority queues and its operations.
IV. Understand balanced trees and their operations.
V. Illustration of tries and pattern matching algorithms.

MODULE - I  OVERVIEW OF DATA STRUCTURES  Classes: 09

Algorithms; Performance analysis: Time complexity and Space complexity, Asymptotic notation. Review of basic data structures - The list ADT, Stack ADT, Queue ADT, Linked list – Single linked list, Double linked list, Circular linked list.

MODULE - II  DICTIONARIES, HASH TABLES  Classes: 09

Dictionaries: Linear list representation, Skip list representation, operations - insertion, deletion and searching, Hash table representation, hash functions, collision resolution - separate chaining, open addressing - linear probing, quadratic probing, double hashing, rehashing, extendible hashing, comparison of hashing and skip lists.

MODULE - III  PRIORITY QUEUES  Classes: 09

Priority Queues – Definition, ADT, Realizing a Priority Queue using Heaps, Insertion, Deletion, Application-Heap Sort, External Sorting- Model for external sorting, Multiway merge, Polyphase merge.

MODULE - VI  SEARCH TREES  Classes: 09


MODULE - V  PATTERN MATCHING AND TRIES  Classes: 09

Pattern matching algorithms - the Boyer - Moore algorithm, the Knuth – Morris - Pratt algorithm. Tries – Definition, concepts of digital search tree, Binary trie, Patricia, Multi-way trie.

Text Books:
**Reference Books:**


**Web References:**

2. https://www.geeksforgeeks.org/data-

**E-Text Books:**

1. https://pdfs.semanticscholar.org/19ec/55ed703eb24e1d98a4abd1a15387281cc0f8.pdf

**MOOC Course**

1. https://nptel.ac.in/courses/106103069/
### DATA COMMUNICATIONS AND NETWORKS

#### OE - I

<table>
<thead>
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<th>Course Code</th>
<th>Category</th>
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**Contact Classes: 45**  
**Tutorial Classes: Nil**  
**Practical Classes: Nil**  
**Total Classes: 45**

### OBJECTIVES:

The course should enable the students to:

I. Develop an understanding of modern network architectures from a design and performance perspective.

II. Understand the basics and challenges of network communication.

III. Provide an opportunity to do network programming using TCP/IP.

IV. Understand the operation of the protocols that are used inside the Internet.

### MODULE - I  
**DATA COMMUNICATIONS**

Classes: 09

Components, Direction of Data flow, Networks, Components and Categories, Types of Connections, Topologies, Protocols and Standards, ISO / OSI model, Example Networks such as ATM, Frame Relay, ISDN.

### MODULE – II  
**THE PHYSICAL LAYER**

Classes: 09

Transmission modes, Switching, Circuit Switched Networks, Transmission Media, Datagram Networks, Virtual Circuit Networks.

### MODULE – III  
**THE DATALINK LAYER**

Classes: 09


### MODULE – IV  
**THE NETWORK LAYER**

Classes: 09


### MODULE – V  
**THE TRANSPORT AND APPLICATION LAYER**

Classes: 09


### Text Books:

### Reference Books:


### Web References:

1. [http://computer.howstuffworks.com/computer-networking-channel.htm](http://computer.howstuffworks.com/computer-networking-channel.htm)
2. [http://www.ietf.org](http://www.ietf.org)

### E-Text Books:

1. [http://www.freebookcentre.net/networking-books-download/Lecture-Notes-on-Computer-Networks.html](http://www.freebookcentre.net/networking-books-download/Lecture-Notes-on-Computer-Networks.html)

### MOOC Course

NETWORK SECURITY

OE - 1

<table>
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Contact Classes: 45  Tutorial Classes: Nil  Practical Classes: Nil  Total Classes: 45

OBJECTIVES:
The course should enable the students to:
I. Learn the basic categories of threats to computers and networks.
II. Understand various cryptographic algorithms and be familiar with public-key cryptography.
III. Apply authentication functions for providing effective security.
IV. Analyze the application protocols to provide web security.
V. Discuss the place of ethics in the information security area.

MODULE-I  ATTACKS ON COMPUTERS AND COMPUTER SECURITY  Classes: 09
Attacks on computers and computer security: Introduction, the need for security, security approaches, principles of security, types of security attacks, security services, security mechanism, a model for network security; Cryptography concepts and techniques: Introduction, plain text and cipher text, substitution techniques, transposition techniques, encryption and decryption, symmetric and asymmetric key cryptography.

MODULE-II  SYMMETRIC AND ASYMMETRIC KEY CIPHERS  Classes: 09
Symmetric key ciphers: Block cipher principles and algorithms (DES,AES), block cipher modes of operation, stream ciphers, and placement of encryption function, key distribution; Asymmetric key ciphers: Principles of public key cryptosystems, algorithms (RSA Diffie-Hellman).

MODULE-III  MESSAGE AUTHENTICATION ALGORITHM AND HASH FUNCTIONS  Classes: 09
Message authentication algorithm and hash functions: Authentication requirements, functions, message, authentication codes.

MODULE-IV  E-MAIL SECURITY  Classes: 09
E-mail Security: Pretty Good Privacy; S/MIME
IP Security: IP security overview, IP security architecture, authentication header, encapsulating security payload, combining security associations, key management.

MODULE-V  WEB SECURITY  Classes: 09
Web security: Web security considerations, secure socket layer and transport layer security, secure electronic transaction.
Intruders; Virus and firewalls: Intruders, intrusion detection password management, virus and related threats, countermeasures, firewall design principles; Types of firewalls.
### Text Books


### Reference Books


### Web References

2. [https://books.google.co.in/books/about/Cryptography_Network_Security_Sie_2E.html?id=Kokjwdf0E7QC](https://books.google.co.in/books/about/Cryptography_Network_Security_Sie_2E.html?id=Kokjwdf0E7QC)
3. [https://books.google.co.in/books/about/Information_Security.html?id=Bh45pU0E_4C](https://books.google.co.in/books/about/Information_Security.html?id=Bh45pU0E_4C)

### E-Text Books

1. [https://books.google.co.in/books/about/Information_Security.html](https://books.google.co.in/books/about/Information_Security.html)
ENERGY FROM WASTE

OE – II

<table>
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Contact Classes: 45 Tutorial Classes: Nil Practical Classes: Nil Total Classes: 45

COURSE OBJECTIVES:
The course should enable the students to:
I. Understand the principles associated with effective energy management and to apply these principles in the day to day life.
II. Develop insight into the collection, transfer and transport of municipal solid waste.
III. Explain the design and operation of a municipal solid waste landfill.
IV. Evaluate the main operational challenges in operating thermal and biochemical energy from waste facilities and device key processes involved in recovering energy from wastes.

MODULE - I INTRODUCTION TO WASTE AND WASTE PROCESSING Classes: 08
Solid waste sources solid waste sources, types, composition, properties, global warming; Municipal solid waste: Physical, chemical and biological properties, waste collection and, transfer stations, waste minimization and recycling of municipal waste, segregation of waste, size reduction, managing waste, status of technologies for generation of energy from waste treatment and disposal aerobic composting, incineration, furnace type and design, medical waste / pharmaceutical waste treatment technologies, incineration, environmental impacts, measures to mitigate environmental effects due to incineration.

MODULE - II WASTE TREATMENT AND DISPOSAL Classes: 10
Land fill method of solid waste disposal land fill classification, types, methods and sitting consideration; Layout and preliminary design of landfills: Composition, characteristics, generation, movement and control of landfill leachate and gases, environmental monitoring system for land fill gases.

MODULE - III BIO-CHEMICAL CONVERSION Classes: 09
Energy generation from waste bio-chemical conversion: Sources of energy generation, anaerobic digestion of sewage and municipal waste, direct combustion of MSW-refuse derived solid fuel. Industrial waste, agro residues and anaerobic digestion.

MODULE - IV THERMO-CHEMICAL CONVERSION Classes: 10
Biogas production, land fill gas generation and utilization, thermo-chemical conversion: Sources of energy generation, gasification of waste using gasifies briquetting, utilization and advantages of briquetting, environmental benefits of bio-chemical and thermo-chemical conversion.

MODULE - V E-WASTE MANAGEMENT Classes: 08
E-waste: E-waste in the global context: Growth of electrical and electronics industry in India, environmental concerns and health hazards; Recycling e-waste: A thriving economy of the unorganized sector, global trade in hazardous waste, impact of hazardous e-waste in India; Management of e-waste: E-waste legislation, government regulations on e-waste management, international experience, need for stringent health safeguards and environmental protection laws of India.
### Text Books:


### Reference Books:


### Web References:

2. https://www. What is the impact of E-waste: Tamara Thompson

### E-Text Books:

1. https://www.unep.org
2. https://www.outledge.com
3. https://www.bookdepository.com
DISASTER MANAGEMENT

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Category</th>
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Contact Classes: 45 Tutorial Classes: Nil Practical Classes: Nil Total Classes: 45

OBJECTIVES:
The course should enable the students to:
I. Identify the major disaster types and develop an understanding of modern disaster management.
II. Recognize and develop awareness of the chronological phases of natural disaster response and refugee relief operations.
III. Understand the key concepts of disaster management related to development and the relationship of different disaster management activities.
IV. Categorize the organizations that are involved in natural disaster assistance and relief system

MODULE - I ENVIRONMENTAL HAZARDS AND DISASTERS Classes: 09

Environmental hazards and disasters: meaning of environmental hazards, environmental disasters and environmental stress; concept of environmental hazards, environmental stress and environmental disasters, different approaches and relation with human ecology, landscape approach, ecosystem approach, perception approach, human ecology and its application in geographical researches.

MODULE - II TYPES OF ENVIRONMENTAL HAZARDS AND DISASTERS Classes: 09

Types of environmental hazards and disasters: Natural hazards and disasters, man induced hazards and disasters, natural hazards, planetary hazards/ disasters, extra planetary hazards/ disasters, planetary hazards, endogenous hazards, exogenous hazards.

MODULE - III ENDOGENOUS HAZARDS Classes: 09

Endogenous hazards, volcanic eruption, earthquakes, landslides, volcanic hazards/ disasters, causes and distribution of volcanoes, hazardous effects of volcanic eruptions, environmental impacts of volcanic eruptions.

Earthquake hazards/ disasters, causes of earthquakes, distribution of earthquakes, hazardous effects of, earthquakes, earthquake hazards in India, human adjustment, perception and mitigation of earthquake.

MODULE - IV EXOGENOUS HAZARDS Classes: 09

Exogenous hazards/ disasters, infrequent events, cumulative atmospheric hazards/ disasters; Infrequent events: Cyclones, lightning, hailstorms; Cyclones: Tropical cyclones and local storms, destruction by tropical cyclones and local storms (causes, distribution human adjustment, perception and mitigation); Cumulative atmospheric hazards/ disasters: Floods, droughts, cold waves, heat waves floods; Causes of floods, flood hazards India, flood control measures (human adjustment, perception and mitigation); Droughts: Impacts of droughts, drought hazards in India, drought control measures, extra planetary hazards/ disasters, man induced hazards/disasters, physical hazards/disasters, soil erosion. Soil erosion: Mechanics and forms of soil erosion, factors and causes of soil erosion, conservation measures of soil erosion; Chemical hazards/ disasters: Release of toxic chemicals, nuclear explosion, sedimentation processes; Sedimentation processes: Global sedimentation problems regional sedimentation problems, sedimentation and environmental problems, corrective measures of erosion and sedimentation, biological hazards/disasters, population explosion.
<table>
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<th>MODULE - V</th>
<th>EMERGING APPROACHES IN DISASTER MANAGEMENT</th>
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<tr>
<td>Emerging approaches in Disaster Management, Three Stages</td>
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<td>2. Emergency Stage</td>
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<td>3. Post Disaster stage, Rehabilitation.</td>
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<td>1. <a href="https://www.google.co.in/?gfe_rd=cr&amp;ei=,iAwWL_iDlaazv8we8_5LADA&amp;q=disater+mangement">https://www.google.co.in/?gfe_rd=cr&amp;ei=,iAwWL_iDlaazv8we8_5LADA&amp;q=disater+mangement</a></td>
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<td><strong>E-Text Books:</strong></td>
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<td>1. <a href="https://www.google.co.in/?gfe_rd=cr&amp;ei=,iAwWL_iDlaazv8we8_5LADA&amp;q=disaster+management+e+textbooks">https://www.google.co.in/?gfe_rd=cr&amp;ei=,iAwWL_iDlaazv8we8_5LADA&amp;q=disaster+management+e+textbooks</a></td>
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ELEMENTS OF AERONAUTICS

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Contact Classes: 45  
Tutorial Classes: Nil  
Practical Classes: Nil  
Total Classes: 45

**OBJECTIVES:**
The course should enable the students to:

I. Get the knowledge of technical areas of aerospace engineering including mechanics and physics of fluids, structures and materials, instrumentation, control and estimation, humans and automation, propulsion and energy conversion, aeronautical and astronautical systems

II. Understand the methodology and experience of analysis, modeling, and synthesis

III. Understand the evolution of human space exploration with a brief introduction to the missions conducted by various countries

IV. Knowledge in satellite engineering and the systems involved in the operation of satellites.

**MODULE -I  
HISTORY OF FLIGHT AND SPACE ENVIRONMENT**

Balloons and dirigibles, heavier than air aircraft, commercial air transport; Introduction of jet aircraft, helicopters, missiles; Conquest of space, commercial use of space; Different types of flight vehicles, classifications exploring solar system and beyond, a permanent presence of humans in space; Earth’s atmosphere, the standard atmosphere; The temperature extremes of space, laws of gravitation, low earth orbit, microgravity, benefits of microgravity; Environmental impact on spacecraft, space debris; Planetary environments

**MODULE -II  
INTRODUCTION TO AERODYNAMICS**

Anatomy of the airplane, helicopter; Understanding engineering models; Aerodynamic forces on a wing, force coefficients; Generating lift, moment coefficients; Aerodynamic forces on aircraft – classification of NACA airfoils, aspect ratio, wing loading, mach number, centre of pressure and aerodynamic centreaerfoil characteristics-lift, drag curves; Different types of drag.

**MODULE -III  
FLIGHT VEHICLVE PERFORMANCE AND STABILITY**

Performance parameters, performance in steady flight, cruise, climb, range, endurance, accelerated flight symmetric maneuvers, turns, sideslips, takeoff and landing. Flight vehicle Stability, static stability, dynamic stability; Longitudinal and lateral stability; Handling qualities of the airplanes

**MODULE -IV  
INTRODUCTION TO AIRPLANE STRUCTURES AND MATERIALS, POWER PLANT**

General types of construction, monocoque, semi-monocoque; Typical wing and fuselage structure; Metallic & non-metallic materials, use of aluminum alloy, titanium, stainless steel and composite materials; Basic ideas about engines, use of propeller and jets for thrust production; Principles of operation of rocket, types of rockets.

**MODULE -V  
SATELLITE SYSTEMS ENGINEERING HUMAN SPACE EXPLORATION**

Satellite missions, an operational satellite system, elements of satellite, satellite bus subsystems; Satellite structures, mechanisms and materials; Power systems; Communication and telemetry; Propulsion and station keeping; Space missions, mission objectives. Goals of human space flight missions, historical background, the Soviet and US missions; The mercury, Gemini, Apollo (manned flight to the moon), Skylab, apollo-soyuz, space Shuttle; International space station, extravehicular activity; The space suit; The US and Russian designs; Life support systems, flight safety; Indian effort in aviation, missile and space technology.
### Text Books:


### Reference Books:


### Web References:

2. https://www.ne.nasa.gov/education/
3. https://nptel.ac.in

### E-Text Books:

3. https://www.academia.edu/7950378/Introduction_to_Flight_-_Anderson_5th_Ed
AVIATION MANAGEMENT

OE – II

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Contact Classes: 45  Tutorial Classes: Nil  Practical Classes: Nil  Total Classes: 45

OBJECTIVES:
The course should enable the students to:
I. Understand about the history of aviation, major player’s airline industry, current trends and challenges.
II. Impart the knowledge on airport planning, airport operation and various authorities involved in airport management.
III. Understand and gain the knowledge on the meteorological services, environmental regulation and airport fee, rates and charges.
IV. Gain the in depth knowledge on safety regulation, economic regulation and aviation security.
V. Understand about the air traffic control, air space and navigational aid.

MODULE -I  INTRODUCTION

History of Aviation- organization, global, social & ethical environment-history of aviation in India-Major players in Airline industry-Swot Analysis of different Airline companies in India- market potential of Airline industry in India- new airport development plans-current challenges in airline industry- competition in Airline industry- Domestic & International from an Indian perspective.

MODULE -II  AIRPORT INFRASTRUCTURE AND MANAGEMENT

Airport planning – Terminal planning design & operation -Airport operations – Airport functions-organization structure in an Airline – Airport Authority of India- comparison of global & Indian Airport management- Role of AAI -Airline privatization – Full privatization- Gradual privatization- partial privatization.

MODULE -III  AIR TRANSPORT SERVICES

Various Airport services- international air transport services – Indian Scenario- An overview of Airport in Delhi, Mumbai, Hyderabad & Bangalore. The role of private operators- Airport development fees, Rates & Tariffs.

MODULE -IV  INSTITUTIONAL FRAMEWORK

Role of DGCA-Slot allocation -Methodology followed by ATC & DGCA – management of bi-laterals – economic Regulations.

MODULE -V  CONTROLLING

Role of air traffic control- airspace & navigational aids- control process – case study in airline industry- Mumbai-Delhi airport privatization-Navi Mumbai airport tendering process- six cases in the airline industry.
### Text Books:


### Reference Books:


### Web References:

2. https://books.google.co.in/books?id=RYR6cu4YSBcC&dq=Planning%20and%20Design%20of%20Airports&source=gbs_similarbooks

### E-Text Books:

INTRODUCTION TO ROBOTICS

OE – II

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Contact Classes: 45 Tutorial Classes: Nil Practical Classes: Nil Total Classes: 45

OBJECTIVES:
The course should enable the students to:
I. Familiarize with the automation and brief history of robot and applications.
II. Understand the kinematics of robots and knowledge about robot end effectors and their design.
III. Apply robot actuators and feedback components to automation.

MODULE I
INTRODUCTION TO ROBOTICS

Introduction: Automation and robotic, an overview of robotics, classification by coordinate system and control systems; Components of the industrial robotics: Degrees of freedom, end effectors: Mechanical gripper, magnetic, vacuum cup and other types of grippers, general consideration on gripper selection and design.

MODULE II
MOTION ANALYSIS AND KINEMATICS

Motion analysis: Basic rotation matrices, composite rotation matrices, Euler angles, equivalent angle and axis, homogeneous transformation, problems; Manipulator kinematics: D-H notations, joint coordinates and world coordinates, forward and inverse kinematics, problems.

MODULE III
KINEMATICS AND DYNAMICS


MODULE IV
TRAJECTORY PLANNING AND ACTUATORS

Trajectory planning: Joint space scheme, cubic polynomial fit, and avoidance of obstacles, types of motion: Slew motion, joint interpolated motion, straight line motion, problems; Robot actuators and feedback components; Actuators: pneumatic and hydraulic actuators.

MODULE V
ELECTRIC ACTUATORS AND ROBOTIC APPLICATIONS

Electric actuators: DC servo motors, stepper motors, feedback components: position sensors, potentiometers, resolvers and encoders, velocity sensors, tactile sensors; Robot application in manufacturing: Material handling, assembly and inspection.

Text Books:

Reference Books:
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RAPID PROTOTYPING

OE – II

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Contact Classes: 45  Tutorial Classes: Nil  Practical Classes: Nil  Total Classes: 45

OBJECTIVES:
The course should enable the students to:
I. Identify suitable time compression techniques for rapid product development.
II. Interpret the concept, process details with respect to different processes.
III. Describe the significance of each process parameter of various prototyping systems.
IV. Interpret the advantages, limitations and applications of various prototyping systems.
V. Identify the various tooling required for rapid prototyping systems and reverse engineering & augmented reality.

MODULE -I  INTRODUCTION TO RAPID PROTOTYPING  Classes: 09


MODULE -II  LIQUID-BASED RAPID PROTOTYPING SYSTEMS  Classes: 09

Liquid-Based Rapid Prototyping Systems: Principle, Process parameter, Process details, Advantages, Disadvantages and Applications of Stereolithography Apparatus (SLA), Solid Ground Curing (SGC), Solid Object Ultraviolet-Laser Printer (SOUP), Rapid Freeze Prototyping and Microfabrication

MODULE -III  SOLID-BASED RAPID PROTOTYPING SYSTEMS  Classes: 09

Solid-Based Rapid Prototyping Systems: Principle, Process parameter, Process details, Advantages, Disadvantages and Applications of Laminated Object Manufacturing (LOM), Fused Deposition Modeling (FDM), Paper Lamination Technology (PLT), Multi-Jet Modeling System (MJM) and CAM-LEM.

MODULE -IV  POWDER-BASED RAPID PROTOTYPING SYSTEMS  Classes: 09

Powder-Based Rapid Prototyping Systems: Principle, Process parameter, Process details, Advantages, Disadvantages and Applications of Selective Laser Sintering (SLS), Laser Engineered Net Shaping (LENS), Multiphase Jet Solidification (MJS), Electron Beam Melting (EBM) and Three-Dimensional Printing (3DP) – Hands on Session

MODULE -V  RAPID TOOLING  Classes : 09

## Field.

### Text Books:


### Reference Books:


### Web References:

1. https://nptel.ac.in/courses/112102103/16
2. https://nptel.ac.in/courses/112107078/37

### E-Text Book:

EMBEDDED SYSTEMS

OE - III

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<th>Tutorial Classes: Nil</th>
<th>Practical Classes: Nil</th>
<th>Total Classes: 45</th>
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</table>

OBJECTIVES:
The course should enable the students to:
I. Imbibe knowledge about the basic functions, structure, concepts and applications of Embedded Systems.
II. Understand Real time operating system concepts.
III. Analyze different tools for development of embedded software.
IV. Be acquainted the architecture of advanced processors.

MODULE - I  EMBEDDED COMPUTING  Classes: 08
Definition of embedded system, embedded systems vs. general computing systems, history of embedded systems, complex systems and microprocessor, classification, major application areas, the embedded system design process, characteristics and quality attributes of embedded systems, formalisms for system design, design examples

MODULE - II  INTRODUCTION TO EMBEDDED C AND APPLICATIONS  Classes: 09
C looping structures, register allocation, function calls, pointer aliasing, structure arrangement, bit fields, unaligned data and endianness, inline functions and inline assembly, portability issues; Embedded systems programming in C, binding and running embedded C program in Keil IDE, dissecting the program, building the hardware; Basic techniques for reading and writing from I/O port pins, switch bounce; Applications: Switch bounce, LED interfacing, interfacing with keyboards, displays, D/A and A/D conversions, multiple interrupts, serial data communication using embedded C interfacing

MODULE - III  RTOS FUNDAMENTALS AND PROGRAMMING  Classes: 09
Operating system basics, types of operating systems, tasks and task states, process and threads, multiprocessing and multitasking, how to choose an RTOS, task scheduling, semaphores and queues, hard real-time scheduling considerations, saving memory and power.
Task communication: Shared memory, message passing, remote procedure call and sockets; Task synchronization: Task communication synchronization issues, task synchronization techniques, device drivers.

MODULE - IV  EMBEDDED SOFTWARE DEVELOPMENT TOOLS  Classes: 09
Host and target machines, linker/locators for embedded software, getting embedded software into the target system; Debugging techniques: Testing on host machine, using laboratory tools, an example system.

MODULE - V  INTRODUCTION TO ADVANCED PROCESSORS  Classes: 10
Introduction to advanced architectures: ARM and SHARC, processor and memory organization and instruction level parallelism; Networked embedded systems: Bus protocols, I2C bus and CAN bus; Internet-EnAna lied systems, design example-Elevator controller.
<table>
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<th>Text Books</th>
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<th>E-Text Books</th>
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<tr>
<td>4. <a href="https://docs.google.com/file/d/0B6Cytl4eS_ahUS1LTkVXb1hxa00/edit">https://docs.google.com/file/d/0B6Cytl4eS_ahUS1LTkVXb1hxa00/edit</a></td>
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COGNITIVE RADIO

OE - III

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Contact Classes: 45 Tutorial Classes: Nil Practical Classes: Nil Total Classes: 45

OBJECTIVES:
The course should enable the students to:
I. Know the basics of the software defined radios.
II. Learn the design of the wireless networks based on the cognitive radios.
III. Understand the concepts of wireless networks and next generation networks.

MODULE - I  INTRODUCTION TO SOFTWARE DEFINED RADIO  Classes: 08
Definitions and potential benefits, software radio architecture evolution, technology tradeoffs and architecture implications.

MODULE - II  SDR ARCHITECTURE  Classes: 09
Essential functions of the software radio, basic SDR, hardware architecture, Computational processing resources, software architecture, top level component interfaces, interface topologies among plug and play modules.

MODULE - III  INTRODUCTION TO COGNITIVE RADIOS  Classes: 09
Marking radio self-aware, cognitive techniques, position awareness.
Environment awareness in cognitive radios, optimization of radio resources, artificial intelligence techniques.

MODULE - IV  COGNITIVE RADIO ARCHITECTURE  Classes: 09
Cognitive Radio: Functions, components and design rules, cognition cycle: orient, plan, decide and act phases, inference hierarchy, architecture maps, building the cognitive radio architecture on software defined radio architecture.

MODULE - V  NEXT GENERATION WIRELESS NETWORKS  Classes: 10
The XG Network architecture, spectrum sensing, spectrum management, spectrum mobility, spectrum sharing, upper layer issues, cross – layer design.

Text Books:
### Reference Books:


### Web References:

1. wcsp.eng.usf.edu/cognitive_radio_links.htm

### E-Text Books:

IOT AND APPLICATIONS

OE - III

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Contact Classes: 45   Tutorial Classes: Nil   Practical Classes: Nil   Total Classes: 45

OBJECTIVES:
The course should enable the students to:
I. Understand the architecture of Internet of Things and connected world.
II. Explore on use of various hardware and sensing technologies to build IoT applications.
III. Illustrate the real time IoT applications to make smart world.
IV. Understand the available cloud services and communication API’s for developing smart cities

MODULE -I  INTRODUCTION TO INTERNET OF THINGS (IoT)  Classes: 10

Definition and characteristics of IoT, physical design of IoT, logical design of IoT, IoT enabling technologies, IoT levels and deployment, domain specific IoTs.

MODULE -II  IoT AND M2M  Classes: 09

Introduction, M2M, difference between IoT and M2M, software defined networking (SDN) and network function virtualization (NFV) for IoT, basics of IoT system management with NETCONF-YANG.

MODULE -III  IOT ARCHITECTURE AND PYTHON  Classes: 08


MODULE -IV  IoT PHYSICAL DEVICES AND ENDPOINTS  Classes: 08

Introduction to Raspberry Pi interfaces (Serial, SPI, I2C), programming Raspberry PI with Python, other IoT devices.

MODULE -V  IoT PHYSICAL SERVERS AND CLOUD OFFERINGS  Classes: 10

Introduction to cloud storage models and communication APIs; WAMP: AutoBahn for IoT, Xively cloud for IoT; Case studies illustrating IoT design: Home automation, smart cities, smart environment.

Text Books:

Reference Books:
**Web References:**

2. [https://www.coursera.org/learn/iot.](https://www.coursera.org/learn/iot.)
3. [https://bcourses.berkeley.edu.](https://bcourses.berkeley.edu.)

**E-Text Books:**

1. [https://mitpress.mit.edu/books/internet-things](https://mitpress.mit.edu/books/internet-things)
2. [http://www.apress.com](http://www.apress.com)
INDUSTRIAL AUTOMATION AND CONTROL

OE - III

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<th>Course Code</th>
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Contact Classes: 45 Tutorial Classes: Nil Practical Classes: Nil Total Classes: 45

OBJECTIVES:
The course should enable the students to:
I. Learn the fundamental concepts about introduction to industrial automation and control and devices.
II. Study the performance of each system in detail along with practical case studies.
III. Develop various types of industrial automation and control and devices.
IV. Understand the process control of PLC automation.

MODULE I  INTRODUCTION TO INDUSTRIAL AUTOMATION AND CONTROL

Introduction to Industrial Automation and Control: Introduction to industrial automation and control architecture of industrial automation system, measurement systems specifications, temperature measurement, pressure and force measurement, displacement and speed measurement, signal conditioning circuits, errors and calibration.

MODULE II  PROCESS CONTROL

Process control: Introduction to process control, PID control, controller tuning, implementation of PID controllers, special control structures, feed forward and ratio control special control structures: predictive control, control of systems with inverse response.

MODULE III  PROGRAMMABLE LOGIC CONTROL SYSTEMS

Programmable logic control systems: introduction to sequence or logic control and programmable logic controllers, the software environment and programming of PLCs, formal modeling of sequence control specifications.

Programming, programming of PLCs: sequential function charts, the PLC hardware environment

MODULE IV  CNC MACHINES AND ACTUATORS

CNC machines and actuators: Introduction to computer numerically controlled machines, control valves, hydraulic actuation systems, principle and components, directional control valves, switches and gauges, industrial hydraulic circuits.

MODULE V  ELECTRICAL MACHINE DRIVES


Text Books:

**Reference Books:**

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<tr>
<th>Number</th>
<th>Author(s)</th>
<th>Title</th>
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</table>

**Web References:**

1. [https://www.google.co.in/search?q=INTRODUCTION+TO+INDUSTRIAL+AUTOMATION+AND+CONTROL&ie=utf-8&oe=utf-8&client=firefox-b-ab&gfe_rd=cr&ei=PUocWOXVL67v8weKwZngAw](https://www.google.co.in/search?q=INTRODUCTION+TO+INDUSTRIAL+AUTOMATION+AND+CONTROL&ie=utf-8&oe=utf-8&client=firefox-b-ab&gfe_rd=cr&ei=PUocWOXVL67v8weKwZngAw)
2. [https://www.noorropidah.files.wordpress.com/2012/01/plc-1-3.pdf](https://www.noorropidah.files.wordpress.com/2012/01/plc-1-3.pdf)

**E-Text Books:**

ARTIFICIAL NEURAL NETWORKS

OE - III

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Contact Classes: 45 | Tutorial Classes: Nil | Practical Classes: Nil | Total Classes: 45

OBJECTIVES:
The course should enable the students to:

I. Understand the biological neural network and to model equivalent neuron models
II. Realise the architecture, learning algorithm and issues of various feed forward and feedback neural networks.
III. Create different neural networks of various architectures both feed forward and feedback.
IV. Perform the training of neural networks using various learning rules.
V. Operate the testing of neural networks and do the perform analysis of these networks for various pattern recognition applications.

MODULE-I INTRODUCTION TO ANN

A Neural Network, Human Brain, Models of a Neuron, Neural Networks viewed as Directed Graphs, Network Architectures, Knowledge Representation, Artificial Intelligence and Neural Networks; Learning Process: Error Correction Learning, Memory Based Learning, Hebbian Learning, Competitive, Boltzmann Learning, Credit Assignment Problem, Memory, Adaption, Statistical Nature of the Learning Process

MODULE-II PERCEPTRON

Single Layer Perceptron: Adaptive Filtering Problem, Unconstrained Organization Techniques, Linear Least Square Filters, Least Mean Square Algorithm, Learning Curves, Learning Rate Annealing Techniques, Perceptron: convergence theorem, Relation Between Perceptron and Bayes Classifier for a Gaussian Environment; Multilayer Perceptron: Back Propagation Algorithm XOR Problem, Heuristics, Output, Representation and Decision Rule, Computer Experiment, Feature Detection

MODULE-III BACK PROPAGATION


Back Propagation Learning, Accelerated Convergence, Supervised Learning

MODULE-IV SELF-ORGANIZATION MAPS

Two Basic Feature Mapping Models, Self-Organization Map, SOM Algorithm, Properties of Feature Map, Computer Simulations, Learning Vector Quantization, Adaptive Patter Classification

MODULE-V DYNAMICAL SYSTEMS

Neuro Dynamics: Dynamical Systems, Stability of Equilibrium States, Attractors, Neuro Dynamical Models, Manipulation of Attractors as a Recurrent Network Paradigm Hopfield Models – Hopfield Models, Computer Experiment
**Text Books:**


**Reference Books:**

1. B. Yegnanarayana, “Artificial Neural Networks”, Prentice Hall of India Private Limited, 2005

**Web References:**


**E-Text Books:**

### COURSE OUTCOMES:

The course should enable the students to:

I. Gain advanced knowledge on role of power electronics for renewable energy.

II. Analyze the power conditioning schemes for grid connected systems.

III. Develop skills in designing wind, solar systems and their integration.

### MODULE- I 

**INTRODUCTION**

Classes: 10


Energy from Sun: Sun-earth Geometric Relationship, Layer of the Sun, Earth – Sun Angles and their Relationships, Solar Energy Reaching the Earth’s Surface, Solar Thermal Energy Applications

### MODULE- II 

**SOLAR SYSTEMS**

Classes: 10


### MODULE- III 

**HYDROGEN, WIND AND GEO-THERMAL SYSTEMS**

Classes: 09


**MODULE- IV  BIOMASS SYSTEMS**  


**MODULE- V  PV WATER PUMPING AND GRID INTERFACE**  


**Text Books:**


**Reference Books:**


**Web References:**

NPTEL video lectures.

**E-Text Books:**

SOFT SKILLS AND INTERPERSONAL COMMUNICATION

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OBJECTIVES:
The course should enable the students to:
I. Communicate in a comprehensible English accent and pronunciation.
II. Use the four language skills i.e., Listening, Speaking, Reading and Writing effectively.
III. Develop the art of interpersonal communication skills to avail the global opportunities
IV. Enhances the understanding of soft skills resulting in an overall grooming of the skills

MODULE-I  SOFT SKILLS  Classes: 09
Soft Skills: An Introduction – Definition and Significance of Soft Skills; Process, Importance and Application of Soft Skills, Discovering the Self; Setting Goals; Positivity and Motivation: Developing Positive Thinking and Attitude

MODULE -II EFFECTIVENESS OF SOFT SKILLS  Classes: 09
Developing interpersonal relationships through effective soft skills; Define Listening, Speaking, Reading and Writing skills; Barriers to Listening, Speaking, Reading and Writing; Essential formal writing skills; Public Speaking: Skills, Methods, Strategies and Essential tips for effective public speaking.

MODULE-III ORAL AND AURAL SKILLS  Classes: 09
Vocabulary:
Sounds of English vowels sounds and constant sounds, Word Accent and connected speech- contractions, questions tags, Listening for information, Taking notes while listening to lectures (use of Dictionary).

Group Discussion: Importance, Planning, Elements, Skills, Effectively disagreeing, Initiating.

MODULE-IV VERBAL AND NON-VERBAL COMMUNICATION  Classes: 09
Interpersonal communication-verbal and nonverbal etiquette; Body language, grapevine, Postures, Gestures, Facial expressions, Proximity; Conversation skills, Critical thinking, Teamwork, Group Discussion, Impact of Stress; Measurement and Management of Stress

MODULE-V INTERPERSONAL COMMUNICATION  Classes: 09
Significance; Effectiveness of writing; Organizing principles of Paragraphs in documents; Writing introduction and conclusion; Techniques for writing precisely; Letter writing; Formal and Informal letter writing; E-mail writing, Report Writing.

Text Books:
Handbook of English for Communication (Prepared by Faculty of English, IARE)
### Reference Books:


### Web References:

1. www.edufind.com
2. www.myenglishpages.com

### E-Text Books:

CYBER LAW AND ETHICS

OE - IV

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<th>Course Code</th>
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Contact Classes: 45 Tutorial Classes: Nil Practical Classes: Nil Total Classes: 45

OBJECTIVES:
The course should enable the students to:

I. Understand key terms and concepts in cyber society, cyber ethics.
II. Analyze fundamentals of Cyber Law
III. Learn the importance of nine P’s in ethics.
IV. Understand artificial intelligence and Blockchain ethics.

MODULE-I CYBER SOCIETY
Classes: 09

MODULE-II CYBER LAW AND CYBER ETHICS
Classes: 09
Cyber Law and Cyber Ethics: The Importance of Cyber Law, The Significance of Cyber Ethics, Cyber Crime is Unethical and Illegal, Ethics Education has Positive Impact, The Need for Cyber Regulation Based on Cyber Ethics, Very Dangerous Times.

MODULE-III ETHICS IN THE INFORMATION SOCIETY, THE NINE P’S
Classes: 09

MODULE-IV DISRUPTIVE CYBER TECHNOLOGIES AND AI ETHICS
Classes: 09
Disruptive Cyber Technologies and Ethics -I

MODULE-V DISRUPTIVE CYBER TECHNOLOGIES AND ETHICS -II
Classes: 09
Disruptive Cyber Technologies and Ethics -II
BLOCKCHAIN ETHICS:
Blockchain Definition and Description, Blockchain Anonymity and Privacy: Ethical, No Possibility to Be Forgotten, Blockchain for Voting, Blockchain for Transparent Trade Tracing, Blockchain Energy: Environmental Impact, Decentralised or Majority-Owned, Ethically More Benefits or Dangers, future jobs in cyber society.
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<th>Text Books:</th>
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<tr>
<th>Reference Books:</th>
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<tbody>
<tr>
<td>1. Dr. Farooq Ahmad, Cyber Law in India, Allahbad Law Agency- Faridabad.</td>
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<tr>
<td>2. J.P. Sharma, SunainaKanojia, Cyber Laws</td>
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<td>3. Harish Chander, Cyber Laws and IT Protection</td>
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ECONOMIC POLICIES IN INDIA

OE - IV

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Contact Classes: 45  Tutorial Classes: Nil  Practical Classes: Nil  Total Classes: 45

OBJECTIVES:
The course should enable the students to:
I. Introduce the economic development elements and its measures
II. Provide inside knowledge on monetary policy and its importance in economic development
III. Communicate the importance of fiscal policies in promoting the economy
IV. Explore the policies and practices in resource base infrastructure
V. Discuss the industrial and exit policies related to the industries

MODULE-I  INTRODUCTION  ECONOMIC DEVELOPMENT AND ITS DETERMINANTS  CLASSES: 09
Approaches to economic development and its measurement – sustainable development; Role of State, market and other institutions; Indicators of development – PQLI, Human Development Index (HDI), gender development indices.

MODULE-II  MONEY, BANKING AND PRICES  CLASSES: 09
Analysis of price behavior in India; Financial sector reforms; Interest rate policy; Review of monetary policy of RBI; Money and capital markets; Working of SEBI in India

MODULE-III  FISCAL POLICY AND PUBLIC FINANCES  CLASSES: 09
Fiscal federalism – Centre-State financial relations; Finances of central government; Finances of state governments; Parallel economy; Problems relating to fiscal policy; Fiscal sector reforms in India.

MODULE-IV  RESOURCE BASE AND INFRASTRUCTURE  CLASSES: 09
Energy; social infrastructure – education and health; Environment; Regional imbalance; Issues and policies in financing infrastructure development. Policies and Performance in Industry Growth; productivity; diversification; small scale industries; public sector; competition policy; foreign investment.

MODULE-V  THE INDUSTRIAL AND EXIT POLICIES  CLASSES: 09
Industrial policy; Public Sector enterprises and their performance; Problem of sick units in India; Privatization and disinvestment debate; Growth and pattern of industrialization; Small-scale sector; Productivity in industrial sector; Exit policy – issues in labour market reforms; approaches for employment generation

Text Books:
2. The Strength of Economic Development by Albert Hirschman.
3. Money, Banking and Public Finance by Dr. V.C.Sinha
### Reference Books:


### Web References:

GLOBAL WARMING AND CLIMATE CHANGE

<table>
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<tr>
<th>Course Code</th>
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Contact Classes: 45 Tutorial Classes: Nil Practical Classes: Nil Total Classes: 45

OBJECTIVES:
The course should enable the students to:

I. Understand the importance of Ozone layer in the atmosphere.
II. Comprehend composition of atmosphere.
III. Understand impacts of climate change on ecosystem.
IV. Understand initiatives taken by different countries to reduce emission of greenhouse gases.

MODULE - I  EARTH’S CLIMATE SYSTEM  Classes: 09

MODULE - II  ATMOSPHERE AND ITS COMPONENTS  Classes: 09

MODULE - III  IMPACTS OF CLIMATE CHANGE  Classes: 09
Causes of Climate change: Changes of Temperature in the environment, Melting of ice pole, sea level rise, Impacts of Climate Change on various sectors – Agriculture, Forestry and Ecosystem, Water Resources, Human Health, Industry, Settlement and Society.

Methods and Scenarios, Projected Impacts for different regions, Uncertainties in the projected impacts of Climate Change, Risk of Irreversible Changes.

MODULE - IV  OBSERVED CHANGES AND ITS CAUSES  Classes: 09

MODULE - V  CLIMATE CHANGE AND MITIGATION MEASURES  Classes: 09

Text Books:
**Reference Books:**


**E-Text Books:**

INTELLECTUAL PROPERTY RIGHTS

OE: IV

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Contact Classes: 45  Tutorial Classes: Nil  Practical Classes: Nil  Total Classes: 45

OBJECTIVES:
The course should enable the students to:
I. Gain knowledge in world trade organization and agreements between nations.
II. Safeguard the intellectual property with international trade agreements.
III. Understand types of intellectual property rights.
IV. Apply different laws in protection of intellectual property rights and its implementation.

MODULE- I  INTRODUCTION  Classes: 10
General agreement on tariffs and trade (GATT) eight rounds: Uruguay round, world trade organization: structure, technology transfer, dispute resolution mechanism, Doha declaration world trade organization agreements including trade related intellectual properties rights and trade related investment measures.

MODULE- II  WORLD INTELLECTUAL PROPERTY ORGANIZATION  Classes: 08
Paris convention, Bern convention, Budapest treaty, Madrid agreement, huge agreement.

MODULE- III  PATENTS  Classes: 09
Historical background of intellectual property rights, introduction, definition and classification of intellectual property, patents, patentable and non-patentable inventions. Legal requirements for patents, types of patent applications, patent document: specification and claims, important procedural aspects, management of intellectual property rights assets and intellectual property portfolio, commercial exploitation of intellectual property.

MODULE- IV  DESIGNS AND GEOGRAPHICAL INDICATIONS  Classes: 10
Designs: basic requirements, procedure, convention application term, date, geographical indication: definition, what can be registered, who can apply, rights, term, restrictions.

MODULE- V  TRADEMARK AND COPYRIGHTS  Classes: 08
Definition, classification of trademarks, classifications of goods and services, Vienna classification, trademarks procedure, trademarks enforcement: infringement and passing off, remedies, copyrights, term of copyrights, and procedure of copyright assignment of copyright, copyright infringement remedies.

Text Books:

Reference Books:
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<tr>
<td>2. <a href="http://Campus">http://Campus</a> guides.lib.utah.edu</td>
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ENTREPRENEURSHIP

OE - IV

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OBJECTIVES:
The course should enable the students to:
I. Understand the Entrepreneurial process and also inspire them to be Entrepreneurs.
II. Adopting of the key steps in the elaboration of business idea.
III. Understand the stages of the entrepreneurial process and the resources needed for the successful development of entrepreneurial ventures.

MODULE-I UNDERSTANDING ENTREPRENEURIAL MINDSET
Classes: 09

MODULE-II INDIVIDUAL ENTREPRENEURIAL MIND-SET AND PERSONALITY
Classes: 09

MODULE-III LAUNCHING ENTREPRENEURIAL VENTURES
Classes: 09
Opportunities identification- Finding gaps in the market place – techniques for generating ideas-entrepreneurial Imagination and Creativity- the nature of the creativity process - Innovation and entrepreneurship.

Methods to initiate Ventures- Creating new ventures-Acquiring an Established entrepreneurial venture- Franchising- advantage and disadvantages of Franchising.

MODULE-IV LEGAL CHALLENGES OF ENTREPRENEURSHIP
Classes: 09
Intellectual property protection - Patents, Copyrights - Trademarks and Trade secrets - Avoiding trademark pitfalls. Feasibility Analysis - Industry and competitor analysis - Formulation of the entrepreneurial Plan- The challenges of new venture start-ups, developing an effective business model – Sources of finance - Critical factors for new venture development - The Evaluation process

MODULE-V STRATEGIC PERSPECTIVES IN ENTREPRENEURSHIP -
Classes: 09
Strategic planning - Strategic actions strategic positioning- Business stabilization - Building the adaptive firms - Understanding the growth stage – Internal growth strategies and external growth strategies, Unique managerial concern of growing ventures. Initiatives by the Government of India to promote entrepreneurship, Social and women entrepreneurship.
### Text Books:


### Reference Books:

### ENVIRONMENTAL SCIENCES

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**Contact Classes:** Nil  
**Tutorial Classes:** Nil  
**Practical Classes:** Nil  
**Total Classes:** Nil

### COURSE OBJECTIVES:
The course should enable the students to:
I. Analyze the interrelationship between living organism and environment.
II. Understand the importance of environment by assessing its impact on the human world.
III. Enrich the knowledge on themes of biodiversity, natural resources, pollution control and waste management.
IV. Understand the constitutional protection given for environment.

### MODULE-I  ENVIRONMENT AND ECOSYSTEMS
Environment: Definition, scope and importance of environment, need for public awareness; Ecosystem: Definition, scope and importance of ecosystem, classification, structure and function of an ecosystem, food chains, food web and ecological pyramids, flow of energy; Biogeochemical cycles; Biomagnifications

### MODULE-II  NATURAL RESOURCES
Natural resources: Classification of resources, living and nonliving resources; Water resources: Use and over utilization of surface and ground water, floods and droughts, dams, benefits and problems; Mineral resources: Use and exploitation; Land resources; Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy source, case studies.

### MODULE-III  BIODIVERSITY AND BIOTIC RESOURCES
Biodiversity and biotic resources: Introduction, definition, genetic, species and ecosystem diversity; Value of biodiversity: Consumptive use, productive use, social, ethical, aesthetic and optional values; India as a mega diversity nation; Hot spots of biodiversity  
Threats to biodiversity: Habitat loss, poaching of wildlife, human-wildlife conflicts; Conservation of biodiversity: In situ and ex situ conservation; National biodiversity act.

### MODULE-IV  ENVIRONMENTAL POLLUTION, POLLUTION CONTROL TECHNOLOGIES AND GLOBAL ENVIRONMENTAL PROBLEMS
Environmental pollution: Definition, causes and effects of air pollution, water pollution, soil pollution, noise pollution; Solid waste: Municipal solid waste management, composition and characteristics of e-waste and its management; Pollution control technologies: Waste water treatment methods, primary, secondary and tertiary; Concepts of bioremediation; Global environmental problems and global efforts: Climate change, ozone depletion, ozone depleting substances, deforestation and desertification

### MODULE-V  ENVIRONMENTAL LEGISLATIONS AND SUSTAINABLE DEVELOPMENT
Environmental legislations: Environmental protection act, air act1981, water act, forest act, wild life act, municipal solid waste management and handling rules, biomedical waste management and handling rules2016, hazardous waste management and handling rules, Environmental impact assessment(EIA); Towards sustainable future: Concept of sustainable development, population and its explosion, crazy consumerism, environmental education, urban sprawl, concept of green building

**Text Books:**
**Reference Books:**


**Web References:**

1. https://www.tndte.com
2. https://www.nptel.ac.in/downloads
4. https://www.cuiet.info
5. https://www.sbtebihar.gov.in
6. https://www.ritchennai.org
### ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE

#### VII Semester: AE / CSE / IT / ECE / EEE / ME / CE

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Category</th>
<th>Hours / Week</th>
<th>Credits</th>
<th>Maximum Marks</th>
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<tr>
<td>AHSB17</td>
<td>Mandatory</td>
<td>L T P C</td>
<td>CIA</td>
<td>SEE Total</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- - - -</td>
<td>30</td>
<td>70 100</td>
</tr>
</tbody>
</table>

**Contact Classes: Nil**  
**Tutorial Classes: Nil**  
**Practical Classes: Nil**  
**Total Classes: Nil**

#### COURSE OBJECTIVES:
The course should enable the students to:

I. Understand the concept of Traditional knowledge and its importance
II. Know the need and importance of protecting traditional knowledge.
III. Know the various enactments related to the protection of traditional knowledge.
IV. Understand the concepts of Intellectual property to protect the traditional knowledge

#### MODULE-I  
**INTRODUCTION TO TRADITIONAL KNOWLEDGE**
Define traditional knowledge, nature and characteristics, scope and importance, kinds of traditional knowledge, the physical and social contexts in which traditional knowledge develop, the historical impact of social change on traditional knowledge systems. Indigenous Knowledge (IK), characteristics, traditional knowledge vis-à-vis indigenous knowledge, traditional knowledge vs western knowledge traditional knowledge vis-à-vis formal knowledge

#### MODULE-II  
**PROTECTION OF TRADITIONAL KNOWLEDGE**
Protection of traditional knowledge: The need for protecting traditional knowledge Significance of TK Protection, value of TK in global economy, Role of Government to harness TK.

#### MODULE-III  
**LEGAL FRAME WORK AND TK**
A: The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, Plant Varieties Protection and Farmer's Rights Act, 2001 (PPVFR Act);


#### MODULE-IV  
**TRADITIONAL KNOWLEDGE AND INTELLECTUAL PROPERTY**
Systems of traditional knowledge protection, Legal concepts for the protection of traditional knowledge, Certain non IPR mechanisms of traditional knowledge protection, Patents and traditional knowledge, Strategies to increase protection of traditional knowledge, global legal FORA for increasing protection of Indian Traditional Knowledge.

#### MODULE-V  
**TRADITIONAL KNOWLEDGE IN DIFFERENT SECTORS:**
Traditional knowledge and engineering, Traditional medicine system, TK and biotechnology, TK in agriculture, Traditional societies depend on it for their food and healthcare needs, Importance of conservation and sustainable development of environment, Management of biodiversity, Food security of the country and protection of TK. 139

#### Text Books:
2. Traditional Knowledge System and Technology in India by Basanta Kumar Mohanta and Vipin Kumar Singh Pratibha Prakashan 2012.

#### Reference Books:
2. "Knowledge Traditions and Practices of India" Kapil Kapoor1, Michel Danino2
VISION AND MISSION OF THE INSTITUTE

VISION
To bring forth professionally competent and socially sensitive engineers, capable of working across cultures meeting the global standards ethically.

MISSION
To provide students with an extensive and exceptional education that prepares them to excel in their profession, guided by dynamic intellectual community and be able to face the technically complex world with creative leadership qualities.

Further, be instrumental in emanating new knowledge through innovative research that emboldens entrepreneurship and economic development for the benefit of wide spread community.

B.TECH - PROGRAM OUTCOMES (POs)

PO-1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems (Engineering Knowledge).

PO-2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences (Problem Analysis).

PO-3: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations (Design/Development of Solutions).

PO-4: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions (Conduct Investigations of Complex Problems).

PO-5: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations (Modern Tool Usage).

PO-6: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice (The Engineer and Society).

PO-7: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development (Environment and Sustainability).

PO-8: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice (Ethics).

PO-9: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings (Individual and Team Work).

PO-10: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions (Communication).

PO-11: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments (Project management and finance).

PO-12: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change (Life-long learning).
OBJECTIVES OF THE DEPARTMENT

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

PROGRAM EDUCATIONAL OBJECTIVES (PEO’S)

A graduate of the Electrical and Electronics Engineering Program should:

PEO – I: To provide students with the knowledge of Basic Sciences in general and Electrical and electronics Engineering in particular so as to acquire the necessary skills for analysis and synthesis of problems in generation, transmission and distribution.

PEO – II: To provide technical knowledge and skills to identify, comprehend and solve complex tasks in industry and research and inspire the students to become future researchers / scientists with innovative ideas.

PEO – III: To prepare the students for successful employment in various Industrial and Government organizations, both at the National and International level, with professional competence and ethical administrative acumen so as to handle critical situations and meet deadlines.

PEO – IV: To train the students in basic human and technical communication skills so that they may be both good team-members, leaders and responsible citizen.

PROGRAM SPECIFIC OUTCOMES (PSO’s)

PSO – I: Able to utilize the knowledge of high voltage engineering in collaboration with power systems in innovative, dynamic and challenging environment, for the research based team work.

PSO – II: To explore the scientific theories, ideas, methodologies and the new cutting edge technologies in renewable energy engineering, and use this erudition in their professional development and gain sufficient competence to solve the current and future energy problems universally.

PSO – III: To be able to utilize of technologies like PLC, PMC, process controllers, transducers and HMI and design, install, test , maintain power systems and industrial applications.
FREQUENTLY ASKED QUESTIONS AND ANSWERS ABOUT AUTONOMY

1. Who grants Autonomy? UGC, Govt., AICTE or University
   In case of Colleges affiliated to a university and where statutes for grant of autonomy are ready, it is
   the respective University that finally grants autonomy but only after concurrence from the respective
   state Government as well as UGC. The State Government has its own powers to grant autonomy
directly to Govt. and Govt. aided Colleges.

2. Shall IARE award its own Degrees?
   No. Degree will be awarded by Jawaharlal Nehru Technological University, Hyderabad with a
   mention of the name IARE on the Degree Certificate.

3. What is the difference between a Deemed University and an Autonomy College?
   A Deemed University is fully autonomous to the extent of awarding its own Degree. A Deemed
   University is usually a Non-Affiliating version of a University and has similar responsibilities like
   any University. An Autonomous College enjoys Academic Autonomy alone. The University to which
   an autonomous college is affiliated will have checks on the performance of the autonomous college.

4. How will the Foreign Universities or other stake – holders know that we are an Autonomous
   College?
   Autonomous status, once declared, shall be accepted by all the stake holders. The Govt. of Telangana
   mentions autonomous status during the First Year admission procedure. Foreign Universities and
   Indian Industries will know our status through our website.

5. What is the change of Status for Students and Teachers if we become Autonomous?
   An autonomous college carries a prestigious image. Autonomy is actually earned out of our continued
   past efforts on academic performances, our capability of self- governance and the kind of quality
   education we offer.

6. Who will check whether the academic standard is maintained / improved after Autonomy? How
   will it be checked?
   There is a built in mechanism in the autonomous working for this purpose. An Internal Committee
called Academic Program Evaluation Committee, which will keep a watch on the academics and keep
its reports and recommendations every year. In addition the highest academic council also supervises
the academic matters. The standards of our question papers, the regularity of academic calendar,
attendance of students, speed and transparency of result declaration and such other parameters are
involved in this process.

7. Will the students of IARE as an Autonomous College qualify for University Medals and Prizes
   for academic excellence?
   No. IARE has instituted its own awards, medals, etc. for the academic performance of the students.
   However for all other events like sports, cultural on co-curricular organized by the University the
   students shall qualify.

8. Can IARE have its own Convocation?
   No. Since the University awards the Degree the Convocation will be that of the University, but there
   will be Graduation Day at IARE.

9. Can IARE give a provisional degree certificate?
   Since the examinations are conducted by IARE and the results are also declared by IARE, the college
   sends a list of successful candidates with their final Grades and Grade Point Averages including
   CGPA to the University. Therefore with the prior permission of the University the college will be
   entitled to give the provisional certificate.
10 Will Academic Autonomy make a positive impact on the Placements or Employability?  
Certainly. The number of students qualifying for placement interviews is expected to improve, due to rigorous and repetitive classroom teaching and continuous assessment. Also the autonomous status is more responsive to the needs of the industry. As a result therefore, there will be a lot of scope for industry oriented skill development built-in into the system. The graduates from an autonomous college will therefore represent better employability.

11 What is the proportion of Internal and External Assessment as an Autonomous College?  
Presently, it is 70% external and 30% internal. As the autonomy matures the internal assessment component shall be increased at the cost of external assessment.

12 Is it possible to have complete Internal Assessment for Theory or Practicals?  
Yes indeed. We define our own system. We have the freedom to keep the proportion of external and internal assessment component to choose.

13 Why Credit based Grade System?  
The credit based grade system is an accepted standard of academic performance the world over in all Universities. The acceptability of our graduates in the world market shall improve.

14 What exactly is a Credit based Grade System?  
The credit based grade system defines a much better statistical way of judging the academic performance. One Lecture Hour per week of Teaching Learning process is assigned One Credit. One hour of laboratory work is assigned half credit. Letter Grades like A, B,C,D, etc. are assigned for a Range of Marks. (e.g. 91% and above is A+, 80 to 90% could be A etc.) in Absolute Grading System while grades are awarded by statistical analysis in relative grading system. We thus dispense with sharp numerical boundaries. Secondly, the grades are associated with defined Grade Points in the scale of 1 to 10. Weighted Average of Grade Points is also defined Grade Points are weighted by Credits and averaged over total credits in a Semester. This process is repeated for all Semesters and a CGPA defines the Final Academic Performance.

15 What are the norms for the number of Credits per Semester and total number of Credits for UG/PG program?  
These norms are usually defined by UGC or AICTE. Usually around 25 Credits per semester is the accepted norm.

16 What is a Semester Grade Point Average (SGPA)?  
The performance of a student in a semester is indicated by a number called SGPA. The SGPA is the weighted average of the grade points obtained in all the courses registered by the student during the semester.

\[ SGPA = \frac{\sum_{i=1}^{n} (C_i \times G_i)}{\sum_{i=1}^{n} C_i} \]

Where, \(C_i\) is the number of credits of the \(i^{th}\) course and \(G_i\) is the grade point scored by the student in the \(i^{th}\) course and \(i\) represent the number of courses in which a student registered in the concerned semester. SGPA is rounded to two decimal places.

17 What is a Cumulative Grade Point Average (CGPA)?  
An up-to-date assessment of overall performance of a student from the time of his first registration is obtained by calculating a number called CGPA, which is weighted average of the grade points obtained in all the courses registered by the students since he entered the Institute.
Where,

\[ CGPA = \frac{\sum_{j=1}^{m} (C_j S_j)}{\sum_{j=1}^{m} C_j} \]

18 **Is there any Software available for calculating Grade point averages and converting the same into Grades?**

Yes, The institute has its own MIS software for calculation of SGPA, CGPA, etc.

19 **Will the teacher be required to do the job of calculating SGPAs etc. and convert the same into Grades?**

No. The teacher has to give marks obtained out of whatever maximum marks as it is. Rest is all done by the computer.

20 **Will there be any Revaluation or Re-Examination System?**

No. There will double valuation of answer scripts. There will be a make up Examination after a reasonable preparation time after the End Semester Examination for specific cases mentioned in the Rules and Regulations. In addition to this, there shall be a ‘summer term’ (compressed term) followed by the End Semester Exam, to save the precious time of students.

21 **How fast Syllabi can be and should be changed?**

Autonomy allows us the freedom to change the syllabi as often as we need.

22 **Will the Degree be awarded on the basis of only final year performance?**

No. The CGPA will reflect the average performance of all the semester taken together.

23 **What are Statutory Academic Bodies?**

Governing Body, Academic Council, Examination Committee and Board of Studies are the different statutory bodies. The participation of external members in every body is compulsory. The institute has nominated professors from IIT, NIT, University (the officers of the rank of Pro-vice Chancellor, Deans and Controller of Examinations) and also the reputed industrialist and industry experts on these bodies.

24 **Who takes Decisions on Academic matters?**

The Governing Body of institute is the top academic body and is responsible for all the academic decisions. Many decisions are also taken at the lower level like Boards of Studies. Decisions taken at the Boared of Studies level are to be ratified at the Academic Council and Governing Body.

25 **What is the role of Examination committee?**

The Examinations Committee is responsible for the smooth conduct of internal, End Semester and make up Examinations. All matters involving the conduct of examinations spot valuations, tabulations preparation of Grade Sheet etc fall within the duties of the Examination Committee.

26 **Is there any mechanism for Grievance Redressal?**

The institute has grievance redressal committee, headed by Dean - Student affairs and Dean - IQAC.

27 **How many attempts are permitted for obtaining a Degree?**

All such matters are defined in Rules & Regulation
28 **Who declares the result?**
The result declaration process is also defined. After tabulation work wherein the SGPA, CGPA and final Grades are ready, the entire result is reviewed by the Moderation Committee. Any unusual deviations or gross level discrepancies are deliberated and removed. The entire result is discussed in the Examinations and Result Committee for its approval. The result is then declared on the institute notice boards as well put on the web site and Students Corner. It is eventually sent to the University.

29 **Who will keep the Student Academic Records, University or IARE?**
It is the responsibility of the Dean, Academics of the Autonomous College to keep and preserve all the records.

30 **What is our relationship with the JNT University?**
We remain an affiliated college of the JNT University. The University has the right to nominate its members on the academic bodies of the college.

31 **Shall we require University approval if we want to start any New Courses?**
Yes, It is expected that approvals or such other matters from an autonomous college will receive priority.

32 **Shall we get autonomy for PG and Doctoral Programs also?**
Yes, presently our PG programs also enjoying autonomous status.
## MALPRACTICES RULES

### DISCIPLINARY ACTION FOR / IMPROPER CONDUCT IN EXAMINATIONS

<table>
<thead>
<tr>
<th>S.No</th>
<th>Nature of Malpractices/Improper conduct</th>
<th>Punishment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>If the candidate:</strong></td>
<td></td>
</tr>
<tr>
<td>1. (a)</td>
<td>Possesses or keeps accessible in examination hall, any paper, note book, programmable calculator, cell phone, pager, palm computer 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)</td>
<td>Expulsion from the examination hall and cancellation of the performance in that subject only.</td>
</tr>
<tr>
<td>(b)</td>
<td>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.</td>
<td>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.</td>
</tr>
<tr>
<td>2.</td>
<td>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.</td>
<td>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 Controller of Examinations.</td>
</tr>
<tr>
<td>3.</td>
<td>Impersonates any other candidate in connection with the examination.</td>
<td>The candidate who has impersonated shall be expelled from examination hall. The candidate is also debarred and forfeits the seat. The performance of the original candidate, who has been impersonated, shall be cancelled in all the subjects of the examination (including practicals and project work) already appeared and shall not be allowed to appear for examinations of the remaining subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all semester end 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.</td>
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<tr>
<td>4.</td>
<td>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.</td>
<td>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 semester end examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.</td>
</tr>
<tr>
<td>5.</td>
<td>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.</td>
<td>Cancellation of the performance in that subject.</td>
</tr>
<tr>
<td>6.</td>
<td>Refuses to obey the orders of the Controller of Examinations /Additional Controller of Examinations /any officer on duty or misbehaves or creates disturbance of any kind in and around the examination hall or organizes a walk out or instigates others to walk out, or threatens the COE or any person on duty in or outside the examination hall of any injury to his person or to any of his relations whether by words, either spoken or written or by signs or by visible representation, assaults the COE 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 Institute premises 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.</td>
<td>In case of students of the college, they shall be expelled from examination halls and cancellation of their performance in that subject and all other subjects the candidate(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the subjects of that semester/year. The candidates also are debarred and forfeit their seats. In case of outsiders, they will be handed over to the police and a police case is registered against them.</td>
</tr>
<tr>
<td>7.</td>
<td>Leaves the exam hall taking away answer script or intentionally tears off the script or any part thereof inside or outside the examination hall.</td>
<td>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 semester end examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.</td>
</tr>
<tr>
<td></td>
<td>Possess any lethal weapon or firearm in the examination hall.</td>
<td>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.</td>
</tr>
<tr>
<td>---</td>
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<tr>
<td>9.</td>
<td>If student of the college, who is not a candidate for the particular examination or any person not connected with the college indulges in any malpractice or improper conduct mentioned in clause 6 to 8.</td>
<td>Student of the college's expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat. Person(s) who do not belong to the College will be handed over to police and, a police case will be registered against them.</td>
</tr>
<tr>
<td>10.</td>
<td>Comes in a drunken condition to the examination hall.</td>
<td>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.</td>
</tr>
<tr>
<td>11.</td>
<td>Copying detected on the basis of internal evidence, such as, during valuation or during special scrutiny.</td>
<td>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.</td>
</tr>
<tr>
<td>12.</td>
<td>If any malpractice is detected which is not covered in the above clauses 1 to 11 shall be reported to the University for further action to award suitable punishment.</td>
<td></td>
</tr>
</tbody>
</table>
UNIVERSITY OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

UNDEARTANGING BY STUDENT / PARENT

“To make the students attend the classes regularly from the first day of starting of classes and be aware of the College regulations, the following Undertaking Form is introduced which should be signed by both student and parent. The same should be submitted to the Dean, Academic”.

I, Mr. / Ms. __________________________ joining I Semester / III Semester for the academic year 2018-2019 / 2019-2020 in Institute of Aeronautical Engineering, Hyderabad, do hereby undertake and abide by the following terms, and I will bring the ACKNOWLEDGEMENT duly signed by me and my parent and submit it to the Dean, Academic.

1. I will attend all the classes as per the timetable from the starting day of the semester specified in the institute Academic Calendar. In case, I do not turn up even after two weeks of starting of classes, I shall be ineligible to continue for the current academic year.
2. I will be regular and punctual to all the classes (theory/laboratory/project) and secure attendance of not less than 75% in every course as stipulated by Institute. I am fully aware that an attendance of less than 65% in more than 60% of theory courses in a semester will make me lose one year.
3. I will compulsorily follow the dress code prescribed by the college.
4. I will conduct myself in a highly disciplined and decent manner both inside the classroom and on campus, failing which suitable action may be taken against me as per the rules and regulations of the institute.
5. I will concentrate on my studies without wasting time in the Campus/Hostel/Residence and attend all the tests to secure more than the minimum prescribed Class/Sessional Marks in each course. I will submit the assignments given in time to improve my performance.
6. I will not use Mobile Phone in the institute premises and also, I will not involve in any form of ragging inside or outside the campus. I am fully aware that using mobile phone to the institute premises is not permissible and involving in Ragging is an offence and punishable as per JNTUH/UGC rules and the law.
7. I declare that I shall not indulge in ragging, eve-teasing, smoking, consuming alcohol drug abuse or any other anti-social activity in the college premises, hostel, on educational tours, industrial visits or elsewhere.
8. I will pay tuition fees, examination fees and any other dues within the stipulated time as required by the Institution / authorities, failing which I will not be permitted to attend the classes.
9. I will not cause or involve in any sort of violence or disturbance both within and outside the college campus.
10. If I absent myself continuously for 3 days, my parents will have to meet the HOD concerned/ Principal.
11. I hereby acknowledge that I have received a copy of IARE - R18 Academic Rules and Regulations, Syllabus copy and hence, I shall abide by all the rules specified in it.

ACKNOWLEDGEMENT

I have carefully gone through the terms of the undertaking mentioned above and I understand that following these are for my/his/her own benefit and improvement. I also understand that if I/he/she fail to comply with these terms, shall be liable for suitable action as per Institute/JNTUH/AICTE/UGC rules and the law. I undertake that I/he/she will strictly follow the above terms.

Signature of Student with Date
Signature of Parent with Date
Name & Address with Phone Number