INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

(Approved by AICTE | NAAC Accreditation with 'A' Grade | Accredited by NBA | Affiliated to JNTUH)

Dundigal, Hyderabad - 500 043, Telangana

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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"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

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

ACADEMIC REGULATIONS

B.Tech. Regular Four Year Degree Program
(for the batches admitted from the academic year 2018 - 19)
&
B.Tech. (Lateral Entry Scheme)
(for the batches admitted from the academic year 2019 - 20)

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 1: Academic Calendar

FIRST SEMESTER (21 weeks)	I Spell Instruction Period	8 weeks	19 weeks
	I Mid Examinations	1 week	
	II Spell Instruction Period	8 weeks	
	II Mid Examinations	1 week	
	Preparation and Practical Examinations	1 week	
	Semester End Examinations		2 weeks
Semester Break and Supplementary Exams			2 weeks
SECOND SEMESTER (21 weeks)	I Spell Instruction Period	8 weeks	19 weeks
	I Mid Examinations	1 week	
	II Spell Instruction Period	8 weeks	
	II Mid Examinations	1 week	
	Preparation & Practical Examinations	1 week	
	Semester End Examinations		2 weeks
Summer Vacation, Supplementary Semester and Remedial Exams			8 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. Student must complete the dropped subject by registering in the supplementary semester / forthcoming semester in order to earn the required credits. 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

S. No	Branch	Code
1	Aeronautical Engineering	AE
2	Computer Science and Engineering	CS
3	Information Technology	IT
4	Electronics and Communication Engineering	EC
5	Electrical and Electronics Engineering	EE
6	Mechanical Engineering	ME
7	Civil Engineering	CE

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

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

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

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

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:

50 %	To test the objectiveness of the concept
50 %	To test the analytical skill of the concept OR to test the application skill of the concept

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

COMPONENT	**THEORY**			**TOTAL MARKS**
Type of Assessment	CIE Exam	Quiz	AAT	
Max. CIA Marks	20	05	05	30

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 student's project activity is spread over in VII semester and in VIII semesters. A student shall carry out the project work under the supervision of a faculty member or in collaboration with an Industry, R&D organization or another academic institution/University where sufficient facilities exist to carry out the project work.

Project work (phase-I) starts in VII semester as it takes a vital role in campus hiring process. Students shall select project titles from their respective logins uploaded by the supervisors at the beginning of VII semester. Three reviews are conducted by department review committee (DRC) for 10 marks each. Student must submit a project report summarizing the work done up to design phase/prototype by the end of VII semester. The semester end examination for project work (phase-I) is evaluated based on the project 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.

Project Work (phase-II) starts in VIII semester, shall be evaluated for 100 marks out of which 30 marks towards continuous internal assessment and 70 marks for semester end examination. Three reviews are to be conducted by DRC on the progress of the project for 30 marks. The semester end examination shall be based on the final 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 atleast 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)

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

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,

$$SGPA = \sum_{i=1}^{n} (C_i G_i) / \sum_{i=1}^{n} C_i$$

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 n represent the number of courses in which a student is registered in the concerned semester.

$$CGPA = \sum_{j=1}^{m} (C_j S_j) / \sum_{j=1}^{m} C_j$$

Where, S_j is the SGPA of the j^{th} semester and C_j is the total number of credits upto the semester and m represent the number of semesters completed in which a student registered upto 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

Course Name	Course Credits	Grade letter	Grade point	Credit Point (Credit x Grade)
Course 1	3	A	8	3 x 8 = 24
Course 2	4	B+	7	4 x 7 = 28
Course 3	3	B	6	3 x 6 = 18
Course 4	3	S	10	3 x 10 = 30
Course 5	3	C	5	3 x 5 = 15
Course 6	4	B	6	4 x 6 = 24
	20			**139**

$$Thus,\ SGPA = 139 / 20 = 6.95$$

16.2 Illustration for CGPA

Semester 1	Semester 2	Semester 3	Semester 4
Credit: 20 SGPA: 6.9	Credit: 22 SGPA: 7.8	Credit: 25 SGPA: 5.6	Credit: 26 SGPA: 6.0
Semester 5	**Semester 6**		
Credit: 26 SGPA: 6.3	Credit: 25 SGPA: 8.0		

$$Thus,\ CGPA = \frac{20x6.9 + 22x7.8 + 25x5.6 + 26x6.0 + 26x6.3 + 25x8.0}{144} = 6.73$$

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) upto 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 5.0, 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 5.0, 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:

CGPA ≥ 8.0	CGPA ≥ 6.5 and < 8.0	CGPA ≥ 5.5 and < 6.5	CGPA ≥ 5.0 and < 5.5	CGPA < 5.0
First Class with Distinction	**First Class**	**Second Class**	**Pass Class**	**Fail**

21.2 A student with final CGPA (at the end of the under graduate programme) ≥8.00, and fulfilling the following conditions - shall be placed in '**first class with distinction'**. However,

(a) Should have passed all the courses in '**first appearance'** within the first 4 academic years (or 8 sequential semesters) from the date of commencement of first year first semester.

(b) Should have secured a CGPA ≥8.00, at the end of each of the 8 sequential semesters, starting from I year I semester onwards.

(c) Should not have been detained or prevented from writing the semester end examinations in any semester due to shortage of attendance or any other reason.

A student not fulfilling any of the above conditions with final CGPA >8 shall be placed in **'first class'.**

21.3 Students with final CGPA (at the end of the B.Tech program) ≥6.50 but <8.00 shall be placed in **'first class'.**

21.4 Students with final CGPA (at the end of the B.Tech program) ≥5.50 but <6.50, shall be placed in '**second class'**.

21.5 All other students who qualify for the award of the degree (as per item 19), with final CGPA (at the end of the B.Tech program) ≥5.0 but <5.50, shall be placed in '**pass class**'.

21.6 A student with final CGPA (at the end of the B.Tech program) < 5.00 will not be eligible for the award of the degree.

21.7 Students fulfilling the conditions listed under item 21.2 alone will be eligible for award of '**Gold Medal**'.

21.8 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.

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.

21 B.TECH WITH HONOURS OR ADDITIONAL MINORS IN ENGINEERING

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:

S. No	Department	Honours scheme
1	Aeronautical Engineering	Aerospace Engineering / Space Science etc.
2	Computer Science and Engineering / Information Technology	Big data and Analytics / Cyber Physical Systems, Information Security / Cognitive Science / Internet of Things (IoT) etc.
3	Electronics and Communication Engineering	Digital Communication / Signal Processing / Communication Networks / VLSI Design / Embedded Systems etc.
4	Electrical and Electronics Engineering	Renewable Energy systems / Energy and Sustainability / IoT Applications in Green Energy Systems etc.
5	Mechanical Engineering	Industrial Automation and Robotics / Manufacturing Sciences and Computation Techniques etc.
6	Civil Engineering	Structural Engineering / Environmental Engineering etc.

21.2 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 first 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

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE STRUCTURE

I SEMESTER

Course Code	Course Name	Subject Area	Category	Periods per week			Credits	Scheme of Examination Max. Marks		
				L	T	P		CIA	SEE	Total
THEORY										
AHSB01	English	HSMC	Foundation	2	0	0	2	30	70	100
AHSB02	Linear Algebra and Calculus	BSC	Foundation	3	1	0	4	30	70	100
AHSB03	Engineering Chemistry	BSC	Foundation	3	1	0	4	30	70	100
PRACTICAL										
AHSB08	English Language and Communication Skills Laboratory	HSMC	Foundation	0	0	2	1	30	70	100
AHSB09	Engineering Chemistry Laboratory	BSC	Foundation	0	0	3	1.5	30	70	100
AMEB02	Engineering Graphics and Design Laboratory	ESC	Foundation	1	0	4	3	30	70	100
TOTAL				**09**	**02**	**09**	**15.5**	**180**	**420**	**600**

II SEMESTER

Course Code	Course Name	Subject Area	Category	Periods per week			Credits	Scheme of Examination Max. Marks		
				L	T	P		CIA	SEE	Total
THEORY										
AHSB11	Mathematical Transform Techniques	BSC	Foundation	3	1	0	4	30	70	100
AHSB04	Waves and Optics	BSC	Foundation	3	1	0	4	30	70	100
ACSB01	Programming for Problem Solving	ESC	Foundation	3	0	0	3	30	70	100
AEEB03	Electrical Circuits	ESC	Foundation	3	1	0	4	30	70	100
PRACTICAL										
ACSB02	Programming for Problem solving Laboratory	ESC	Foundation	0	0	4	2	30	70	100
AHSB10	Engineering Physics Laboratory	BSC	Foundation	0	0	3	1.5	30	70	100
AEEB07	Electrical Circuits Laboratory	ESC	Foundation	0	0	3	1.5	30	70	100
AMEB01	Workshop / Manufacturing Practices Laboratory	ESC	Foundation	0	0	3	1.5	30	70	100
TOTAL				**12**	**03**	**13**	**21.5**	**240**	**560**	**800**

III SEMESTER

Course Code	Course Name	Subject Area	Category	Periods per week			Credits	Scheme of Examination Max. Marks		
				L	T	P		CIA	SEE	Total
THEORY										
AEEB09	Network Analysis	PCC	Core	3	0	0	3	30	70	100
AEEB10	Electromagnetic Fields	PCC	Core	3	1	0	4	30	70	100
AECB02	Analog Electronics	PCC	Core	3	1	0	4	30	70	100
AECB03	Digital Electronics	PCC	Core	3	0	0	3	30	70	100
AEEB11	Electrical Machines – I	PCC	Core	3	1	0	4	30	70	100
PRACTICALS										
AEEB12	Network Analysis Laboratory	PCC	Core	0	0	2	1	30	70	100
AECB04	Analog and Digital Electronics Laboratory	PCC	Core	0	0	3	1.5	30	70	100
AEEB13	Electrical Machines Laboratory - I	PCC	Core	0	0	3	1.5	30	70	100
TOTAL				**15**	**03**	**08**	**22**	**240**	**560**	**800**

IV SEMESTER

Course Code	Course Name	Subject Area	Category	Periods per week			Credits	Scheme of Examination Max. Marks		
				L	T	P		CIA	SEE	Total
THEORY										
AHSB06	Complex Analysis and Probability Distributions	PCC	Core	3	0	0	3	30	70	100
AEEB14	Electrical Power Generation Systems	PCC	Core	3	1	0	4	30	70	100
AEEB15	Electrical Machines – II	PCC	Core	3	1	0	4	30	70	100
AEEB16	Control Systems	PCC	Core	3	1	0	4	30	70	100
ACSB03	Data Structures	PCC	Core	3	0	0	3	30	70	100
AHSB07	Environmental Sciences	MC-I	---	0	0	0	0	30	70	100
PRACTICALS										
AEEB17	Electrical Machines Laboratory - II	PCC	Core	0	0	3	1.5	30	70	100
AEEB18	Control Systems Laboratory	PCC	Core	0	0	2	1	30	70	100
ACSB05	Data Structures Laboratory	PCC	Core	0	0	3	1.5	30	70	100
	TOTAL			**15**	**03**	**08**	**22**	**270**	**630**	**900**

V SEMESTER

Course Code	Course Name	Subject Area	Category	Periods per week			Credits	Scheme of Examination Max. Marks		
				L	T	P		CIA	SEE	Total
THEORY										
AEEB19	Electrical Power Transmission Systems	PCC	Core	2	1	0	3	30	70	100
AEEB20	Power Electronics	PCC	Core	2	1	0	3	30	70	100
AECB24	Microprocessors and Microcontrollers	PCC	Core	3	0	0	3	30	70	100
AHSB14	Business Economics and Financial Analysis	HSMC	Core	3	0	0	3	30	70	100
	Professional Elective - I	PEC	Elective	3	0	0	3	30	70	100
	Open Elective -I	OEC	Elective	3	0	0	3	30	70	100
AHSB15	Project Based Learning (Prototype / Design Building)	PCC	Core	2	0	0	2	30	70	100
PRACTICALS										
AEEB21	Power Electronics Laboratory	PCC	Core	0	0	2	1	30	70	100
AECB26	Microprocessors and Microcontrollers Laboratory	PCC	Core	0	0	2	1	30	70	100
TOTAL				**18**	**02**	**04**	**22**	**270**	**630**	**900**

VI SEMESTER

Course Code	Course Name	Subject Area	Category	Periods per week			Credits	Scheme of Examination Max. Marks		
				L	T	P		CIA	SEE	Total
THEORY										
AEEB22	Power System Analysis	PCC	Core	2	1	0	3	30	70	100
AEEB23	Electric Drives and Static Control	PCC	Core	2	1	0	3	30	70	100
AEEB24	Electrical Measurements and Instrumentation	PCC	Core	3	0	0	3	30	70	100
	Professional Elective - II	PEC	Elective	3	0	0	3	30	70	100
	Professional Elective - III	PEC	Elective	3	0	0	3	30	70	100
	Open Elective - II	OEC	Elective	3	0	0	3	30	70	100
AHSB16	Research Based Learning (Fabrication / Model Development)	PCC	Core	2	0	0	2	30	70	100
PRACTICALS										
AEEB25	Electrical Measurements and Instrumentation Laboratory	PCC	Core	0	0	2	1	30	70	100
AEEB26	PLC and Industrial Automation Laboratory	PCC	Core	0	0	2	1	30	70	100
TOTAL				**18**	**02**	**04**	**22**	**270**	**630**	**900**

VII SEMESTER

Course Code	Course Name	Subject Area	Category	Periods per week			Credits	Scheme of Examination Max. Marks		
				L	T	P		CIA	SEE	Total
THEORY										
AEEB27	Power System Protection	PCC	Core	3	0	0	3	30	70	100
AEEB28	Power System Operation and Control	PCC	Core	3	0	0	3	30	70	100
	Professional Elective - IV	PEC	Elective	3	0	0	3	30	70	100
	Professional Elective - V	PEC	Elective	3	0	0	3	30	70	100
	Open Elective - III	OEC	Elective	3	0	0	3	30	70	100
AHSB17	Essence of Indian Traditional Knowledge	MC-II	----	0	0	0	0	30	70	100
PRACTICALS										
AEEB29	Electrical Power Systems Laboratory	PCC	Core	0	0	3	1.5	30	70	100
AEEB30	Power System Simulation Laboratory	PCC	Core	0	0	3	1.5	30	70	100
AEEB61	Project Work (phase - I)	PROJ	Project	0	0	10	5	30	70	100
TOTAL				**15**	**00**	**16**	**23**	**270**	**630**	**900**

VIII SEMESTER

Course Code	Course Name	Subject Area	Category	Periods per week			Credits	Scheme of Examination Max. Marks		
				L	T	P		CIA	SEE	Total
THEORY										
	Professional Elective - VI	PEC	Elective	3	0	0	3	30	70	100
	Open Elective - IV	OEC	Elective	3	0	0	3	30	70	100
PRACTICALS										
AEEB62	Project Work (phase – II) / Full Semester Internship	PROJ	Project	0	0	12	6	30	70	100
TOTAL				**06**	**00**	**12**	**12**	**90**	**210**	**300**

PROFESSIONAL ELECTIVES COURSES

Professional Elective – I: ELECTRICAL ENGINEERING

Course Code	Course Title
AEEB31	Electrical Machine Design
AEEB32	Computational Electromagnetics
AEEB33	Special Electrical Machines
AEEB34	Electrical Energy Conservation and Auditing

Professional Elective – II: SYSTEMS AND CONTROL

Course Code	Course Title
AEEB35	Digital Control Systems
AECB63	Principles of Signals and Systems
AEEB37	Control Systems Design
AEEB38	Linear System Analysis

Professional Elective – III: STABILITY STUDIES

Course Code	Course Title
AEEB39	Power System Stability
AEEB40	Power System Dynamics and Control
AEEB41	Electrical Safety and Safety Management
AEEB42	Real Time Control of Power Systems

Professional Elective – IV: GENERATION AND TRANSMISSION

Course Code	Course Title
AEEB43	HVDC Transmission
AEEB44	EHVAC Transmission
AEEB45	Power Electronics in Renewable Energy Systems
AEEB46	Wind and Solar Energy Systems

Professional Elective – V: ADVANCED POWER SYSTEMS

Course Code	Course Title
AEEB47	High Voltage Engineering
AEEB48	Energy Storage Systems
AEEB49	Power Quality and FACTS
AEEB50	Switch Mode Power Supplies

Professional Elective – VI: POWER SYSTEMS AND CONTROL

Course Code	Course Title
AEEB51	Utilization of Electric Power
AEEB52	Industrial Electrical Systems
AEEB53	Smart Grid Technology
AEEB54	Electrical and Hybrid Vehicles

OPEN ELECTIVE - I

Course	Course Title
ACSB32	Computer Architecture
ACSB33	Analysis of Algorithms and Design
ACSB34	Relational Database Management Systems
AITB30	Advanced Data Structures
AITB31	Data Communications and Networks
AITB32	Network Security

OPEN ELECTIVES – II

Course	Course Title
ACEB52	Energy from Waste
ACEB53	Disaster Management
AAEB55	Elements of Aeronautics
AAEB28	Aviation Management
AMEB56	Introduction to Robotics
AMEB57	Rapid Prototyping

OPEN ELECTIVE - III

Course	Course Title
AECB58	Embedded Systems
AECB59	Cognitive Radio
AECB60	IoT and Applications
AEEB58	Industrial Automation and Control
AEEB59	Artificial Neural Networks
AEEB60	Renewable Energy Sources

OPEN ELECTIVE - IV

Course	Course Title
AHSB18	Soft Skills and Interpersonal Communication
AHSB19	Cyber Law and Ethics
AHSB20	Economic Policies in India
AHSB21	Global Warming and Climate Change
AHSB22	Intellectual Property Rights
AHSB23	Entrepreneurship

MANDATORY COURSES

Course Code	Course
AHSB07	Environmental Sciences
AHSB17	Essence of Indian Traditional Knowledge
AHSB24	Gender Sensitivity

SYLLABUS

ENGLISH

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

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AHSB01	Foundation	2	0	0	2	30	70	100
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 LISTENIG 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:

1. Sanjay Kumar and Pushp Lata. "Communications Skills". Oxford University Press. 2011.
2. Michael Swan. "Practical English Usage", Oxford University Press, 1995.
3. F.T. Wood. "Remedial English Grammar", Macmillan. 2007.
4. William Zinsser. "On Writing Well". Harper Resource Book, 2001.
5. Raymond Murphy, "Essential English Grammar with Answers", Cambridge University Press, 2nd Edition.

Web References:

1. www.edufind.com
2. www.myenglishpages.com
3. http://grammar.ccc.comment.edu
4. http://owl.english.prudue.edu

E-Text Books:

1. http://bookboon.com/en/communication-ebooks-zip
2. http://www.bloomsbury-international.com/images/ezone/ebook/writing-skills-pdf.pdf
3. https://americanenglish.state.gov/files/ae/resource_files/developing_writing.pdf
4. http://learningenglishvocabularygrammar.com/files/idiomsandphraseswithmeaningsandexamplespdf.pdf
5. http://www.robinwood.com/Democracy/General Essays/CriticalThinking.pdf

LINEAR ALGEBRA AND CALCULUS

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

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AHSB02	Foundation	3	1	-	4	30	70	100
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 $f(x) = e^{ax}, \sin ax, \cos ax$ and $f(x) = x^n, e^{ax}v(x), xv(x)$; 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	Classes: 09

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:

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 36th Edition, 2010.
2. N.P. Bali and Manish Goyal, "A Text Book of Engineering Mathematics", Laxmi Publications, Reprint, 2008.
3. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill New Delhi, 11th Reprint, 2010.

Reference Books:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", 9th Edition, John Wiley & Sons, 2006.
2. Veerarajan T., "Engineering Mathematics" for first year, Tata McGraw-Hill, New Delhi, 2008.
3. D. Poole, "Linear Algebra A Modern Introduction", 2nd Edition, Brooks/Cole, 2005.
4. Dr. M Anita, "Engineering Mathematics-I", Everest Publishing House, Pune, First Edition, 2016.

Web References:

1. http://www.efunda.com/math/math_home/math.cfm
2. http://www.ocw.mit.edu/resources/#Mathematics
3. http://www.sosmath.com/
4. http://www.mathworld.wolfram.com/

E-Text Books:

1. http://www.e-booksdirectory.com/details.php?ebook=10166
2. http://www.e-booksdirectory.com/details.php?ebook=7400re

ENGINEERING CHEMISTRY

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

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AHSB03	Foundation	3	1	0	4	30	70	100
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.

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.

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 N_2, O_2,F_2 ,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 SN^1, SN^2 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 $KMnO_4$ and chromicacid; Reduction reactions: Reduction of carbonyl compounds using $LiAlH_4$ & $NaBH_4$; 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:

1. P. C. Jain, Monica Jain, "Engineering Chemistry", Dhanpat Rai Publishing Company, 16th Edition, 2017.
2. Shasi Chawla, "Text Book of Engineering Chemistry", Dhantpat Rai Publishing Company, New Delhi, 2017.
2. R.T. Morrison, RN Boyd and SK Bhattacharya "Organic Chemistry", Pearson, 7th Edition, 2011.
3. K.F. Purcell and J.C. Kotz, "Inorganic Chemistry", Cengage learning, 2017.

Reference Books:

1. K.P.C. Volhardt and N. E. Schore, "Organic Chemistry Structure and Functions", Oxford Publications, 7th Edition.
2. B. H. Mahan, "University Chemistry", Narosa Publishers, 4th Edition, 2009.

Web References:

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

ENGLISH LANGUAGE AND COMMUNICATION SKILLS LABORATORY

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

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AHSB08	Foundation	-	-	2	1	30	70	100
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-l	**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.

Week-6	**READING SKILL**
a. Intonation. b. Reading newspaper and magazine articles; Reading selective autobiographies for critical commentary.	
Week-7	**READING SKILL**
a. Improving pronunciation through tongue twisters. b. Reading advertisements, pamphlets; Reading comprehension exercises with critical and analytical questions based on context.	
Week-8	**WRITING SKILL**
a. Listening to inspirational short stories. b. Writing messages, leaflets, Notice; Writing tasks; Flashcards – Exercises.	
Week-9	**WRITING SKILL**
a. Write the review on a video clipping of short duration (5 to 10minutes). b. Write a slogan related to the image; Write a short story of 6-10 lines based on the hints given.	
Week-10	**WRITING SKILL**
a. Minimizing Mother Tongue Influence to improve fluency through watching educational videos. b. Writing practices – précis writing; Essay writing.	
Week-11	**THINKING SKILL**
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.	
Week-12	**THINKING SKILL**
a. Correcting common errors in day to day conversations. b. Making pictures and improvising diagrams to form English words, phrases and proverbs.	
Reference Books:	
1. Meenakshi Raman, Sangeetha Sharma, "Technical Communication Principles and Practices", Oxford University Press, New Delhi, 3rd Edition, 2015. 2. Rhirdion, Daniel, "Technical Communication", Cengage Learning, New Delhi, 1st Edition, 2009.	
Web References:	
1. http://learnenglish.britishcouncil.org 2. http://www.esl-lab.com/ 3. http://www.elllo.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

Course Code	Category	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AHSB09	Foundation	0	0	3	1.5	30	70	100
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-l	**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:

1. Vogel's, "Quantitative Chemical Analysis", Prentice Hall, 6th Edition, 2000.
2. Gary D. Christian, "Analytical Chemistry", Wiley India, 6th Edition, 2007.

Web References:

http://www.iare.ac.in

LIST OF EQUIPMENT REQUIRED FOR A BATCH OF 30 STUDENTS:

S. No	Name of the Apparatus	Apparatus Required	Quantity
1	Analytical balance	04	100 gm
2	Beaker	30	100 ml
3	Burette	30	50 ml
4	Burette Stand	30	Metal
5	Clamps with Boss heads	30	Metal
6	Conical Flask	30	250 ml
7	Conductivity cell	10	K=1
8	Calomel electrode	10	Glass
9	Digital Potentiometer	10	EI
10	Digital Conductivity meter	10	EI
11	Digital electronic balance	01	RI
12	Distilled water bottle	30	500 ml

13	Funnel	30	Small
14	Glass rods	30	20 cm length
15	Measuring Cylinders	10	10 ml
16	Oswald Viscometer	30	Glass
17	Pipette	30	20 ml
18	Platinum Electrode	10	PP
19	Porcelain Tiles	30	White
20	Reagent bottle	30	250 ml
21	Standard Flask	30	100 ml
22	Stalagmo meter	30	Glass
23	TLC Plates	40	--
24	UV Chamber	02	--

ENGINEERING GRAPHICS AND DESIGN LABORATORY

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

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AMEB02	Foundation	1	0	4	3	30	70	100
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-Plain, Diagonal and Vernier 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 ofPrism, 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:

1. N. D. Bhatt (2012), "Engineering Drawing", Charotar Publications, New Delhi, 49th Edition, 2010.
2. C.M. Agarwal, Basant Agarwal, "Engineering Drawing", Tata McGrawHill, 2nd Edition, 2013.

Reference Books:

1. K. Venugopal, "Engineering Drawing and Graphics". New Age Publications, 2nd Edition, 2010.
2. Dhananjay. A. Johle, "Engineering Drawing", Tata McGraw Hill, 1st Edition, 2008.
3. S.Trymbaka Murthy, "Computer Aided Engineering Drawing", I.K. International Publishers, 3rd Edition, 2011.
4. A. K. Sarkar, A.P Rastogi, "Engineering graphics with Auto CAD", PHI Learning, 1st Edition, 2010.

Web References:

1. http://nptel.ac.in/courses/112103019
2. http://www.autocadtutorials.net/
3. http://gradcab.com/questions/tutorial-16-for -beginner-engineering-drawing-I

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**

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AHSB11	Foundation	3	1	-	4	30	70	100
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:

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 36th Edition, 2010.
2. N.P. Bali and Manish Goyal, "A Text Book of Engineering Mathematics", Laxmi Publications, Reprint, 2008.
3. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill New Delhi, 11th Reprint, 2010.

Reference Books:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", 9th Edition, John Wiley & Sons, 2006.
2. Veerarajan T., "Engineering Mathematics" for first year, Tata McGraw-Hill, New Delhi, 2008.
3. D. Poole, "Linear Algebra A Modern Introduction", 2nd Edition, Brooks/Cole, 2005.
4. Dr. M Anita, "Engineering Mathematics-I", Everest Publishing House, Pune, First Edition, 2016.

Web References:

1. http://www.efunda.com/math/math_home/math.cfm
2. http://www.ocw.mit.edu/resources/#Mathematics
3. http://www.sosmath.com/
4. http://www.mathworld.wolfram.com/

E-Text Books:

1. http://www.e-booksdirectory.com/details.php?ebook=10166
2. http://www.e-booksdirectory.com/details.php?ebook=7400re

WAVES AND OPTICS

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

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AHSB04	Foundation	3	1	0	4	30	70	100
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, Davisson 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:

1. Dr. K Vijay Kumar and Dr. S Chandralingam, "Modern Engineering Physics" Volume-1&2, S Chand.Co, 2018.
2. I. G. Main, "Vibrations and Waves in Physics", Cambridge University Press, 1993.
3. R. K. Gaur, S. L. Gupta, "Engineering Physics", Dhanpat Rai Publications, 8th Edition, 2001.

Reference Books:

1. H.J. Pain, "The Physics of Vibrations and Waves", Wiley, 2006.
2. A. Ghatak, "Optics", McGraw Hill Education, 2012.
3. O. Svelto, "Principles of Lasers", Springer Science & Business Media, 2010.

Web References:

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

E-Text Books:

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

PROGRAMMING FOR PROBLEM SOLVING

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

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
ACSB01	Foundation	3	0	0	3	30	70	100
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

MODULE - V	FILE HANDLING AND BASICALGORITHMS	Classes: 08

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).

Text Books:

1. Byron Gottfried, "Programming with C", Schaum's Outlines Series, McGraw Hill Education, 3rd Edition, 2017.
2. E. Balagurusamy, "Programming in ANSI C", McGraw Hill Education, 6th Edition, 2012.

Reference Books:

1. W. Kernighan Brian, Dennis M. Ritchie, "The C Programming Language", PHI Learning, 2nd Edition, 1988.
2. Yashavant Kanetkar, "Exploring C", BPB Publishers, 2nd Edition, 2003.
3. Schildt Herbert, "C: The Complete Reference", Tata McGraw Hill Education, 4th Edition, 2014.
4. R. S. Bichkar, "Programming with C", Universities Press, 2nd Edition, 2012.
5. Dey Pradeep, Manas Ghosh, "Computer Fundamentals and Programming in C", Oxford University Press, 2nd Edition, 2006.
6. Stephen G. Kochan, "Programming in C", Addison-Wesley Professional, 4th Edition, 2014.

Web References:

1. https://www.bfoit.org/itp/Programming.html
2. https://www.khanacademy.org/computing/computer-programming
3. https://www.edx.org/course/programming-basics-iitbombayx-cs101-1x-0
4. https://www.edx.org/course/introduction-computer-science-harvardx-cs50x

E-Text Books:

1. http://www.freebookcentre.net/Language/Free-C-Programming-Books-Download.htm
2. http://www.imada.sdu.dk/~svalle/courses/dm14-2005/mirror/c/
3. http://www.enggnotebook.weebly.com/uploads/2/2/7/1/22718186/ge6151-notes.pdf

MOOC Course

1. https://www.alison.com/courses/Introduction-to-Programming-in-c
2. http://www.ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-s096-effective-programming-in-c-and-c-january-iap-2014/index.htm

ELCTRICAL CIRCUITS

II Semester: EEE / ECE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AEEB03	Foundation	3	1	0	4	30	70	100
Contact Classes: 45	Tutorial Classes: 15	Practical Classes: Nil				Total Classes: 60		

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

Magnetic circuits: Faraday's laws of electromagnetic induction, concept of self and mutual inductance, dot convention, coefficient of coupling, composite magnetic circuit, analysis of series and parallel magnetic circuits.

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:

1. A Sudhakar, Shyammohan S Palli, “Circuits and Networks”, Tata McGraw-Hill, 4th Edition, 2010.
2. M E Van Valkenberg, “Network Analysis”, PHI, 3rd Edition, 2014.

Reference Books:

1. John Bird, “Electrical Circuit Theory and Technology”, Newnes, 2nd Edition, 2003.
2. C L Wadhwa, “Electrical Circuit Analysis including Passive Network Synthesis”, New Age International, 2nd Edition, 2009.
3. David A Bell, “Electric circuits”, Oxford University Press, 7th Edition, 2009.
4. E Hughes, “Electrical and Electronics Technology”, Pearson Education, 2010.
5. A Chakrabarthy, “Electric Circuits”, Dhanipat Rai & Sons, 6th Edition, 2010.
6. V D Toro, “Electrical Engineering Fundamentals”, Prentice Hall India, 1989.

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:

1. https://www.bookboon.com/en/concepts-in-electric-circuits-ebook
2. https://www.www.jntubook.com
3. https://www.allaboutcircuits.com
4. https://www.archive.org

PROGRAMMING FOR PROBLEM SOLVING LABORATORY

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

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
ACSB02	Foundation	0	0	4	2	30	70	100
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 of 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.

Characters	ASCII values
A–Z	65 –90
a – z	97 –122
0 – 9	48 – 57
Special symbols	0 – 47, 58 – 64, 91 – 96, 123 –127

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 profitor 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:

$$sum = 1 - x^2/2! + x^4/4! - x^6/6! + x^8/8! - x^{10}/10!$$

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
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 1if 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:
   i. Reading a complex number
   ii. Writing a complex number
   iii. Addition and subtraction of two complex numbers
   iv. 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: $1+x+x^2+x^3+\ldots\ldots\ldots\ldots+x^n$. 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 to400.

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 15meters.
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.

Week-12	COMMAND LINE ARGUMENTS AND NUMERICAL METHODS

a. Write a C program to read two numbers at the command line and perform arithmetic operations on it.
b. Write a C program to read a file name at the command line and display its contents.
c. Write a C program to solve numerical methods problems (root finding, numerical differentiation and numerical integration)

Reference Books:

1. Yashavant Kanetkar, "Let Us C", BPB Publications, New Delhi, 13th Edition, 2012.
2. Oualline Steve, "Practical C Programming", O'Reilly Media, 3rd Edition, 1997.
3. King KN, "C Programming: A Modern Approach", Atlantic Publishers, 2nd Edition, 2015.
4. Kochan Stephen G, "Programming in C: A Complete Introduction to the C Programming Language", Sam's Publishers, 3rd Edition, 2004.
5. Linden Peter V, "Expert C Programming: Deep C Secrets", Pearson India, 1st Edition, 1994.

Web References:

1. http://www.sanfoundry.com/c-programming-examples
2. http://www.geeksforgeeks.org/c
3. http://www.cprogramming.com/tutorial/c
4. http://www.cs.princeton.edu

ENGINEERING PHYSICS LABORATORY

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

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AHSB10	Foundation	0	0	3	1.5	30	70	100
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes: 36				Total Classes: 36		

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-l	**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.	

Week-10	**PLANK'S CONSTANT**
Determination of Plank's constant using LED.	
Week-11	**LIGHT EMITTING DIODE**
Studying V-I characteristics of LED	
Week-12	**NEWTONS RINGS**
Determination of radius of curvature of a given plano-convex lens.	
Week-13	**SINGLE SLIT DIFFRACTION**
Determination of width of a given single slit.	
Manuals:	
1. C. L. Arora, "Practical Physics", S. Chand & Co., New Delhi, 3rd Edition, 2012. 2. Vijay Kumar, Dr. T. Radhakrishna, "Practical Physics for Engineering Students", S M Enterprises, 2nd Edition, 2014.	
Web Reference:	
http://www.iare.ac.in	

ELECTRICAL CIRCUITS LABORATORY

II Semester: EEE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AEEB07	Foundation	-	-	3	1.5	30	70	100
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

Expt. 1	**STUDY OF ELECTRICAL AND ELECTRONIC COMPONENTS AND THEIR SPECIFICATIONS**

To identify the electrical and electronic components and selection of these components based on their specifications.

Expt. 2	**TYPES OF ELECTRICAL WIRING AND RESIDENTIAL HOUSE WIRING**

Study the staircase wiring, fluorescent lamp wiring and corridor wiring; To implement residential house wiring using switches, fuse, indicator and lamp.

Expt. 3	**SOLDERING PRACTICE**

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).

Expt. 4	**MEASUREMENT OF POWER CONSUMED BY A FLUORESCENT LAMP**

To obtain power consumed and power factor of a fluorescent lamp, operated at different voltages.

Expt. 5	**OHM'S LAW, KCL AND KVL**

Verification of Ohm's law, KCL and KVL.

Expt. 6	**DESIGN OF CHOKE AND SMALL TRANSFORMER**

Study the design concepts and assembly of prototype choke and small transformer.

Expt. 7	**DETERMINATION OF CIRCUIT IMPEDANCE**

Calculation and verification of impedance and current of RL, RC and RLC series circuits.

Expt. 8	**STUDY OF CONSTANT CURRENT SOURCE**
To develop a circuit which provides substantially constant current using a low voltage input source..	
Expt. 9	**MEASUREMENT OF ELECTRICAL PARAMETERS**
To measure the electrical quantities like voltage, current, power and power factor in RLC series circuit.	
Expt. 10	**MEASUREMENT OF ELECTRICAL ENERGY**
To measure the electrical energy using single phase and three phase energy meters	
Expt. 11	**CHARECTERISTICS OF PERIODIC WAVEFORMS**
Calculation of average value, RMS value, form factor, peak factor of sinusoidal and square waveform.	
Expt. 12	**IMPEDANCE OF SERIES RL,RC,RLC CIRCUIT**
Examine the impedance of series RL, RC, RLC circuit.	
Expt. 13	**SERIES RESONANCE AND PARALLEL RESONANCE**
Demonstrating resonance phenomena in series and parallel RLC circuits and measurements of resonance characteristics using hardware and digital simulation.	
Expt. 14	**MEASUREMENT OF EARTH RESISTANCE AND EARTH POTENTIAL**
Study of earthing and determination of earth resistance and earth potential.	

Reference Books:

1. A Chakrabarti, "Circuit Theory", Dhanpat Rai Publications, 6th Edition, 2006.
2. William Hayt, Jack E Kemmerly S.M. Durbin, "Engineering Circuit Analysis", Tata McGraw Hill, 7th Edition, 2010.
3. K S Suresh Kumar, "Electric Circuit Analysis", Pearson Education, 1st Edition, 2013.

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

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AMEB01	Foundation	0	0	3	1.5	30	70	100
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

Week-1	**MACHINE SHOP-Turning and other machines**

Batch I: Working on central lathe and shaping machine.
Batch II: Working on drilling, grinding machines.

Week-2	**MACHINE SHOP-Milling and other machines**

Batch I: Working on milling machine.
Batch II: Working on milling and shaping machine.

Week-3	**ADVANCED MACHINE SHOP**

Batch I: Working on CNC Turning machines.
Batch II: Working on CNC Vertical Drill Tap Center.

Week-4	**FITTING**

Batch I: Make a straight fit and straight fit for given dimensions.
Batch II: Make a square fit for straight fit for given sizes.

Week-5	**CARPENTRY-I**

Batch I: Preparation of lap joint as per given dimensions.
Batch II: Preparation of dove tail joint as per given taper angle.

Week-6	**CARPENTRY-II**

Batch I: Preparation of dove tail joint as per given taper angle.
Batch II: Preparation of lap joint as per given dimensions.

Week-7	**ELECTRICAL AND ELECTRONICS**

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.	
Week-8	**WELDING**
Batch I: Arc welding & Gas Welding. Batch II: Gas welding & Arc Welding.	
Week-9	**MOULD PREPARATION**
Batch I: Prepare a wheel flange mould using a given wooden pattern. Batch II: Prepare a bearing housing using an aluminum pattern.	
Week-10	**MOULD PREPARATION**
Batch I: Prepare a bearing housing using an aluminum pattern. Batch II: Prepare a wheel flange mould using a given wooden pattern.	
Week-11	**BLACKSMITHY- I, TINSMITHY- I,**
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.	
Week-12	**TINSMITHY- I, BLACKSMITHY- I**
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.	
Week-13	**PLASTIC MOULDING, INJECTION MOULDING, GLASS CUTTING**
Batch I: Plastic Moulding and Glass cutting. Batch II: Plastic Moulding and Glass cutting.	
Week-14	**BLOW MOULDING**
Batch I& II: Blow Moulding.	

Reference Books:

1. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology", Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.
2. Kalpakjian S, Steven S. Schmid, "Manufacturing Engineering and Technology", Pearson Education India Edition, 4th Edition, 2002.
3. Gowri P. Hariharan, A. Suresh Babu," Manufacturing Technology – I", Pearson Education, 2008.
4. Roy A. Lindberg, "Processes and Materials of Manufacture", Prentice Hall India, 4th Edition, 1998.
5. Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata McGraw-Hill House, 2017.

Web References:

http://www.iare.ac.in

NETWORK ANALYSIS

III Semester: EEE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AEEB09	Core	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Analyse three phase star and delta connected circuits to calculate the active and reactive power.
II. Understand the transient response of series and parallel RL, RC and RLC circuits for DC and AC excitations
III. Discuss the concepts of locus diagram, network functions and to calculate the two port network parameters.
IV. Design different types of filters and perform the digital simulation of electric circuits

MODULE-I	THREE PHASE CIRCUITS	Classes: 09

Three phase circuits: Star and delta connections, phase sequence, relation between line and phase voltages and currents in balanced systems(both Y&Δ), three phase three wire and three phase four wire systems, analysis of balanced and unbalanced three phase circuits, measurement of active and reactive power.

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 PORTNETWORK 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.

Text Books:

1. A Chakrabarthy, “Electric Circuits”, Dhanpat Rai & Sons, 6th Edition, 2010.
2. A Sudhakar, Shyammohan S Palli, “Circuits and Networks”, Tata McGraw Hill, 4th Edition, 2010.

Reference Books:

1. John Bird, “Electrical Circuit Theory and technology”, Newnes, 2nd Edition, 2003.
2. C L Wadhwa, “Electrical Circuit Analysis including Passive Network Synthesis”, New Age International, 2nd Edition, 2009.
3. David A Bell, “Electric Circuits”, Oxford University press, 7th Edition, 2009.
4. M E Van Valkenberg, “Network Analysis”, Prentice Hall India, 3rd Edition, 2014.
5. Rudrapratap, “Getting started with MATLAB: A Quick Introduction for Scientists and Engineers”, Oxford University Press, 1st Edition, 1999.

Web References:

1. https://www.igniteengineers.com
2. https://www.ishuchita.com/PDF/Matlab%20rudrapratap.pdf
3. https://www.ocw.nthu.edu.tw
4. https://www.uotechnology.edu.iq
5. https://www.iare.ac.in

E-Text Books:

1. https://www.bookboon.com/en/concepts-in-electric-circuits-ebook
2. https://www.jntubook.com
3. https://www.allaboutcircuits.com
4. https://www.archive.org

ELECTROMAGNETIC FIELDS

III Semester: EEE

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

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	Classes:09

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	Classes: 09

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	Classes: 09

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, 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	Classes: 09

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.

MODULE-V	TIME VARYING FIELDS AND FINITE ELEMENT METHOD	Classes: 09

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.

Text Books:

1. William H Hayt, John A Buck, "Engineering Electromagnetics", McGraw-Hill Publications, 8th Edition, 2012.
2. David J Griffiths, "Introduction to Electrodynamics", Pearson Education Ltd., 4th Edition, 2014.
3. Sunil Bhooshan, "Fundamentals of Engineering Electromagnetics", Oxford University Press, 1st Edition, 2012.
4. E Kuffel, W S Zaengl, J Kuffel, "High Voltage Engineering Fundamentals", Newnes, 2nd Edition, 2000.

Reference Books:

1. Matthew N O Sadiku, S V Kulkarni, "Principles of Electromagnetics", Oxford University Press, 6th Edition, 2015.
2. J D Krauss, Fleish, "Electromagnetics with Applications", McGraw-Hill Publications, 5th Edition, 1999.
3. Matthew N O Sadiku, "Numerical Techniques in Electromagnetics", CRC Press, 2nd Edition, 2001.
4. William H Hayt, John A Buck, "Problems and Solutions in Electromagnetics", McGraw-Hill Publications, 1st Edition, 2010.

Web References:

1. https://www.calvin.edu/~pribeiro/courses/engr315/EMFT_Book.pdf
2. https://www.web.mit.edu/viz/EM/visualizations/coursenotes/modules/guide02.pdf
3. https://www.nptel.ac.in/courses/108106073/
4. https://www.iare.ac.in

E-Text Books:

1. https://www.bookboon.com/en/electromagnetism-for-electronic-engineers
2. https://www.books.google.co.in/books/.../Fundamentals of Electromagnetic Fields
3. https://www.aliexpress.com/item/EBOOK...Electromagnetic-Fields-2

ANALOG ELECTRONICS

III Semester: EEE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AECB02	Core	3	1	-	4	30	70	100
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, f_{α}, 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	Classes: 09
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:

1. Jacob Millman, Christos C Halkias, "Integrated Electronics", McGraw Hill Education, 2nd Edition 2010.
2. Ramakanth A, Gayakwad, "Op-Amps & Linear Ics", PHI, 2003.

Reference Books:

1. Electronic Devices Conventional and current version -Thomas L. Floyd 2015, pearson.
2. J. Millman and A. Grabel, "Microelectronics", McGraw Hill Education, 1988.
3. P. Horowitz and W. Hill, "The Art of Electronics", Cambridge University Press, 1989.
4. P. R. Gray, R. G. Meyer and S. Lewis, "Analysis and Design of Analog Integrated Circuits", John Wiley & Sons, 2001.

Web References:

1. http://www-mdp.eng.cam.ac.uk/web/library/enginfo/electrical/hong1.pdf
2. https://archive.org/details/ElectronicDevicesCircuits
3. http://nptel.ac.in/courses/Webcourse-contents/IIT-ROORKEE/BASIC ELECTRONICS/home_page.htm
4. www.nptel.ac.in
5. notes.specworld.in/pdc-pulse-and-digital-circuits

E-Text Books:

1. http://services.eng.uts.edu.au/pmcl/ec/Downloads/LectureNotes.pdf
2. http://nptel.ac.in/courses/122106025/
3. http://www.freebookcentre.net/electronics-ebooks-download/Electronic-Devices-and-Circuits-(PDF-313p).html
4. http:// www.introni.it/pdf/Millman-Taub- Pulse and Digital Switching Waveforms 1965.pdf
5. https://www.jntubook.com/pulse-digital-circuits-textbook-free-download/

DIGITAL ELECTRONICS

III Semester: EEE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AECB03	Core	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

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 lCs, 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, De-Multiplexer, Decoders, Adders, Sub tractors, 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 lCs, 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.

MODULE-V	SEMICONDUCTOR MEMORIES AND PROGRAMMABLE LOGIC DEVICES	Classes: 09
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).		

Text Books:

1. P Jain, "Modern Digital Electronics", McGraw Hill Education, 2009.
2. M M Mano, "Digital logic and Computer design", Pearson Education India, 2016.

Reference Books:

1. A Kumar, "Fundamentals of Digital Circuits", Prentice Hall India, 2016.

Web References:

1. https://www.calvin.edu/~pribeiro/courses/engr315/EMFT_Book.pdf
2. https://www.web.mit.edu/viz/EM/visualizations/coursenotes/modules/guide02.pdf
3. https://www.nptel.ac.in/courses/108106073/
4. https://www.iare.ac.in

E-Text Books:

1. https://*www*.bookboon.com/en/electromagnetism-for-electronic-engineers
2. https://www.books.google.co.in/books/.../Fundamentals of Electromagnetic Fields
3. https://www.aliexpress.com/item/EBOOK...Electromagnetic-Fields-2

ELECTRICAL MACHINES – I

III Semester: EEE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AEEB11	Core	3	1	-	4	30	70	100
Contact Classes: 45	Tutorial Classes: 15	Practical Classes: Nil				Total Classes: 60		

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.

MODULE-V	POLY PHASE TRANSFORMERS	Classes: 09
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.		

Text Books:

1. A E Fitzgerald and C Kingsley, "Electric Machinery", New York, McGraw Hill Education, 1st Edition, 2013.
2. A E Clayton and N N Hancock, "Performance and design of DC machines", CBS Publishers, 1st Edition, 2004.
3. M G Say, "Performance and design of AC machines", CBS Publishers, 1st Edition, 2002.
4. P S Bimbhra, "Electrical Machinery", Khanna Publishers, 1st Edition, 2011.
5. I J Nagrath and D P Kothari, "Electric Machines", McGraw Hill Education, 1st Edition, 2010.

Reference Books:

1. M G Say, E O Taylor, "Direct Current Machines", Longman Higher Education, 1st Edition, 1985.
2. M V Deshpande, "Electrical Machines", PHI Learning Private Limited, 3rd Edition, 2011.
3. Ian McKenzie Smith, Edward Hughes, "Electrical Technology", Prentice Hall, 10thEdition, 2015.

Web References:

1. https://www.electrical4u.com\
2. https://www.freevideolectures.com
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

NETWORK ANALYSIS LABORATORY

III Semester: EEE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AEEB12	Core	-	-	2	1	30	70	100
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes: 24				Total Classes: 24		

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

Expt. 1	**MESH AND NODAL ANALYSIS**
Verification of mesh and nodal analysis using hardware.	
Expt. 2	**SUPERPOSITION AND RECIPROCITY THEOREMS**
Verification of super position and reciprocity theorems using hardware.	
Expt. 3	**MAXIMUM POWER TRANSFER THEOREM**
Verification of maximum power transfer theorem using hardware.	
Expt. 4	**THEVENIN'S AND NORTON'S THEOREMS**
Verification of Thevenin's and Norton's theorems using hardware.	
Expt. 5	**COMPENSATION AND MILLIMAN'S THEOREM**
Verification of compensation and Milliman's theorems using hardware.	
Expt. 6	**IMPEDANCE (Z) AND ADMITTANCE (Y) PARAMETERS**
To calculate and verify 'Z' parameters and 'Y' parameters of two-port network	
Expt. 7	**TRANSMISSION (ABCD) AND HYBRID (H) PARAMETERS**
To calculate and verify 'ABCD' parameters and 'H' parameters of two-port network.	

Expt. 8	**VIRTUAL INSTRUMENTS (VI) USING LABVIEW**
Editing and building a VI, creating a sub VI.	
Expt. 9	**GENERATION OF COMMON WAVE FORMS USING LABVIEW**
Signal generation of triangular wave; saw tooth, square wave and display of wave form, minimum and maximum values of wave form and modulation.	
Expt.10	**FREQUENCY MEASUREMENT USING LABVIEW**
Frequency measurement using Lissajous figures in Lab View.	
Expt. 11	**STRUCTURES USING LABVIEW**
Using FOR loop, WHILE loop, charts and arrays, graph and analysis VIs.	
Expt. 12	**SERIES, PARALLEL AND CASCADE CONNECTION OF TWO PORT NETWORK**
To determine the equivalent parameters of series, parallel, cascade connection of two port network.	
Expt. 13	**SOURCE TRANSFORMATION**
Analysis of given circuit using source transformation technique	
Expt. 14	**MODELLING ELECTRICAL NETWORK IN FREQUENCY DOMAIN**
To learn modelling of electrical network in frequency domain using digital simulation.	

Reference Books:

1. Department Lab Manual.
2. A Chakrabarti, "Circuit Theory", Dhanpat Rai Publications, 6th Edition, 2006.
3. V K Mehta, Rohit Mehta, "Principles of Electrical Machines", 1st Edition, 2013.
4. I J Nagarath & D P Kothari, "Electrical Machines", 1st Edition, 2011.

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)

ANALOG AND DIGITAL ELECTRONICS LABORATORY

III Semester: EEE

Course Code	Category	Hours /Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AECB04	Core	-	-	3	1.5	30	70	100
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

Expt. 1	**PN JUNCTION DIODE CHARACTERISTICS**
Verification of V-I characteristics of PN diode and calculate static and dynamic resistance using Hardware.	
Expt. 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.	
Expt. 3	**HALF WAVE AND FULL WAVE RECTIFIER**
Verification of Half wave rectifier and Full wave rectifier without and with filters using hardware.	
Expt. 4	**TRANSISTOR CE CHARACTERISTICS**
Verification of Input and Output characteristics of CE configuration using hardware	
Expt. 5	**TRANSISTOR CB CHARACTERISTICS**
Verification of Input and Output characteristics of CB configuration using hardware	
Expt. 6	**FREQUENCY RESPONSE OF CE AMPLIFIER**
Determine the Gain and Bandwidth of CE amplifier using hardware.	
Expt. 7	**BOOLEAN EXPRESSIONS USING GATES**
Realization of Boolean Expressions using Gates	

Expt. 8	**UNIVERSAL GATES**
Design and realization of logic gates using universal gates	
Expt. 9	**NAND / NOR GATES**
Generation of clock using NAND / NOR gates	
Expt. 10	**ADDER/ SUBTRACTOR**
Design a 4 – bit Adder / Subtractor	
Expt. 11	**BINARY TO GRAY CONVERTER**
Design and realization of a 4 – bit gray to Binary and Binary to Gray Converter	
Expt. 12	**TRUTH TABLES AND EXCITATION TABLES**
Verification of truth tables and excitation tables	
Expt. 13	**SHIFT REGISTER**
Design and realization of an 8 bit parallel load and serial out shift register using flip-flops	
Expt. l4	**MULTIPLEXER**
Design and realization of 8x1 using 2x1 MUX	
Expt. l5	**2 BIT COMPARATOR**
Design and realization of 2 bit comparator	

Reference Books:

1. Jacob Millman, Herbert Taub, Mothiki S PrakashRao, –Pulse Digital and Switching Waveforms‖, Tata McGraw-Hill, 3rd Edition, 2008.
2. David A. Bell, Solid State Pulse Circuits‖, PHI, 4th Edition, 2002.
3. D Roy Chowdhury, Linear Integrated Circuits‖, New Age International (p) Ltd, 2nd Edition, 2003.
4. Ramakanth A. Gayakwad, –Op-Amps & linear ICs‖, PHI, 3rd Edition, 2003.

Web References:

1. http://www.tedpavlic.com/teaching/osu/ece327/
2. http://www.ee.iitkgp.ac.in
3. http://www.citchennai.edu.in
4. http://american.cs.ucdavis.edu/academic/ecs154a.sum14/postscript/cosc205.pdf
5. http://www.ece.rutgers.edu/~marsic/Teaching/DLD/slides/lec-1.pdf

ELECTRICAL MACHINES LABORATORY - I

III Semester: EEE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AEEB13	Core	-	-	3	1.5	30	70	100
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	

Expt. 10	**RETARDATION TEST**
Study the performance characteristics by using retardation test on DC shunt motor	
Expt. 11	**SEPARATION OF LOSSES IN DC SHUNT MOTOR**
Study the method used for separation of losses in DC shunt motor	
Expt. 12	**MAGNETIZATION CHARACTERISTICS OF DC SHUNT GENERATOR**
Study the magnetization characteristics of DC shunt generator using digital simulation.	
Expt. 13	**LOAD TEST ON DC SHUNT GENERATOR USING DIGITAL SIMULATION**
Perform the load test on DC shunt generator using digital simulation	
Expt. 14	**SPEED CONTROL OF DC SHUNT MOTOR USING DIGITAL SIMULATION**
Verify the speed control techniques of DC motor using digital simulation	

Reference Books:

1. P S Bimbhra, “Electrical Machines”, Khanna Publishers, 2nd Edition, 2008.
2. M G Say, E O Taylor, “Direct Current Machines”, Longman Higher Education, 1st Edition, 1985.
3. Hughes, “Electrical Technology”, Prentice Hall, 10th Edition, 2015.
4. Nesimi Ertugrul, “LabVIEW for Electric Circuits, Machines, Drives, and Laboratories”, Prentice Hall, 1 st Edition, 2002.
5. Gupta, Gupta & John, “Virtual Instrumentation Using LabVIEW”, Tata McGraw-Hill, 1st Edition, 2005

Web References:

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

COMPLEX ANALYSIS AND PROBABILITY DISTRIBUTIONS

IV Semester: EEE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AHSB06	Core	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

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

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

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

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

1. $\int_0^{2\Pi} f(\cos\theta, \sin\theta)d\theta$ 2. $\int_{-\infty}^{\infty} f(x)dx$

MODULE-IV	SINGLE RANDOM VARIABLES	Classes: 09

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

Binomial, Poisson and normal distributions and their properties.

Text Books:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons Publishers, 10th Edition, 2014.
2. B S Grewal, "Higher Engineering Mathematics", Khanna Publishers, 42nd Edition, 2012.

Reference Books:

1. Churchill, RV and Brown, J W, "Complex Variables and Applications", Tata Mc Graw-Hill, 8th Edition, 2012.
2. A K Kapoor, "Complex Variables Principles and Problem Sessions", World Scientific Publishers, 1st Edition, 2011.
3. Murray Spiegel, John Schiller, "Probability and Statistics", Schaum's Outline Series, 3rd Edition, 2010.

Web References:

1. http://www.efunda.com/math/math_home/math.cfm
2. http://ocw.mit.edu/resources/#Mathematics
3. http://www.sosmath.com/
4. http://mathworld.wolfram.com/

E-Text Books:

1. http://keralatechnologicaluniversity.blogspot.in/2015/06/erwin-kreyszig-advanced-engineering-mathematics-ktu-ebook-download.html
2. http://www.faadooengineers.com/threads/13449-Engineering-Maths-II-eBooks.

ELECTRICAL POWER GENERATION SYSTEMS

IV Semester: EEE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AEEB14	Core	3	1	-	4	30	70	100
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.

MODULE-V	ECONOMIC ASPECTS OF POWER GENERATION	Classes: 09

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:

1. C L Wadhawa, "Generation, Distribution and Utilization of Electrical Energy", New Age International Limited, New Delhi, 3rd Edition, 2005.
2. G D Rai, "Non-Conventional Energy Sources", Khanna Publishers, 1st Edition, 2011.
3. G N Tiwari, M K Ghosal, "Fundamentals of Renewable Energy Sources", Narosa Publications, New Delhi, 1st Edition, 2007.
4. Chetan Singh Solanki, "Solar Photovoltaics", PHI Publications, 2nd Edition, 2011.
5. M L Soni, P V Gupta, U S Bhatnagar and A Chakraborti, "A text book on Power system engineering", Dhanpat Rai and Co. Pvt. Ltd, 1999

Reference Books:

1. J B Gupta, "A Course in Electrical Power", S K Kataria and Sons, New Delhi, 15th Edition, 2013.
2. M V Deshpande, "Elements of Power Station design", Prentice Hall India Learning Private Limited, New Delhi, 1st Edition, 1992.
3. Mukund R Patel, "Wind and Solar Power Systems", CRC Press, 1st Edition, 1999.
4. V K Mehta and Rohit Mehta, "Principle of Power Systems", S Chand & Company, Ltd, New Delhi, 3rd Edition, 2005.

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:

1. https://www.amazon.in/Electrical-Power-Engineering-Reference-Applications
2. https://www.nitt.edu
3. https://www.textbooksonline.tn.nic.in

ELECTRICAL MACHINES - II

IV Semester: EEE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AEEB15	Core	3	1	-	4	30	70	100
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.

MODULE-I	PULSATING AND REVOLVING MAGNETIC FIELDS	Classes: 09

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.

MODULE-II	INDUCTION MACHINES	Classes: 09

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.

MODULE-III	ALTERNATORS	Classes: 09

Synchronous generators: Introduction, principle of operation, constructional features, armature windings, integral slot and fractional slot windings, distributed and concentrated windings, winding factors, basic synchronous machine model, circuit model of a synchronous machine, phasor diagrams, determination of synchronous impedance, short circuit ratio, armature reaction, ampere turns and leakage reactance.

Voltage regulation: Calculation of regulation by synchronous impedance method, MMF, ZPF and ASA methods, slip test, parallel operation of alternators, synchronization of alternators, problems.

MODULE-IV	SYNCHRONOUS MOTORS	Classes: 09

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.

MODULE-V	SINGLE-PHASE INDUCTION MOTORS	Classes: 09

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:

1. A E Fitzgerald and C Kingsley, "Electric Machinery", McGraw Hill Education, 2013.
2. P S Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.
3. I J Nagrath and D P Kothari, "Electric Machines", McGraw Hill Education, 2010.
4. A S Langsdorf, "Alternating current machines", McGraw Hill Education, 1984.

Reference Books:

1. A E Fitzgerald, Charles Kingsley JR., Stephen D Umans, "Electric Machinery", McGraw- Hill, 6th Edition, 1985.
2. M G Say, "Alternating Current Machines", Pitman Publishing Ltd, 4th Edition, 1976.
3. P C Sen, "Principles of Electric Machines and Power Electronics", John Wiley & Sons, 2007.
4. S K Bhattacharya, "Electrical Machines", TMH publication, 2nd Edition, 2006.

Web References:

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

E-Text Books:

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

CONTROL SYSTEMS

IV Semester: ECE, EEE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AEEB16	Core	3	1	-	4	30	70	100
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 force, 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:

1. I J Nagrath, M Gopal, “Control Systems Engineering”, New Age International Publications, 3rd Edition, 2007.
2. K Ogata, “Modern Control Engineering”, Prentice Hall, 4th Edition, 2003.
3. N C Jagan, “Control Systems”, BS Publications, 1st Edition, 2007.

Reference Books:

1. Anand Kumar, “Control Systems”, PHI Learning, 1st Edition, 2007.
2. S Palani, “Control Systems Engineering”, Tata McGraw-Hill Publications, 1st Edition, 2001.
3. N K Sinha, “Control Systems”, New Age International Publishers, 1st Edition, 2002.

Web References:

1. https://www.researchgate.net
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: CSE / IT / ECE / ME / CE | IV Semester: AE / EEE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
ACSB03	Core	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The students will try to learn:

I. To provide students with skills needed to understand and analyze performance trade-offs of different algorithms / implementations and asymptotic analysis of their running time and memory usage.
II. To provide knowledge of basic abstract data types (ADT) and associated algorithms: stacks, queues, lists, tree, graphs, hashing and sorting, selection and searching.
III. The fundamentals of how to store, retrieve, and process data efficiently.
IV. To provide practice by specifying and implementing these data structures and algorithms in Python.
V. Understand essential for future programming and software engineering courses.

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; Algorithm Specification, Recursive algorithms, Data Abstraction, Performance analysis- time complexity and space complexity, Asymptotic Notation-Big O, Omega, and Theta notations. Introduction to Linear and Non Linear data structures, Searching techniques: Linear and Binary search; Sorting techniques: Bubble sort, Selection sort, Insertion sort, Quick sort, Merge sort and comparison of sorting algorithms.

MODULE - II	LINEAR DATA STRUCTURES	Classes: 09

Stacks: Stack ADT, definition and operations, Implementations of stacks using array, 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, linked list representation and operations of 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, threaded binary trees, application of trees, Graphs: Basic concept, graph terminology, Graph Representations - Adjacency matrix, Adjacency lists, graph implementation, Graph traversals – BFS, DFS, Application of graphs, Minimum spanning trees – Prims and Kruskal algorithms.

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.

Text Books:
1. Rance D. Necaise, “Data Structures and Algorithms using Python”, Wiley Student Edition. 2. Benjamin Baka, David Julian, “Python Data Structures and Algorithms”, Packt Publishers, 2017.
Reference Books:
1. S. Lipschutz, “Data Structures”, Tata McGraw Hill Education, 1st Edition, 2008. 2. D. Samanta, “Classic Data Structures”, PHI Learning, 2nd Edition, 2004.
Web References:
1. https://www.tutorialspoint.com/data_structures_algorithms/algorithms_basics.htm 2. https://www.codechef.com/certification/data-structures-and-algorithms/prepare 3. https://www.cs.auckland.ac.nz/software/AlgAnim/ds_ToC.html 4. https://online-learning.harvard.edu/course/data-structures-and-algorithms

ELECTRICAL MACHINES LABORATORY - II

IV Semester: EEE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AEEB17	Core	-	-	3	1.5	30	70	100
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

Expt. 9	**REGULATION OF ALTERNATOR BY EMF METHOD**
Determine the regulation of alternator using synchronous impedance method.	
Expt. 10	**REGULATION OF ALTERNATOR BY MMF METHOD**
Determine the regulation of alternator using amperes turns method.	
Expt. 11	**SLIP TEST ON THREE PHASE SALIENT POLE SYNCHRONOUS MOTOR**
Determination of Xd and Xq in a three phase salient pole synchronous motor.	
Expt. 12	**V' AND INVERTED 'V' CURVES OF SYNCHRONOUS MOTOR**
Plot 'V' and inverted 'V' curves to study the effect of power factor in synchronous motor.	
Expt. 13	**EQUIVALENT CIRCUIT PARAMETERS OF SINGLE PHASE INDUCTION MOTOR**
Determine the equivalent circuit parameters of a single phase induction motor	
Expt. 14	**STARTING AND SPEED CONTROL OF INDUCTION MOTOR USING PLC**
Implementation of star-delta starter using PLC; Speed control of three phase slip ring induction motor with rotor resistance cutting using PLC.	

Reference Books:

1. P S Bimbhra, "Electrical Machines", Khanna Publishers, 2nd Edition, 2008.
2. M V Deshpande, "Electrical Machines", PHI Learning Private Limited, 3rd Edition, 2011.
3. R K Srivastava, "Electrical Machines", Cengage Learning, 2nd Edition, 2013.

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

Course Code	Category	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AEEB18	Core	-	-	2	1	30	70	100
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**
Stability analysis using root locus, Bode plot, Polar, Nyquist criterions of linear time invariant system by 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	

Expt. 10	LADDER DIAGRAMS USING PLC
Input output connection, simple programming, ladder diagrams, uploading, running the program and debugging in programmable logic controller.	
Expt. 11	**TRUTH TABLES USING PLC**
Study and verification of truth tables of logic gates, simple boolean expressions and application to speed control of DC motor using programmable logic controller.	
Expt. 12	**IMPLEMENTATION OF COUNTER**
Implementation of counting number of objects and taking action using PLC.	
Expt. 13	**BLINKING LIGHTS USING PLC**
Implementation of blinking lights with programmable logic controller.	
Expt. 14	**WATER LEVEL CONTROL**
Control of maximum and minimum level of water in a tank using PLC.	

Reference Books:

1. J Nagrath, M Gopal, "Control Systems Engineering", New Age International, 3rd Edition, 2007.
2. K Ogata, "Modern Control Engineering", Prentice Hall, 4th Edition, 2003.
3. Benjamin Kuo, "Automatic Control Systems", PHI, 7th Edition, 1987.

Web References:

1. https://www.ee.iitkgp.ac.in
2. https://www.ggnindia.dronacharya.info/ece2dept/Downloads/Labmanuals/VI Sem/Control_ System _ Lab.pdf
3. https://www.iare.ac.in
4. https://www.deltaww.com

SOFTWARE AND HARDWARE REQUIREMENTS FOR A BATCH OF 36 STUDENTS:
SOFTWARE: MATLAB, WPL soft Software
HARDWARE: Desktop Computers (04 nos)

DATA STRUCTURES LABORATORY

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

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
ACSB05	Core	0	0	3	1.5	30	70	100
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.

WEEK6	IMPLEMENTATION OF SINGLE LINKED LIST
Write Python programs for the following operations on Single Linked List. (i) Creation (ii) insertion (iii) deletion (iv) traversal	
WEEK-7	**IMPLEMENTATION OF CIRCULAR SINGLE LINKED LIST**
Write Python programs for the following operations on Circular Linked List. (i) Creation (ii) insertion (iii) deletion (iv) traversal	
WEEK-8	**IMPLEMENTATION OF DOUBLE LINKED LIST**
Write Python programs for the following operations on Double Linked List. (i) Creation (ii) insertion (iii) deletion (iv) traversal in both ways.	
WEEK-9	**IMPLEMENTATION OF STACK USING LINKED LIST**
Write a Python program to implement Stack using linked list.	
WEEK-10	**IMPLEMENTATION OF QUEUE USING LINKED LIST**
Write a Python program to implement Linear Queue using linked list.	
WEEK-11	**GRAPH TRAVERSAL TECHNIQUES**
Write Python programs to implement the following graph traversal algorithms: a. Depth first search. b. Breadth first search.	
WEEK-12	**IMPLEMENTATION OF BINARY SEARCH TREE**
Write a Python program to perform the following: a. Create a binary search tree. b. Traverse the above binary search tree recursively in pre-order, post-order and in-order. c. Count the number of nodes in the binary search tree.	

LIST OF REFERENCE BOOKS:

1. Rance D. Necaise, “Data Structures and Algorithms using Python”, Wiley, John Wiley & Sons, INC., 2011.
2. Benjamin Baka, David Julian, “Python Data Structures and Algorithms”, Packt Publishing Ltd., 2017.

WEB REFERENCES:

1. https://docs.python.org/3/tutorial/datastructures.html
2. http://interactivepython.org/runestone/static/pythonds/index.html
3. http://www.tutorialspoint.com/data_structures_algorithms
4. http://www.geeksforgeeks.org/data-structures/
5. http://www.studytonight.com/data-structures/
6. http://www.coursera.org/specializations/data-structures-algorithms

ELECTRICAL POWER TRANSMISSION SYSTEMS

V Semester: EEE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AEEB19	Core	2	1	-	3	30	70	100
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 transmissions 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 over head 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 LINE S	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:

1. William D Stevenson,"Elements of Power System Analysis", McGraw Hill Higher Education, 4th revised Edition, 1982.
2. C L Wadhwa, "Electric Power Systems", New age publications, New Delhi, 9th Edition, 2007.

Reference Books:

1. D Kothari and I J Nagrath, "Power System Engineering", McGraw-Hill Education, 2nd Edition, 2007.
2. Singh S N, "Electric Power Generation, Transmission and Distribution", Prentice Hall of India Pvt. Ltd., New Delhi, 2nd Edition, 2002.
3. M L Soni, P V Gupta, U S Bhatnagar and A Chakrabarthy, "A Text Book on Power System Engineering", Dhanpat Rai and Co Pvt. Ltd., revised Edition, 2009.
4. Turan Gonen, "Electrical Power Distribution System Engineering", CRC Press, 3rd Edition, 2014.
5. V Kamaraju, "Electrical Power Distribution Systems", TMH, Publication, Edition 2009
6. J B Gupta, "A Course in Power Systems", S K Kataria and Sons, 2013 Edition, 2013
7. V K Mehta and Rohit Mehta, "Principles of Power System", S Chand, 3rd revised Edition, 2015.

Web References:

1. https://www.en.wikipedia.org/wiki/Electric_power_transmission
2. https://www.iec.ch/about/brochures/pdf/technology/transmission.pdf
3. https://www.teriin.org/upfiles/pub/papers/ft33.pdf
4. https://www.energy.gov/sites/prod/files/2015/09/f26/QTR2015-3F-Transmission-and-Distribution_1.pdf

E-Text Books:

1. https://www.jfgieras.com/Grigsby_Chapter_34_LEM.pdf
2. https://www.personal.psu.edu/sab51/vls/vonmeier.pdf
3. https://www.edsonjosen.dominiotemporario.com/doc/Livro_Electric_Power_Distribution_System_Engineering_-_Turan_Gonen.pdf

POWER ELECTRONICS

V Semester: EEE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AEEB20	Core	2	1	-	3	30	70	100
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 Resistive 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^{o} and 120^{o} conduction modes of operation.

Text Books:

1. Dr. P S Bimbhra, "Power Electronics", Khanna Publishers, Delhi, 4th Edition, 2008.
2. M H Rashid, "Power electronics: circuits, devices, and applications", Pearson Education India, 3rd Edition, 2009.

Reference Books:

1. L Umanand, "Power Electronics: Essentials and Applications", Wiley India, 3rd Edition, 2009.
2. N Mohan and T M Undeland, "Power Electronics: Converters, Applications and Design", John Wiley & Sons, 2nd Edition, 2007.
3. R. W. Erickson and D Maksimovic, "Fundamentals of Power Electronics", Springer Science & Business Media, 2nd Edition, 2007.

Web References:

1. https://www.bank.engzenon.com/download/.../PowerElectronics_Handbook_3rd_Edition_M_Rashid
2. https://www.nptel.iitm.ac.in
3. https://www.iare.ac.in
4. https://www.bookboon.com/en/introduction-to-power-electronics-ebook

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

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AECB24	CORE	2	1	-	3	30	70	100
Contact Classes: 30	Tutorial Classes: 15	Practical Classes: Nil				Total Classes: 45		

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 programs 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**	**Classes : 08**

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**	**Classes : 09**

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**	**Classes: 08**

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**	**Classes: 10**

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**	**Classes : 10**

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:

1. Ray A.K, Bhurchandi K.M, “Advanced Microprocessor and Peripherals”, TMH, 2nd Edition, 2012
2. Muhammad Ali Mazidi, J.G. Mazidi, R.D McKinlay,” The 8051 Microcontroller and Embedded systems using Assembly and C”, Pearson education, 2nd Edition, 2009.
3. Douglas V. Hall, “Microprocessors and Interfacing Programming and Hardware”, TMGH,
4. 2nd Edition, 1994.

Reference Books

1. Kenneth J. Ayala, “The 8051 Microcontroller”, Thomson Learning, 3rd edition, 2005.
2. Manish K. Patel, “The 8051 Microcontroller Based Embedded Systems”, McGraw Hill, 1st Edition, 2014.
3. Ajay V Deshmukh, “Microcontrollers”, TATA McGraw Hill publications, 2nd Edition, 2012.

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
2. http://www.www.jntubook.com
3. http://www.ebooklibrary.org/articles/mpmc

BUSINESS ECONOMICS AND FINANCIAL ANALYSIS

III Semester: CSE / IT | V Semester: EEE / CE / MECH | VI Semester: ECE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AHSB14	HSMC	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

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-Dougles 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:

1. Aryasri, "Managerial Economics and Financial Analysis", TMH publications, 4th Edition, 2012.
2. M. Kasi Reddy, Saraswathi, "Managerial Economics and Financial Analysis", PHI Publications, New Delhi, 2nd Edition, 2012.
3. Varshney, Maheswari, "Managerial Economics", Sultan Chand Publications, 11th Edition, 2009.

Reference Books:

1. S. A. Siddiqual, A. S. Siddiqual, "Managerial Economics and Financial Analysis", New Age International Publishers, Hyderabad, Revised 1st Edition, 2013.
2. S. N. Maheswari, S. K. Maheswari, "Financial Accounting", Vikas publications, 3rd Edition, 2012.
3. J. V. Prabhakar Rao, P. V. Rao, "Managerial Economics and Financial Analysis", Maruthi Publishers, Reprinted Edition, 2011.
4. Vijay Kumar, Appa Rao, "Managerial Economics and Financial Analysis", Cengage Publications, 1st Edition, Paperback, 2011.

Web References:

1. https:// www.slideshare.net/glory1988/managerial-economics-and- financial analysis
2. https:// thenthata.web4kurd.net/mypdf/managerial-economics-and- financial analysis
3. https:// bookshallcold.link/pdfread/managerial-economics-and-financial analysis
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
2. http://www. ebooktake.in/pdf/title/managerial-economics-and-financial analysis
3. http://all4ryou.blogspot.in/2012/06/mefa-managerial-economics and financial analysis
4. http://books.google.com/books/about/Managerial economics and financial analysis
5. http://www.scribd.com/doc/37684926

POWER ELECTRONICS LABORATORY

V Semester: EEE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AEEB21	Core	-	-	2	1	30	70	100
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 cyclo converters.
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

Expt. 1	**SCR, MOSFET AND IGBT**
Study the characteristics of SCR, MOSFET and IGBT.	
Expt. 2	**GATE FIRING CIRCUITS**
Study the operation of gate firing circuits of SCR.	
Expt. 3	**HALF CONTROLLED CONVERTER**
Study the performance characteristics of single phase half controlled converter with R and RL loads.	
Expt. 4	**FORCED COMMUTATION CIRCUITS**
Plot the characteristics of forced commutation circuits (Class A, Class B, Class C, Class D and Class E).	
Expt. 5	**FULLY CONTROLLED BRIDGE CONVERTER**
Study the characteristics of single phase fully controlled bridge converter with R and RL loads.	
Expt. 6	**SERIES INVERTER**
Study the characteristics of single phase series inverter with different loads.	
Expt. 7	**PARALLEL INVERTER**
Study the characteristics of single phase parallel inverter with different loads.	
Expt. 8	**VOLTAGE CONTROLLER**
Plot the characteristics of single phase AC voltage controller with R and RL loads.	

Expt. 9	**DUAL CONVERTER**
Study the characteristics of single phase dual converter with R and RL loads.	
Expt. 10	**CYCLOCONVERTER**
Study the characteristics of single phase cycloconverter with R and RL loads.	
Expt. 11	**THREE PHASE SEMI CONVERTER**
Plot the characteristics of three phase half converter with R and RL loads.	
Expt. 12	**MOSFET BASED CHOPPERS**
Study the principle of operation of step down chopper using MOSFET.	
Expt. 13	**SIMULATION OF THREE PHASE FULL CONVERTER AND PWM INVERTER**
Simulation of three phase full converter and PWM inverter with R and RL loads by using MATLAB.	
Expt. 14	**SIMULATION OF DC CONVERTERS**
Simulation of boost, buck, buck - boost converter with R and RL loads by using MATLAB.	

Reference Books:

1. M H Rashid, "Power Electronics, Circuits, Devices and Applications", Pearson, 3rd Edition, 2001.
2. M D Singh, K B Kanchandhani, "Power Electronics", Tata McGraw-Hill Publishing Company, 7th Edition, 2007.
3. P S Bimbhra, "Power Electronics", Khanna Publishers, 5th Edition, 2012.

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)

MICRO PROCESSORS AND MICROCONTROLLERS LABORATORY

VI Semester: ECE | V Semester: EEE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AECB26	Core	-	-	2	1	30	70	100
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes: 24				Total Classes: 24		

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 BITARITHMETIC AND LOGICAL OPERATIONS

Write an ALP program to perform 16 Bit arithmetic and logical operations using WIN862 software

WEEK-3 MULTIBYTE ADDITION AND SUBRACTION

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 othe
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 8086**
Write an ALP program to interface keyboard to 8086	
WEEK-l0	**SERIAL AND PARALLEL COMMUNICATION**
a) Parallel communication between two microprocessors using 8255 b) Serial communication between two microprocessor kits using 8251	
WEEK-l1	**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-l2	**ARITHMETIC AND LOGICAL OPERATIONS USING 8051**
Write an ALP program to perform 16 Bit arithmetic and logical operations using 8051 microcontroller	
WEEK-l3	**TIMER/COUNTER**
Write an ALP Program and verify Timer/Counter using 8051	
WEEK-l4	**INTERFACING KEYBOARD TO 8051**
Write an ALP program to interface keyboard to 8051	

Reference Books:

1. Ray A.K, Bhurchandi K.M, ―Advanced Microprocessor and Peripherals‖, 2/e TMH, 2012
2. Muhammad Ali Mazidi, J.G. Mazidi and R.D McKinlay, ―The 8051 Microcontroller and Embedded systems using Assembly and C‖, 2nd Edition, Pearson education, 2009.

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

SOFTWARES: win 862

POWER SYSTEM ANALYSIS

VI Semester: EEE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AEEB22	Core	2	1	-	3	30	70	100
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 of 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 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 AND SHORT CIRCUIT ANALYSIS	Classes: 10

Per unit system: Equivalent reactance network of a three phase power system, numerical problems; Symmetrical fault analysis: Short circuit current and MVA calculations, fault levels, application of series reactors, numerical problems; Symmetrical component theory: Symmetrical component transformation, positive, negative and zero sequence components, voltages, currents and impedances.

Sequence networks: Positive, negative and zero sequence networks, numerical problems; Unsymmetrical fault analysis: LG, LL, LLG faults with and without fault impedance, numerical problems.

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:

1. I J Nagrath & D P Kothari, "Modern Power system Analysis", Tata McGraw-Hill Publishing Company, 2nd Edition, 2001.
2. M A Pai, "Computer Techniques in Power System Analysis", TMH Publications, 2nd Edition, 2004.

Reference Books:

1. K Umarao, "Computer techniques and models in power systems", I K International Pvt. Ltd, 1st Edition, 2000.
2. C L Wadhwa, "Electrical Power Systems", New age International, 3rd Edition, 2002.
3. HadiSaadat, "Power System Analysis", TMH, 2nd Edition, 2003.
4. Grainger and Stevenson, "Power System Analysis", Tata McGraw-Hill, 3rd Edition, 2011.
5. J Duncan Glover and M S Sarma., THOMPSON, "Power System Analysis and Design", 3rd Edition 2006.
6. Abhijit Chakrabarthi and Sunita Haldar, "Power system Analysis Operation and control", PHI 3rd Edition, 2010.

Web References:

1. https://www.worldcat.org/title/computer-methods-in-power-system-analysis/.../600788826
2. https://www.sjbit.edu.in/.../COMPUTER%20%20TECHNIQUES%20IN%20POWER%20%20SYS..
3. https://www.books.google.com › Technology & Engineering › Electrical
4. https://www.nptel.ac.in/courses/108105067/
5. https://www.jntusyllabus.blogspot.com/2012/01/computer-methods-power-systems-syllabus.html

E-Text Books:

1. https://www.scribd.com/.../Computer-Methods-in-Power-System-Analysis-by-G-W-St...
2. https://www.academia.edu/8352160/Computer_Methods_and_Power_System_Analysis_Stagg
3. https://www.uploady.com/#!/download/ddC9obmVTiv/NwO1AnQrlmogeJjS
4. https://www.materialdownload.in/article/Computer-Methods-in-Power-System-Analysis_159/ 5.
5. https://www.ee.iitm.ac.in/2015/07/ee5253/

ELECTRIC DRIVES AND STATIC CONTROL

VI Semester: EEE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AEEB23	Core	2	1	-	3	30	70	100
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	CONTROL OF DC MOTORS THROUGH PHASE CONTROLLED RECTIFIERS	Classes: 09

Introduction to thyristor controlled drives: Single phase semi and fully controlled converters connected to DC separately excited and dc series motors, continuous current operation, output voltage and current waveforms, speed and torque expressions, speed torque characteristics, problems on converter fed DC motors; Three phase semi and fully controlled converters connected to DC separately excited and DC series motors, output voltage and current waveforms, speed and torque expressions, speed torque characteristics and problems.

MODULE-II	SPEED CONTROL OF DC MOTORS	Classes: 09

Introduction to four quadrant operation: Motoring operations, electric braking, plugging, dynamic and regenerative braking operations; Four quadrant operation of DC motors by dual converters, closed loop operation of DC motor; Chopper fed DC drives: Single quadrant, two quadrant and four quadrant chopper fed DC separately excited and series excited motors, continuous current operation output voltage and current wave forms, speed torque expressions, speed torque characteristics, problems on chopper fed DC motors and closed loop operation.

MODULE-III	SPEED CONTROL OF INDUCTION MOTORS THROUGH VARIABLE VOLTAGE AND FREQUENCY	Classes: 09

Variable voltage characteristics: Control of induction motor by AC voltage controllers, waveforms, speed torque characteristics.

Variable frequency characteristics: Variable frequency characteristics, variable frequency control of induction motor by voltage source and current source inverter and cycloconverters, pulse with modulation control, comparison of voltage source inverter and current source inverter operations, speed torque characteristics, numerical problems on induction motor drives, closed loop operation of induction motor drives.

MODULE-IV	SPEED CONTROL OF INDUCTION MOTORS THROUGH ROTOR RESISTANCE AND VECTOR CONTROL	Classes: 09

Static rotor Resistance control: Slip power recovery schemes, static Scherbius drive, static Kramer drive, their performance and speed torque characteristics, advantages and applications, vector control of induction motor drives: Principles of vector control, vector control methods, direct methods of vector control, indirect methods of vector control and problems.

MODULE-V	SPEED CONTROL OF SYNCHRONOUS MOTORS	Classes: 09

Separate control and self control of synchronous motors, operation of self controlled synchronous motors by voltage source inverter and current source inverter cyclo converters. Load commutated CSI fed synchronous motor, operation, waveforms, speed torque characteristics, applications, advantages and numerical problems, closed loop control

operation of synchronous motor drives (block diagram only), variable frequency control, cycloconverter, PWM, variable frequency inverter and current source inverter.

Text Books:

1. G K Dubey, "Fundamentals of Electric Drives", Narosa Publications, 2nd Edition, 2001.
2. SB Devan, GR Slemon, A Straughen, "Power Semiconductor drives", Wiley Pvt. Ltd. 4th Edition, 2001.
3. PV Rao, "Power Semiconductor Drives", BS Publications, 1st Edition, 2014.
4. B K Bose, "Modern Power Electronics and AC Drives", Prentice Hall India Learning Private Limited, 2005

Reference Book

1. Vedam Subramanyam, "Thyristor Control of Electric Drives", Tata McGraw Hill Publication, 5th Edition, 2008.
2. John Hindmarsh, Alasdair Renfew", Electrical machines and drive systems", Oxford Butterworth Heinemann, 3rd Edition.
3. Austin Hughes, "Electrical motors and drives Fundamentals Types and Applications", Elsevier, 3rd Edition, 2006.
4. M D Singh, K B Kanchandhani, "Power Electronics", Tata Mc Graw Hill Publishing Company, 2nd Edition, 1998.
5. M H Rashid, "Power Electronics, Circuits, Devices and Applications", Pearson, 3rd Edition, 2001

J. Gnanavadivel, "Power Semiconductor drives", Anuradha, 2nd Edition, 2007

Web References:

1. https://www.nptel.iitm.ac.in
2. https://www.iare.ac.in
3. https://www.bookboon.com/en/introduction-to-power-electronics-ebook

E- Text Books:

1. https://www.freebookcentre.net
2. https://www.amazon.in/Fundamentals of electrical drives
3. https://www.circuitstoday.com

ELECTRICAL MEASUREMENTS AND INSTRUMENTATION

VI Semester: EEE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AEEB24	Core	3	-	-	3	30	70	100
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	Classes:09

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).

Text Books:

1. A K Sawhney, "Electrical and Electronic measurement and instruments", Dhanpat Rai and Sons Publications, 2002.
2. E W Golding and F C Widdis, "Electrical measurements and measuring instruments", Wheeler publishing, 5th Edition, 2006.

Reference Books:

1. Buckingham and Price, "Electrical measurements", Prentice Hall.
2. D V S Murthy, "Transducers and Instrumentation", Prentice Hall of India, 2nd Edition, 2009.
3. A S Morris, "Principles of measurement of instrumentation", Pearson/Prentice Hall of India, 2nd Edition, 1994.
4. H S Kalsi, "Electronic Instrumentation", Tata McGraw-Hill Publications, 1st Edition 1995.

Web References:

1. https://www.researchgate.net
2. https://www.aar.faculty.asu.edu/classes/
3. https://www.electrical4u.com
4. https://www.efficientcarbon.com/wp-content/uploads/2013/07/Net-Metering-and-Solar-Rooftop_Whitepaper_EfficientCarbon.pdf
5. https://www.electrical4u.com/digital-storage-oscilloscope/
6. https://www.iare.ac.in

E-Text Books:

1. https://www.jntubook.com
2. https://www.freeengineeringbooks.com
3. https://www.bookboon.com/en/mechanics

ELECTRICAL MEASUREMENTS AND INSTRUMENTATION LABORATORY

VI Semester: EEE

Course Code	Category	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AEEB25	Core	-	-	2	1	30	70	100
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes: 24				Total Classes: 24		

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

Expt. 1	**SENSING OF TEMPERATURE AND SPEED**

Measurement of temperature using transducers like thermocouple, thermistors and resistance temperature detector with signal conditioning; speed measurement using proximity sensor.

Expt. 2	**MEASUREMENT OF RESISTANCE**

Measurement of low resistance using Kelvin's double bridge

Expt. 3	**MEASUREMENT OF STRAIN AND PRESSURE**

Measurement of strain using strain gauge and measurement of pressure using differential pressure transducer.

Expt. 4	**MEASUREMENT OF POSITION AND LEVEL**

Measurement of position using encoders and measurement of level using capacitive transducer.

Expt. 5	**PHANTOM LOADING ON LPF WATTMETER**

Calibration of electrodynamometer type LPF wattmeter using phantom loading

Expt. 6	**CALIBRATION OF SINGLE PHASE ENERGY METER AND POWER FACTOR METER**

Calibration of single phase energy meter using resistive load and dynamometer power factor meter.

Expt. 7	**MEASUREMENT OF TURNS RATIO AND APPLICATIONS OF CTs**

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.

Expt. 8	**MEASUREMENT OF REACTIVE POWER**
Measurement of reactive power using one single phase wattmeter.	
Expt. 9	**CT TESTING USING MUTUAL INDUCTOR MEASUREMENT OF % RATIO ERROR AND PHASE ANGLE OF GIVEN CT BY NULL METHOD**
Measurement of % ratio error and phase angle of given ct by null method.	
Expt. 10	**CROMPTON DC POTENTIOMETER**
Calibration of PMMC ammeter and PMMC voltmeter.	
Expt. 11	**ANALYSIS OF WAVE FORMS, FREQUENCY AND THD USING DIGITAL SIMULATION**
Measurement and display of voltage, current wave forms, frequency Lissajeous patterns and THD using LabVIEW.	
Expt. 12	**MEASUREMENT OF THREE PHASE POWER**
Measurement of three phase power with single wattmeter and two numbers of current transformer.	
Expt. 13	**WORKING OF STATIC ENERGY METER USING DIGITAL SIMULATION**
Measurement of energy using static energy meter and verification with LabVIEW.	
Expt. 14	**MEASUREMENT OF PASSIVE PARAMETERS USING DIGITAL SIMULATION**
Inductance measurement using Anderson bridge and capacitance measurement using Schering bridge and verification with LabVIEW.	
Reference Books:	
1. https://www.bookpump.com/bwp/pdf-b/2335004b.pdf. 2. https://www.books.google.co.in › Technology & Engineering › Sensors 3. https://www.bambang.lecturer.pens.ac.id/rekayasa%20sensor%20aktuator/sensors%20&%20Trans. 4. https://www.sae.org/images/books/toc_pdfs/BELS036.pdf	
Web References:	
1. https://www.gnindia.dronacharya.info/EEEDept/Downloads/Labmanuals/EMI_Lab.pdf 2. https://www.scribd.com/doc/25086994/electrical-measurements-lab	
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

VI Semester: EEE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AEEB26	Core	-	-	2	1	30	70	100
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.	

Expt. 8	**IMPLEMENTATION OF TIMERS**
Implementation of ON - delay and OFF - delay timers using PLC.	
Expt. 9	**SOLAR TRACKING**
Solar tracking using programmable logic controller.	
Expt. 10	**DIRECT ONLINE STARTER**
Direct online starter for AC motor implementation using programmable logic controller.	
Expt. 11	**UP DOWN COUNTER**
Implementation of up down counter to count the objects in a store using programmable logic controller	
Expt. 12	**DIGITAL CLOCK**
Implementation of 24 hour digital clock using programmable logic controller.	
Expt. 13	**TIMERS**
Implementation of on delay, off delay and retentive timer using programmable logic controller.	
Expt. 14	**SEQUENTIAL CONTROL**
Sequential control of three motors to start one after the other with a time delay using programmable logic controller.	

Reference Books:

1. L A Bryan, E A Bryan, "Programmable Controllers: Theory & Implementation", Industrial Text Company Publications, 2nd Edition, 1997.
2. John R Hackworth & Frederick D. Hackworth Jr., "Programmable Logic Controllers: Programming methods and applications", Pearson education, 2008.

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

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AEEB27	Core	3	-	-	3	30	70	100
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 substation (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:

1. Badari Ram, D N Viswakarma, "Power System Protection and Switchgear", TMH Publications, 1st Edition, 2001.
2. Sunil S Rao, "Switchgear and Protection", Khanna Publishers, 1st Edition, 2013.

Reference Books:

1. A R van C Warrington, "Protective Relays: Their Theory and Practice", Springer Science & Business Media, Volume 2, 2nd Edition, 1977.
2. B L Soni, Gupta, Bhatnagar, Chakrabarthy, "Power System Engineering", Dhanpat Rai & Co, 3rd Edition, 2007.
3. T S Madhava Rao, "Power System Protection: static relays", McGraw-Hill Companies, 2nd Edition, 1989.
4. Paithankar, S R Bhide, "Fundamentals of Power System Protection", PHI, 1st Edition, 2003.
5. C LWadhwa, "Electrical Power Systems", New Age international (P) Limited, 6th Edition, 2010.
6. VK Mehta, "Principles of power systems", S Chand Publications, 4th Edition, 2009.

Web References:

1. https://www.eiseverywhere.com/file_uploads/aaf42a76a5588f69c7a1348d6f77fe0f_Introduction_to_System_Protection-_Protection_Basics.pdf
2. https://www.scribd.com/doc/94677925/Protection-and-Switch-Gear-by-U-a-bakshi-and-M-v-bakshi
3. https://www.scadec.ac.in/upload/file/psg%20notes_opt.pdf
4. https://www.vssut.ac.in/lecture_notes/lecture1425873259.pdf
5. https://www.en.wikipedia.org/wiki/Power-system_protection

E-Text Books:

1. https://www.igs.nigc.ir/STANDS/BOOK/Electrical-Eng-HB.pdf
2. https://www.file:///C:/Users/iare20071/Downloads/Electrical_Power_Systems_Quality_Second_Edition_007138622X.pdf
3. https://www.google.co.in/url?sa=t&rct=j&q=&esrc=s&source=web&cd=49&cad=rja&uact=8&ved=0ahUKEwiB89WRo5vQAhWMuY8KHYNDCPA4KBAWCEcwCA&url=http%3A%2F%2Fbank.engzenon.com%2Fdownload%2F565727ab-789c-4920-a807-4447c0feb99b%2Fpower_ system_ relaying_by_stanley_h_horowitz_4th.pdf&usg=AFQjCNFH1CozChcgjUBC3AUV_XJPG1Raog&bvm=bv.138169073,d.c2I

POWER SYSTEM OPERATION AND CONTROL

VII Semester: EEE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AEEB28	Core	3	-	-	3	30	70	100
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	Classes: 06

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:

1. C L Wadhwa, "Electrical power systems", New age International, 3rd Edition, 2005.
2. I J Nagarath, D P Kothari, "Modern power system analysis", Tata McGraw-Hill, 2nd Edition, 2006.

Reference Books:

1. Singh S N, "Electric Power Generation, Transmission and Distribution", Prentice Hall of India Pvt. Ltd., New Delhi, 2nd Edition, 2002.
2. T J E Miller, "Reactive power control in Electrical system", Wiley Interscience Publication, 1982.
3. V K Mehta and Rohit Mehta, "Principles of Power System", S Chand, 3rd revised Edition, 2015.
4. Turan Gonen, "Electrical Power Distribution System Engineering", CRC Press, 3rd Edition, 2014.
5. V Kamaraju, "Electrical Power Distribution Systems", TMH, Publication, Edition, 2009
6. O I Elgerd, "Electrical Energy Systems Theory", Tata McGraw-Hill, 2nd Edition, 2007.

Web References:

1. https://www.electrical4u.com/working-or-operating-principle-of-dc-motor
2. https://www.freevideolectures.com
3. https://www.ustudy.in › Electrical Machines
4. https://www.freeengineeringbooks.com

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

Course Code	Category	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AEEB29	Core	-	-	3	1.5	30	70	100
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

Expt. 1	**CHARACTERISTICS OF AN MCB**
Plotting the Characteristics of Miniature Circuit Breaker (MCB).	
Expt. 2	**CHARACTERISTICS OF FUSE AND THERMAL OVERLOAD PROTECTION**
Study of characteristics of High Rupturing Capacity (HRC) fuse and tripping of bimetallic thermal overload protection and its characteristics.	
Expt. 3	**ABCD PARAMETERS OF TRANSMISSION LINE**
Measurement of ABCD parameters of a transmission line.	
Expt. 4	**FERRANTI EFFECT IN A TRANSMISSION LINE**
Study of Ferranti effect in a transmission line.	
Expt. 5	**SURGE IMPEDANCE LOADING**
Study of Surge Impedance Loading (SIL) of a transmission line.	
Expt. 6	**EFFECT OF SHUNT COMPENSATION**
Determine shunt compensation to counteract the voltage rise on no load and zero regulation at different loads in a transmission line.	
Expt. 7	**VOLTAGE PROFILE IMPROVEMENT USING TAP CHANGING TRANSFORMER**
Study of voltage improvement by reactive power control using tap changing transformer.	

Expt. 8	**EFFICINCY AND REGULATION OF A TRANSMISSION LINE**
Determine the performance of a transmission line by calculating its efficiency and regulation.	
Expt. 9	**PERFORMANCE OF IMPEDANCE RELAY**
Study the working principle of impedance relay and its effect during faults in a transmission line.	
Expt. 10	**PERFORMANCE OF OVER CURRENT RELAY**
Study the working principle of over current relay and its effect during faults in a transmission line.	
Expt. 11	**EARTH FAULT PROTECTION**
Study of earth fault detection methods and various earth fault protection schemes.	
Expt. 12	**FEEDER PROTECTION**
Study the various protection schemes in radial feeder under various fault conditions.	
Expt. 13	**MEASURMENT OF SEQUENCE IMPEDANCES OF SYNCHRONOUS MACHINE**
Measurement of positive, negative and zero sequence impedances of synchronous machine by using direct method and fault analysis method.	
Expt. 14	**STRING EFFICIENCY OF INSULATORS**
Determination of string efficiency in a string of insulators.	

Reference Books:

1. Paithankar, S R Bhide, "Fundamentals of Power System Protection", PHI, 1st Edition, 2003.
2. C L Wadhwa, "Electrical Power Systems", New Age international (P) Limited, 6rd Edition, 2010.
3. VK Mehta, "Principles of power systems", S Chand Publications, 4th Edition, 2009.
4. T S Madhava Rao, "Power system Protection static relay", Tata McGraw-Hill Publishing Company limited, 2nd Edition, 1989.
5. Badri Ram and D N Vishwakarma, "Power system Protection and Switchgear ", Tata McGraw-Hill Publication company limited 1st Edition, 1995.

Web References:

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

LIST OF EQUIPMENT REQUIRED FOR A BATCH OF 36 STUDENTS:

S No	Name of the Equipment	No.s / Range
1	Miniature Circuit Breaker (MCB)	01
2	HRC Fuse	01
3	Impedance Relay	01
4	Over Current Relay	01
5	Earth Fault Relay	01
6	Radial Feeder Protection Unit	01
7	Transmission Line Simulating Unit	01
8	Three Phase Alternator	01
9	Capacitors / String Insulators	05

POWER SYSTEM SIMULATION LABORATORY

VII Semester: EEE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AEEB30	Core	-	-	3	1.5	30	70	100
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 system.
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.

Expt. 8	**STUDY OF TRANSMISSION SYSTEM AND SHORT CIRCUIT ANALYSIS OF 9 BUS SYSTEM**
Study of simple transmission system and also Perform short circuit analysis on IEEE 9 bus system using PSCAD.	
Expt. 9	**TRANSFORMER INRUSH CURRENT**
Determination of transformer inrush current under unbalanced three phase parameters using PSCAD.	
Expt. 10	**SMALL SIGNAL STABILITY ANALYSIS**
Development of PSCAD model for stability analysis of single machine - infinite bus with STATCOM.	
Expt. 11	**TRANSMISSION LINE PARAMETERS**
Obtaining parameters of a typical transmission line and modelling it in PSCAD.	
Expt. 12	**LOAD FREQUENCY CONTROL**
Obtain the frequency response of single and two area power system using PSCAD.	
Expt. 13	**POWER QUALITY**
Familiarization with PSCAD and understanding of reactive power and power factor correction in AC circuits, current harmonics drawn by power electronics interface.	
Expt. 14	**DISTANCE PROTECTION**
Development of PSCAD model to study the distance protection scheme in long transmission line.	

Reference Books:

1. M A Pai, "Computer Techniques in Power System Analysis", TMH Publications, 1st Edition, 2010
2. Grainger, Stevenson, "Power System Analysis", Tata McGraw-Hill, 1st Edition, 2010.
3. Badri Ram and D N Vishwakarma, "Power System Protection and Switchgear", Tata McGraw-Hill Publication company limited, 1st Edition, 1995.
4. Paithankar, S R Bhide, "Fundamentals of Power System Protection", PHI, 1st Edition, 2003.
5. C L Wadhwa, "Electrical Power Systems", New Age international (P) Limited, 6rd Edition, 2010.

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 (phase – I)

VII Semester: Common for all branches

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AEEB61	Core	0	0	10	5	30	70	100
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes: 150				Total Classes: 150		

The object of Project Work (phase – I) is to enable the student to take up investigative study in the broad field of Electrical & Electronics 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 (phase – II)

VIII Semester: Common for all branches

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AEEB62	Core	0	0	12	06	30	70	100
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes: 180				Total Classes: 180		

The object of Project Work (phase – II) & Dissertation is to enable the student to extend further the investigative study taken up under EE 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 EE P1;
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.

PROFESSIONAL ELECTIVES

ELECTRICAL MACHINE DESIGN

PE – I

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AEEB31	Elective	3	-	-	3	30	70	100
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, 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:

1. A K Sawhney, "A Course in Electrical Machine Design", Dhanpat Rai and Sons, 1st Edition, 1970.
2. MG Say, "Theory & Performance & Design of A.C. Machines", ELBS London, 2nd Edition, 1998.

Reference Books:

1. K M V Murthy, "Computer Aided Design of Electrical Machines", B S Publications, 2nd Edition, 2008.
2. A Shanmugasundaram, G Gangadharan and R Palani, "Electrical Machine Design Data Book", New Age International, 1st Edition, 1979.
3. S K Sen, "Principles of Electrical Machine Design with computer programmes", Oxford and IBH Publishing, 2nd Edition, 2006.
4. K L Narang, "A Text Book of Electrical Engineering Drawings", Satya Prakashan, 1st Edition, 1969.

Web References:

1. https://www.oreilly.com/library/view/electrical-machine-design/9789353063740/.
2. https://www.sanfoundry.com/1000-design-electrical-machines-questions-answers/
3. https://nptel.ac.in/courses/108106023/

E-Text Books:

1. https://www.forgottenbooks.com/en/books/ElectricalMachineDesign_10055170.
2. https://www.scribd.com/document/309280673/EEE-VI-ELECTRICAL-MACHINE-DESIGN-10EE63-NOTES-pdf.
3. https://www.forgottenbooks.com/en/books/ElectricalMachineDesign_10055170.

COMPUTATIONAL ELECTROMAGNETICS

PE – I

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AEEB32	Elective	3	-	-	3	30	70	100
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 magnetic 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 Helmhotz 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 AND FINITE ELEMENT METHOD	Classes:08

Finite Difference Method: Finite difference schemes, treatment of irregular boundaries, accuracy and stability of FD solutions, Finite Difference Time-Domain (FDTD) method- Uniqueness and convergence.

Finite Element Method: 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-IV	OTHER COMPUTATIONAL TECHNIQUES	Classes:09

Background of experimental methods-electrolytic tank, R-C network solution, Field, graphical plotting method, hybrid methods, coupled circuit, field computations, electromagnetic-thermal and electromagnetic, structural coupled computations, solution of equations, method of moments, Poisson's fields.

MODULE-V	APPLICATIONS	Classes:09

Low frequency electrical devices, static / time-harmonic / transient problems in transformers, rotating machines, actuators. CAD packages.

Text Books:

1. M. N. O. Sadiku, "Numerical Techniques in Electromagnetics", CRC press, 2001.
2. P. P. Silvester and R. L. Ferrari "Finite Element for Electrical Engineers", Cambridge University press, 1996.

Reference Books:
1. Jin, Jian-Ming, "The Finite Element Method in Electromagnetics", IEEE Press, 3rd Edition, Wiley Publishers, 1962. 2. Andrew F. Peterson , Scott L. Ray, "Computational Methods for Electromagnetics, 1st Edition, IEEE Press, Wiley Publishers, 1997. 3. Anastasis Polycarpou, "Introduction to the Finite Element Method in Electromagnetics (Synthesis Lectures on Computational Electromagnetics, Morgan and Claypool Publishers, 2006.
Web References:
1. https://nptel.ac.in/courses/108/101/108101090/ 2. Lecture notes from iare website http://www.iare.ac.in 3. https://nptel.ac.in/courses/108/106/108106152/
E-Text Books:
1. https://www.engbookspdf.com/download/matlab/Computational-Electromagnetics-MATLAB 2. https://www.freebookcentre.net 3. http://home.cc.umanitoba.ca/~lovetrij/cECE4390/Notes/Sadiku.ch6.pdf

SPECIAL ELECTRICAL MACHINES

PE – I

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AEEB33	Elective	3	-	-	3	30	70	100
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	Classes: 08

Reluctance motors: Constructional features, types, axial and radial flux motors, operating principles, variable reluctance motors, voltage and torque equations, phasor diagram, performance characteristics, applications.

MODULE-II	STEPPER MOTORS	Classes: 08

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.

MODULE-III	SWITCHED RELUCTANCE MOTORS (SRM)	Classes: 10

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.

MODULE-IV	PERMANENT MAGNET BRUSHLESS D.C. MOTORS	Classes: 09

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.

MODULE-V	PERMANENT MAGNET SYNCHRONOUS MOTORS (PMSM)	Classes: 10

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.

Text Books:

1. K Venkataratnam, "Special Electrical Machines", Universities Press (India) Private Limited, 2nd Edition, 2008.
2. T J E Miller, "Brushless Permanent Magnet and Reluctance Motor Drives", Clarendon Press, 1st Edition, 1989.
3. T Kenjo, "Stepping Motors and Their Microprocessor Controls", Clarendon Press London, 1st Edition, 1984.

Reference Books:

1. R Krishnan, "Switched Reluctance Motor Drives: Modeling, Simulation, Analysis, Design and Application", CRC Press, 1st Edition, 2001.
2. P P Aearnley, "Stepping Motors: A Guide to Motor Theory and Practice", Peter Perengrinus London, 2nd Edition, 1982.
3. T Kenjo and S Nagamori, "Permanent Magnet and Brushless DC Motors", Clarendon Press, 1st Edition, 1988.
4. E G Janardanan, "Special electrical machines", PHI learning Private Limited, 2nd Edition, 2014.

Web References:

1. https://www.textofvideo.nptel.iitm.ac.in/108103007/lec1.pdf
2. https://www.books.askvenkat.com/engineering-textbooks-materials-notes-free-download/
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E-Text Books:

1. https://www.sasurieengg.com/e-course-material/EEE/IV-Year%20Sem%207/EE2403%20Special%20Electrical%20Machines.pdf
2. https://www.textbooksonline.tn.nic.in/
3. https://www.faadooengineers.com/threads/32837-Control-Systems-Engineering-by-Norman-S-Nise-full-books-pdf-download

ELECTRICAL ENERGY CONSERVATION AND AUDITING

PE – I

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AEEB34	Elective	3	-	-	3	30	70	100
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, bench marking, 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	Classes: 08

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:

1. Anthony J Pansini, Kenneth D Smalling, "Guide to Electric Load Management", Pennwell Pud, 2nd Edition, 1998.
2. E Jordan, "Energy-Efficient Electric Motors and Their Applications", Plenum Publication, corp, 2nd Edition, 1994.

Reference Books:

1. Y P Abbi, and Shashank Jain, "Energy Audit and Environment Management", Hand book on, 2nd Edition 2006.
2. S C Tripathy, "Utilization of Electrical Energy and Conservation", McGraw Hill, 1st Edition, 1991.
3. Albert Thumann, William J Younger, Terry Niehus, "Hand book of Energy Audits, 2nd Edition, 2009.
4. Giovanni Petrecca, "Industrial Energy Management", "Principles and Applications", The Kluwer international series - 207, 2nd Edition, 1999.

Web References:

1. http://www.rroij.com/open-access/energy-conservation-andaudita-case-study.php?aid=42307
2. http://www.ijsrp.org/research-paper-0813/ijsrp-p2044.pdf
3. https://beeindia.gov.in/sites/default/files/1Ch3.pdf
4. https://www.slideshare.net/rayvarun/energy-conservation-ppt-by-vp-singh
5. 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
2. https://www.worldcat.org/title/energy-management-audit-and-conservation/oclc/891484955

DIGITAL CONTROL SYSTEMS

PE: II

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AEEB35	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

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:

1. B C Kuo, “Digital Control Systems”, Oxford University Press, 2nd Edition, 2007.
2. K Ogata, “Discrete Time Control Systems”, Prentice Hall, 2nd Edition, 1995.
3. M Gopal, “Digital Control and State Variable Methods”, Tata McGraw-Hill, 2nd Edition, 2003.

Reference Books:

1. K Warwick, D Rees, “Industrial Digital Control Systems”, Peter Peregrines Ltd. 2nd Edition, 1988.
2. K J Astroms and B. Wittenmark, “Computer Controlled Systems - Theory and Design”, Prentice Hall, 3rd Edition, 1997.
3. Richard C Dorf, Robert H. Bishop, “Modern Control Systems”, Pearson Education inc., 1st Edition, 2008.

Web References:

1. https://www.nptel.ac.in/syllabus/108103008/
2. https://www.sciencedirect.com/science/book/9780123744982
3. https://www.springer.com/us/book/9781846280559

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

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AECB63	Elective	3	-	-	3	30	70	100
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:

1. B.P. Lathi, “Signals, Systems & Communications”, BS Publications, 2009.
2. A.V. Oppenheim, A.S. Willsky and S.H. Nawab, “Signals and Systems”, PHI, 2nd Edition 2009.
3. John G. Proakis, Dimitris G. Manolakis, “Digital Signal Processing, Principles, Algorithms, and Applications” Pearson Education / PHI. 2007.

Reference Books:

1. Simon Haykin and Van Veen, “Signals & Systems” Wiley, 2nd Edition, 2009.
2. Iyer and K. Satya Prasad, “Signals and Signals”, Cengage Learning, 2nd Edition, 2009.
3. A. V. Oppenheim and R.W. Schaffer, “Discrete Time Signal Processing”, PHI, 2009.
4. Loney Ludeman. John Wiley, “Fundamentals of Digital Signal Processing” PHI, 2009

Web References:

1. https://www.edx.org/course/discrete-time-signal-processing-mitx-6-341x-1
2. https://www.mooc-list.com/course/digital-signal-processing-coursera

E-Text Books:

1. http://onlinevideolecture.com/ebooks
2. http://www.freebookcentre.net/SpecialCat/Free-Signal-Processing-Boo

CONTROL SYSTEMS DESIGN

PE: II

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AEEB37	Elective	3	-	-	3	30	70	100
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

Introduction to compensator. Design of Lag, lead lag-lead compensator in time domain. Feedback and Feed forward compensator design. Feedback compensation. Realization of compensators.

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:

1. N Nise, “Control system Engineering”, John Wiley, 1st Edition, 2000.
2. I J Nagrath and M. Gopal, “Control system engineering”, Wiley, 1st Edition, 2000..

Reference Books:

1. M Gopal, “Digital Control Engineering”, Wiley Eastern, 1st Edition, 1988.
2. K Ogata, “Modern Control Engineering”, Prentice Hall, 1st Edition, 2010.
3. B C Kuo, “Automatic Control system”, Prentice Hall, 1st Edition, 1995.
4. J J D’Azzo and C. H. Houpis, “Linear Control System Analysis and Design (conventional and modern)”, McGraw Hill, 1st Edition, 1995.
5. R T Stefani and G. H. Hostetter, “Design of Feedback Control Systems”, Saunders College Pub, 1st Edition, 1994.

Web References:

1. https://www.researchgate.net
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

PE: II

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AEEB38	Elective	3	-	-	3	30	70	100
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

Choice of state variables in Electrical networks-Formulation of state equations for Electrical networks Equivalent source method. Network topological method - Solution of state equations-Analysis of simple networks with state variable approach.

MODULE-II	FOURIER SERIES AND FOURIER TRANSFORM REPRESENTATION	Classes: 09

Introduction, Trigonometric form of Fourier series, Exponential form of Fourier series, Wave symmetry, Fourier integrals and transforms, Fourier transform of a periodic function , Properties of Fourier Transform , Parseval's theorem , Fourier transform of some common signals, Fourier transform relationship with Laplace Transform. Applications of Fourier series and Fourier Transform Representation: Introduction, Effective value, and average values of non sinusoidal periodic waves, currents, Power Factor, Effects of harmonics, Application in Circuit Analysis, Circuit Analysis using Fourier Series.

MODULE-III	LAPLACE TRANSFORM APPLICATIONS	Classes: 09

Application of Laplace transform Methods of Ananlysis – Response of RL, RC, RLC Networks to Step, Ramp, and impulse functions, Shifting Theorem – Convolution Integral – Applications Testing of Polynomials: Elements of realisability - Hurwitz polynomials-positive real functions-Properties-Testing-Sturm's Test, examples.

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	Classes: 09

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:

1. B. P. Lathi", "Signals, Systems and Communications", BS Publications 2003.
2. Umesh Sinha, "Network Analysis and Synthesis", Satya Prakashan Publications, 2013.

Reference Books:

1. A. N. Tripathi, "Linear System Analysis", New Age International, 2nd Edition 1987.
2. D. Roy Chowdhary, "Network and Systems", New Age International, 2005.
3. Gopal G Bhise, Prem R. Chadha", Engineering Network Analysis and Filter Design, Umesh Publications 2009
4. A. Cheng, linear system analysis, Oxford publishers, 1999.

Web References:

1. https://www.aar.faculty.asu.edu/classes.
2. https://www.books.askvenkat.com/engineering-textbooks/
3. https://www.electrical4u.com.

E-Text Books:

1. https://www.freebookcentre.net

POWER SYSTEM STABILITY

PE: III

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AEEB39	Elective	3	-	-	3	30	70	100
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

Definition of stability, classification of stability, rotor angle stability, frequency stability, voltage stability, midterm and long term stability, classical representation of synchronous machine in a single machine infinite bus system (SMIB), equal area criterion to asses stability of a single machine infinite bus system, limitations of classical model of synchronous machines.

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

Fundamentals of transient stability, numerical solutions: simultaneous implicit and partitioned explicit methods, simulation of dynamic response, analysis of unbalanced faults, direct method of transient stability, transient energy function method, methods of improving transient stability.

MODULE- V	VOLTAGE STABILITY	Classes: 08

Classification of voltage stability, modeling requirements, voltage stability analysis, static and dynamic, sensitivity analysis, modal analysis, voltage collapse.

Text Books:

1. P Kundur, “Power system stability and control”, Tata McGraw-Hill, 1st Edition, 2001.
2. M A Pai and Peter W Sauer, “Power system stability”, Pearson Education, 1st Edition, 2000.

Reference Books:

1. M A Pai, K Sengupta and K R Padiyar, “Topics on Small Signal Stability Analysis”, Tata McGraw-Hill, 1st Edition, 2005.
2. K R Padiyar, “Power system dynamics”, BSP publications, 2nd Edition, 2010.
3. Paul M Anderson and A Fouad, “Power system stability”, Wiley-inter science, 1st Edition, 2002.

Web References:

1. https://www.researchgate.net
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

POWER SYSTEM DYNAMICS AND CONTROL

PE: III

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AEEB40	Elective	3	-	-	3	30	70	100
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:

1. K R Padiyar, "Power system dynamics", B S Publications, 1st Edition, 2001.
2. P M Anderson and A A Fouad, "Power system control and stability", IEEE Press, 2003.

Reference Books:

1. R Ramanujam, "Power Systems Dynamics", PHI Publications, 1st Edition, 1998.

Web References:
1. https://www.eecs.umich.edu/eecs/pdfs/news/Hiskens598.pdf 2. https:// www.onlinecourses.nptel.ac.in/noc19_ee14/preview
E-Text Books:
1. https://courses.engr.illinois.edu/ece576/sp2018/Sauer%20and%20Pai%20book%20-%20Jan%202007 .pdf. 2. https://www.researchgate.net/publication/41231911_Power_System_Dynamics_Stability_and_Control

ELECTRICAL SAFETY AND SAFETY MANAGEMENT

PE - III

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AEEB41	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil		Practical Classes: Nil			Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Introduce IE rules and its significance in commercial electrical systems.
II. Realize the electrical safety in residential, commercial and industrial installations.
III. Demonstrate installation, testing and commissioning, operation and maintenance.
IV. Summarize the effect of power factor on Quality control and management.

MODULE-I	**REVIEW OF IE RULES AND ACTS AND THEIR SIGNIFICANCE**	**Classes: 09**

Objective and scope: Ground clearances and section clearances, standards on electrical safety, safe limits of current, voltage; earthing of system neutral, codes of conduct, rules regarding first - aid and fire fighting facility.

MODULE-II	**ELECTRICAL SAFETY IN RESIDENTIAL, COMMERCIAL AND AGRICULTURAL INSTALLATIONS**	**Classes: 09**

Wiring and fitting: Domestic appliances, water tap giving shock, shock from wet wall, fan Firing shock; multi-storied building, Temporary installations, Agricultural pump installation, Do's and Don'ts for safety in the use of domestic electrical appliances.

MODULE-III	**SAFETY DURING INSTALLATION, TESTING AND COMMISSIONING, OPERATION AND MAINTENANCE**	**Classes: 09**

Safety during Installation: Preliminary preparations, safe sequence, risk of plant and equipment, safety documentation, field quality and safety;

Protective Equipment: Personal protective equipment, safety clearance notice, safety precautions, safe guards for operators, safety.

MODULE-IV	**ELECTRICAL SAFETY IN HAZARDOUS AREAS**	**Classes: 09**

Hazardous zones: class0, 1 and 2; spark, flash overs and corona discharge and functional requirements, Specifications of electrical plants, equipments for hazardous locations, Classification of equipment enclosure for various hazardous gases and vapours, classification of equipment / enclosure for hazardous locations.

MODULE-V	**ELECTRICAL SAFETY IN DISTRIBUTION SYSTEM**	**Classes: 09**

Total quality control and management: Importance of high load factor, Disadvantages of low power factor, Causes of low P.F., power factor improvement, equipments, Importance of P.F. improvement.

Text Books:

1. S. Rao, Prof. H.L. Saluja, "Electrical safety, fire safety Engg and safety management", Khanna Publishers, New Delhi, 1988.
2. Pradeep Chaturvedi, "Energy management policy, planning and utilization", Concept Publishing company,New Delhi, 1997.

Reference Books:

1. Nagrath. I.J. and Kothari. D.P. “Power System Engineering”, Tata McGrawHill Publishing company Ltd. New Delhi, 1998.
2. R. K. Jain and Sunil S. Rao, “Industrial Safety, Health and Environment Management Systems”, Khanna Publishers, 1st Edition, 2000.
3. Prekash Sesha, “Manual of Fire Safety”, CBS Publishers and Distributers Limited, 1st Edition, 2017
4. Basudev Panda, “Industrial Safety, Health Environment and Security”, University Science Press, 2nd Edition, 2013.
5. M. P. Poonia, S. C. Sharma, “Industrial Safety and Maintenance Management”, Khanna Publishers, 1st Edition, Re-Print, 2019.

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1. http://www.qelectrical.com.au/profile/Quality-Safety-and-Environment.aspx
2. https://electrical-engineering-portal.com/21-safety-rules-for-working-with-electrical-equipment
3. https://www.lanl.gov/safety/electrical/docs/arc_flash_safety.pdf
4. https://www-d0.fnal.gov/~hance/doe_esh.pdf

E-Text Books:

1. https://law.resource.org/pub/us/cfr/ibr/004/ieee.c2.2007.pdf
2. https://www.engbookspdf.com/Electrical-Books/Electrical-Safety-Code-Manual
3. https://www.nfpa.org/NEC/electrical-codes-and-standards
4. https://www.academia.edu/34853171/IEEE_Std_134324538_Electrical_Safety_Code_Manual_pdf
5. https://www.labtrain.noaa.gov/osha600/refer/menu12a.pdf
6. http://environmentclearance.nic.in/writereaddata/FormB/EC/Risk_Assessment/161220151OW2FVMUAllStdCodes.pdf

REAL TIME CONTROL OF POWER SYSTEMS

PE : III

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AEEB42	Elective	3	-	-	3	30	70	100
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:

1. R N Dhar, "Computer Aided Power Systems Operation and Analysis", Tata McGraw-Hill, 2nd Edition, 1982.
2. LP Singh, "Advanced Power System Analysis and Dynamics", Wiley Eastern Ltd., 1st Edition, 1986.
3. Prabha Kundur, "Power System Stability and Control", McGraw Hill, 1st Edition, 1994.
4. P D Wasserman, "Neural Computing Theory and Practice", Van Nostrand - Reinhold, New York, 1st Edition, 1989.

Reference Books:

1. John J Grainger and William D Stevenson, Jr., "Power System Analysis", McGraw-Hill, 1st Edition, 1994,
2. Allen J Wood and Bruce F Wollen berg, "Power Generation operation and control", John Wiley & Sons, 1st Edition ,1984.

Web References:

1. https://www.certs.lbl.gov/sites/all/files/rt-security-monitoring_0
2. https://www.researchgate.net/.../2993799
3. https://www.ieeexplore.ieee.org/iel5/5/31182/01451471

E-Text Books:

1. https://www.calvin.edu/.../Power%20Systems%20Interim 2. 2.
2. https://www.onlinelibrary.wiley.com/doi/10.1002/9780470423912.fmatter
3. https://www.selixc.com/api/download/248
4. https://www.cdn.intechopen.com/pdfs/37991.pdf

Course Home Page:

HVDC TRANSMISSION

PE: IV

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AEEB43	Elective	3	-	-	3	30	70	100
Contact Classes:45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

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.

MODULE-V	MTDC LINKS	Classes: 09

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.

Text Books:

1. K R Padiyar, "HVDC Power Transmission Systems: Technology and system Interactions", New Age International (P) Limited, 1st Edition, 1999.
2. S Rao, "EHVAC and HVDC Transmission Engineering and Practice", PHI, 3rd Edition, 1990.

Reference Books:

1. J Arrillaga, "High Voltage Direct Current Transmission", Peter Peregrinus Ltd., 1st Edition 1983.
2. E W Kimbark, "Direct Current Transmission", Vol.1, Wiley-Interscience, 1st Edition 1971.
3. E Uhlmann, "Power Transmission by Direct Current", B S Publications, 1st Edition, 1975.

Web References:

1. https://www.as.wiley.com/WileyCDA/WileyTitle/productCd-1118634039.html.
2. https://www.academia.edu/3409546/Power_Electronics_Application_in_Renewable_Energy_System
3. https://www.springer.com/us/book/9788132221180.
4. https://www.springer.com/us/book/9781447151036.

E- Text Books:

1. https://www.ijtra.com/view/role-of-power-electronics-in-non-renewable-and-renewable-energysystems.pdf.
2. https://www.nitgoa.ac.in/News_files/STC.pdf.
3. https://www.jee.ro/covers/art.php?issue=WN1438788776W55c22ca867606.
4. https://www.magnelab.com/wp-content/uploads/2015/01/Role-of-power-electronics-in-renewableenergy-systems.pdf.

EHV AC TRANSMISSION

PE: IV

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AEEB44	Elective	3	-	-	3	30	70	100
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 electro static 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 electrostatic 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.

MODULE-V	VOLTAGE CONTROL	Classes: 09
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.		

Text Books:

1. R D Begamudre, " EHVAC Transmission Engineering", New Age International (p) Ltd, 1st Edition, 2010.
2. S Rao, "HVAC and DC Transmission", Khanna Publishers, 3rd Edition, 2010.

Reference Books:

1. Rokosh Das Begamudre, "Extra High Voltage AC Transmission Engineering", Wiley Eastern Limited, 1st Edition, 2010.
2. Sanjay Kumar Sarma, "EHV-AC, HVDC Transmission and Distribution Engineering", Kataria & Sons, 1st Edition, 2014.

Web References:

1. https://www.rceroorkee.in/pdf/pdfo/tee033.pdf
2. https://www.books.google.com/books?id=e24fndv2aroc
3. https://www.nptel.ac.in/syllabus/108108033/

E-Text Books:

1. https://www.rceroorkee.in/pdf/pdfo/tee033.pdf
2. https://www.archive.org/stream/extrahighvoltage00meht/extrahighvoltage00meht_djvu.txt

POWER ELECTRONICS IN RENEWABLE ENERGY SYSTEMS

PE: IV

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AEEB45	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

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 TO RENEWABLE ENRGY SYSTEMS	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

Renewable energy conversion systems: fundamental principle of operation of self excited induction generator, squirrel cage induction generator, doubly fed induction generator, synchronous generator, permanent magnet synchronous generator; Grid related problems: harmonic reduction and power factor improvement

MODULE-III	POWER CONVERTERS	Classes: 09

Solar: Block diagram of solar photo voltaic system, Line commutated converters (inversion mode), boost and buck-boost converters, selection of inverter, battery sizing, array sizing. Wind: three phase AC voltage controllers used in wind energy conversion.

Switching devices: AC - DC converters, 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), biomass-fuel cell hybrid systems, fuel cell-PV hybrid system and wind-fuel cell hybrid system

Text Books:
1. Mukund R Patel, “Wind and Solar Power Systems”, CRC Press, 1st Edition, 1999. 2. Publications, 2nd Edition, 2001. G D Rai, “Non- Conventional Energy Resources”, Khanna Publishers, 1st Edition, 2002.
Reference Books:
1. Daniel, Hunt. V Wind Power, A Hand Book of WECS, Van Nostrend Co., Newyork, 2nd Edition, 1998. 2. ArindamGhosh, Gerard Ledwich, “Power Quality Enhancement Using Custom Power Devices”, Springer, 1st Edition, 2002. 3. Roger C Dugan, Mark E Mc. Granaghan, Surya Santosoh and H. Wayne Beaty, “Electrical Power Systems Quality”, TATA McGraw Hill, 2nd Edition, 2010.
Web References:
1. https://www.NPTEL video lectures. 2. https://www.electrical4u.com.
E-Text Books:
1. https://www.freebookcentre.net 2. https://www.books.askvenkat.com/engineering-textbooks

WIND AND SOLAR ENERGY SYSTEMS

PE: IV

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AEEB46	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

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 Z 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

Solar Photovoltaic Power System: The PV Cell, module and array, equivalent electrical circuit, open circuit voltage and short circuit current, I-V and P-V curves, array design, peak power point operation, PV system components; Solar Thermal System: Energy collection, synchronous generator, equivalent electrical circuit, excitation methods, electrical power output, transient stability limit, commercial power plants.

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:

1. Mukund R Patel, “Wind and Solar Power Systems”, CRC Press, 1st Edition, 1999.
2. G D Rai, “Non- Conventional Energy Resources”, Khanna Publishers, 1st Edition, 2002.

Reference Books:

1. Daniel, Hunt. V Wind Power, A Hand Book of WECS, Van Nostrend Co., Newyork, 2nd Edition, 1998.
2. Arindam Ghosh, Gerard Ledwich, “Power Quality Enhancement Using Custom Power Devices”, Springer, 1st Edition, 2002.
3. Roger C Dugan, Mark E Mc. Granaghan, Surya Santosoh and H. Wayne Beaty, “Electrical Power Systems Quality”, TATA Mc Graw Hill, 2nd Edition, 2010.

Web References:

1. https://www.NPTEL video lectures.
2. https://www.books.askvenkat.com/engineering-textbooks/
3. https://www.electrical4u.com.

E-Text Books:

1. Arindam Ghosh, Gerard Ledwich, Power Quality Enhancement Using Custom Power Devices, Springer, 2002.
2. https://www.freebookcentre.net

HIGH VOLTAGE ENGINEERING

PE: V

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AEEB47	Elective	3	-	-	3	30	70	100
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:

1. S Naidu, V Kamaraju, “High Voltage Engineering”, Tata McGraw-Hill, 5th Edition, 2013.

2. E Kuffel, W S Zaengl, J Kuffel, “High voltage Engineering fundamentals”, Newnes, 2nd Edition Elsevier, New Delhi, 2005.

Reference Books:

1. L L Alston, “High Voltage Technology”, Oxford University Press, 1st Indian Edition, 2011.
2. C L Wadhwa, “High Voltage Engineering”, New Age International Publishers, 3rd Edition, 2010.
3. Subir Ray, “An Introduction to High Voltage Engineering”, PHI Learning Private Limited, New Delhi, 2nd Edition, 2013.

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
4. https://www.wikipedia.org/wiki/High_voltage
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
3. https://www.itebooks.zone/1849192634.html
4. https://www.studynama.com/community/threads/329-High-voltage-engineering-ebook-pdf-lecture-notes-download-for-electrical

ENERGY STORAGE SYSTEMS

PE: V

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AEEB48	Elective	3	-	-	3	30	70	100
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.

Text Books:

1. James M. Eyer, Joseph J. Iannucci and Garth P. Corey, “Energy Storage Benefits and Market Analysis”, Sandia National Laboratories, 2004.
2. The Electrical Energy Storage by IEC Market Strategy Board.
3.

Reference Books:

1. Jim Eyer, Garth Corey, Energy Storage for the Electricity Grid: Benefits and Market Potential Assessment Guide, Report, Sandia National Laboratories, Feb 2010.

Web References:

1. https://www.textofvideo.nptel.iitm.ac.in/108103007/lec1.pdf
2. https://www.books.askvenkat.com/engineering-textbooks-materials-notes-free-download/
3. https://www.freeengineeringbooks.com

E-Text Books:

1. https://www.sasurieengg.com/e-course-material/EEE/IV-Year%20Sem%207/EE2403%20Special%20Electrical%20Machines.pdf
2. https://www.textbooksonline.tn.nic.in/
3. https://www.faadooengineers.com/threads/32837-Control-Systems-Engineering-by-Norman-S-Nise-full-books-pdf-download

POWER QUALITY AND FACTS

PE: V

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AEEB49	Elective	3	-	-	3	30	70	100
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:

1. Narain G.Hingorani, Laszi Gyugyi, Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems, IEEE press, Delhi, 2nd Edition, 2001.
2. Roger C Dugan, Mark F Mc Granaghan, Surya Santoso, H.WayneBeaty, Electrical Power Systems Quality, TMH Education Pvt. Ltd., 3rd Edition, 2012.

Reference Books:

1. Math H J Bollen, "Understanding Power quality problems", IEEE Press, 2nd Edition, 2007.
2. Arindam Ghosh,Gerard Ledwich , "Power Quality Enhancement using Custom Power Devices", Kluwer Academic Publishers, 2nd Edition, 2002.
3. Mohan Mathur, Rajiv K Varma, "Thyristor - based FACTS Controllers for Electrical Transmission Systems", A John Wiley and Sons Publications, 2nd Edition, 2002.

Web References:

1. http://www.powerqualityworld.com/.
2. https://www.researchgate.net.
3. https://www.aar.faculty.asu.edu/classes.

E-Text Books:

1. Arindam Ghosh, Gerard Ledwich, Power quality enhancement using custom power devices, Kluwer academic publishers, 2002.
2. https://www.freebookcentre.net.

SWITCH MODE POWER SUPPLIES

PE: V

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AEEB50	Elective	3	-	-	3	30	70	100
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

Introduction to Switched Mode Power Supply Topologies, The Power Supply Designer's Guide to High Voltage Transistors;

Base Circuit Design for High Voltage Bipolar Transistors in Power Converters, Isolated Power Semiconductors for High Frequency Power Supply Applications.

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

Introduction, variable SMPS techniques, operating principles, practical limiting factors, Efficiency and EMI Applications. Resonant Power Supplies: An Introduction to Resonant Power Supplies, Resonant Power Supply Converters - The Solution for Mains Pollution Problems.

Text Books:

1. Keith H. Billings and Taylor Morey, “Switch Mode Power Supplies”, Tata McGraw-Hill Publishing Company, 3rd edition 2010.
2. Robert W. Erickson, “Switch Mode Power Supplies”, Springer, 2nd Edition 2001.

Reference Books:

1. Sanjaya Maniktala, “Switching Power Supplies A-Z”, Elsevier, 2nd Edition 2012.
2. Steven M. Sandler”, Switch Mode Power Supplies, Tata McGraw Hill, 1st Edition 2006.

Web References:

1. http://www.powerqualityworld.com/.
2. https://www.researchgate.net.
3. https://www.aar.faculty.asu.edu/classes.

E-Text Books:

1. https://www.freebookcentre.net.

UTILIZATION OF ELECTRIC POWER

PE:VI

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AEEB51	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

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 DC 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:

1. S Sivarnagaraju, D Srilatha, M Balasubbareddy, "Generation and Utilization of Electrical Energy", Pearson Education India, 1st Edition, 2010.
2. E Openshaw Taylor, Orient Longman , "Utilizations of Electric Energy", 1st Edition, 2003.

Reference Books:

1. N V Suryanarayana, "Utilization of Electrical Power including Electric drives and Electric traction New Age International (P) Limited, Publishers, 1st Edition, 1996.
2. C L Wadhwa, "Generation, Distribution and Utilization of electrical Energy", New Age International (P) Limited, 1st Edition,1997.
3. Partab, "Art & Science of Utilization of electrical Energy", Dhanpat Rai &Sons 2nd Edition, 2000.

Web References:

1. https://lecturenotes.in/subject/386/utilization-of-electric-energy-uee
2. http://shareurnoteshere.blogspot.com/2015/01/utilisation-of-electrical-power-by-r-k.html
3. https://lecturenotes.in/notes/14714-note-for-utilization-of-electric-energy-uee-by-jntu

E-Text Books:

1. https://www.freebookcentre.net
2. https://www.amazon.in/Utilisation-Electrical-Power-R-K-Rajput/dp/8131808297
3. https://plus.google.com/+GoogleforgeniusBlogspot1/posts/MuFTRDqJ3iJ

INDUSTRIAL ELECTRICAL SYSTEMS

PE:VI

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AEEB52	Elective	3	-	-	3	30	70	100
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:

1. S L Uppal and G C Garg, "Electrical Wiring, Estimating & Costing", Khanna publishers, 2nd Edition, 2008.
2. K B Raina, "Electrical Design, Estimating & Costing", New age International, 2nd Edition, 2007.
3. S Singh and R D Singh, "Electrical estimating and costing", Dhanpat Rai and Co., 1st Edition, 1997.

Reference Books:

1. Amman Jordan, Mohammad Tawfeeq ALZu "hairi, Electrical Installation for buildings & facilities", 2nd Edition 2016.
2. H. Joshi, "Residential Commercial and Industrial Systems", McGraw Hill Education, 3rd Edition, 2008.
3. Gupta J B Katson, Ludhiana, "Electrical Installation, estimating and costing", S K Kataria and sons, 3rd Edition, 2013.

Web References:

1. http://www.turfproductscorp.com/wp-content/uploads/2017/07/Service
2. https://en.wikipedia.org/wiki/Electric_power_system
3. https://nptel.ac.in/courses/Webcourse

E-Text Books:

1. http://www.newelectric.com/what-we-do/services/industrial-automation/
2. https://en.wikipedia.org/wiki/Electric_light

SMART GRID TECHNOLOGY

PE: VI

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AEEB53	Elective	3	-	-	3	30	70	100
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 and extended formulations, 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

Voltage stability assessment: Voltage stability analysis tools, voltage stability assessment techniques, voltage stability indexing application and implementation plan of voltage stability in smart grid, angle stability assessment in smart grid approach of smart grid to state estimation, energy management in smart grid.

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:

1. James Momoh, "Smart Grid: Fundamentals of design and analysis", John Wiley & sons Inc, 2nd Edition, 2012.
2. Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama, "Smart Grid: Technology and Applications", John Wiley & sons inc., 1st Edition, 2012.

Reference Books:

1. Clark W Gellings, "The smart grid: Enabling energy efficiency and demand response", Fairmont Press Inc, 2nd Edition, 2009.
2. Fereidoon P Sioshansi, "Smart Grid: Integrating Renewable, Distributed & Efficient Energy", Academic Press, 2nd Edition, 2012.

Web References:

1. https://www.researchgate.net
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

PE:VI

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AEEB54	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

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	Classes: 09

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:

1. C Mi, M A Masrur and DW Gao, "Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives", John Wiley & Sons, 1st Edition, 2011.
2. S Onori, L Serrao and G Rizzoni, "Hybrid Electric Vehicles: Energy Management Strategies", Springer, 2015.
3. Mehrdad Ehsani, Yimi Gao, Sebastian E Gay, Ali Emadi, "Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals Theory and Design", CRC Press, 2nd Edition, 2004.
4. T Denton, "Electric and Hybrid Vehicles", Routledge, 1st Edition, 2016.

Reference Books:

1. James Larminie, John Lowry, "Electric Vehicle Technology", Wiley publications, 1st Edition, 2003
2. Iqbal Hussein, "Electric and Hybrid Vehicles: Design Fundamentals", CRC Press, 2nd Edition, 2003.
3. B D McNicol, D A J Rand, "Power Sources for Electric Vehicles", Elsevier publications, 1st Edition, 1998.
4. Seth Leitman, "Build Your Own Electric Vehicle" McGraw-Hill, 1st Edition, 2013.

Web References:

1. https://www.ae.pwr.wroc.pl/filez/20110606092353_HEV.pdf
2. https://www.unep.org/transport/pcfv/PDF/HEV_Report.pdf
3. https://www.seai.ie/News_Events/Press_Releases/Costs_and_benefits.pdf
4. https://www.afdc.energy.gov/pdfs/52723.pdf
5. https://www.leb.eei.uni-langen.de/winterakademie/2010/report/content/course03/pdf/0308.pdf

E-Text Books:

1. https://www.kobo.com/us/en/ebook/electric-and-hybrid-vehicles-2
2. https://www.onlinelibrary.wiley.com/book/10.1002/9781119998914
3. https://www.go2hev.com/hybrid-electric-vehicles-student-textbook.html

COMPUTER ARCHITECTURE

OE – I

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
ACSB32	Elective	3	0	0	3	30	70	100
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:

1. M. Morris Mano, "Computer Systems Architecture", Pearson, 3rd Edition, 2015.
2. Patterson, Hennessy, "Computer Organization and Design: The Hardware/Software Interface", Morgan Kaufmann, 5th Edition, 2013.

Reference Books:

1. John. P. Hayes, “Computer System Architecture”, McGraw-Hill, 3rd Edition, 1998.
2. Carl Hamacher, Zvonko G Vranesic, Safwat G Zaky, “Computer Organization”, McGraw-Hill, 5th Edition, 2002.
3. William Stallings, “Computer Organization and Architecture”, Pearson Edition, 8th Edition, 2010.

Web References:

1. https://www.tutorialspoint.com/computer_logical_organization/
2. https://www.courseera.org/learn/comparch
3. https://www.cssimplified.com/.../computer-organization-and-assembly-language-programming

E-Text Books:

1. https://www.groupes.polymtl.ca/inf2610/.../ComputerSystemBook.pdf
2. https://www.cse.hcmut.edu.vn/~vtphuong/KTMT/Slides/TextBookFull.pdf

ANALYSIS OF ALGORITHMS AND DESIGN

OE - I

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
ACSB33	Elective	3	-	-	3	30	70	100
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**	**Classes: 09**

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.

MODULE -II	**DIVIDE AND CONQUER**	**Classes: 09**

Divide and Conquer: General method, applications: Binary search, quick sort, merge sort, Strassen‘s matrix multiplication.

MODULE -III	**TRAVERSAL TECHNIQUES AND GREEDY METHOD**	**Classes: 09**

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.

MODULE -IV	**DYNAMIC PROGRAMMING**	**Classes: 09**

Dynamic programming: The general method, matrix chain multiplication, optimal binary search trees, 0/1 knapsack problem, all pairs shortest paths problem.

MODULE -V	**BRANCH AND BOUND, BACKTRACKING**	**Classes: 09**

Branch and bound: The general method, travelling salesperson problem; Backtracking: The general method, the 8 queens problem, graph coloring.

Text Books:

1. Ellis Horowitz, Satraj Sahni, Sanguthevar Rajasekharan, “Fundamentals of Computer Algorithms, Universities Press, 2nd Edition, 2015.
2. Alfred V. Aho, John E. Hopcroft, Jeffrey D, “The Design And Analysis Of Computer Algorithms, Pearson India, 1st Edition, 2013.

Reference Books:

1. Levitin A, “Introduction to the Design and Analysis of Algorithms”, Pearson Education, 3rd Edition, 2012.
2. Goodrich, M. T. R Tamassia, “Algorithm Design Foundations Analysis and Internet Examples”, John Wiley and Sons, 1st Edition, 2001.
3. Base Sara Allen Vangelder, “Computer Algorithms Introduction to Design and Analysis”, Pearson, 3rd Edition, 1999.

Web References:

1. http://www.personal.kent.edu/~rmuhamma/Algorithms/algorithm.html
2. http://openclassroom.stanford.edu/MainFolder/CoursePage.php?course=IntroToAlgorithms
3. http://www.facweb.iitkgp.ernet.in/~sourav/daa.html

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
3. http://www.amazon.com/Computer-Algorithms-Introduction-Design-Analysis/dp/0201612445

MOOC Course:

1. https://www.coursera.org/learn/algorithm-design-analysis
2. http://www.online.stanford.edu/course/algorithms-design-and-analysis-part-1
3. https://www.onlinecourses.nptel.ac.in/noc16_cs04/preview

RELATIONAL DATABASE MANAGEMENT SYSTEMS

OE – I

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
ACSB34	Elective	3	-	-	3	30	70	100
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

Database Design and ER diagrams – Attributes and Entity Sets – Relationships and Relationship Sets – Constraints - Keys - Design Issues - Entity-Relationship Diagram- Weak Entity Sets - Extended E-R Features- Database Design with ER model - Database Design for Banking Enterprise.

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

Functional Dependencies– Introduction , Basic Definitions, Trivial and Non trivial dependencies, closure of a set of dependencies, closure of attributes, irreducible set of dependencies- Schema Refinement in Database Design- Problems Caused by Redundancy Decompositions – Problem Related to Decomposition –- Lossless Join Decomposition – Dependency Preserving Decomposition - FIRST, SECOND, THIRD Normal Forms – BCNF –Multi valued Dependencies – Fourth Normal Form.

MODULE -V	DATA STORAGE AND QUERY PROCESSING	Classes: 09

Transaction concept- Transaction state- Implementation of atomicity and Durability- Concurrent executions – Serializability, Recoverability; File Organization – Organization of records in file - Data Dictionary Storage – Indexing and Hashing – Basic Concepts , Ordered Indices,B^+Tree Index files, B- tree index files

Text Books:

1. Abraham Silberschatz, Henry F. Korth, S. Sudarshan, "Database System Concepts", McGraw-Hill, 6th Edition, 2017.

Reference Books:

1. Ramez Elmasri, Shamkant B. Navathe, "Fundamental Database Systems", Pearson Education, 6th Edition, 2014.
2. Raghu Ramakrishnan, "Database Management System", Tata McGraw-Hill Publishing Company, 3rd Edition, 2007.
3. Hector Garcia Molina, Jeffrey D. Ullman, Jennifer Widom, "Database System Implementation", Pearson Education, United States, 1st Edition, 2000.
4. Peter Rob, Corlos Coronel, "Database System, Design, Implementation and Management", Thompson Learning Course Technology, 5th Edition, 2003.

Web References:

1. https://www.youtube.com/results?search_query=DBMS+onluine+classes
2. http://www.w3schools.in/dbms/
3. http://beginnersbook.com/2015/04/dbms-tutorial/

E-Text Books:

1. http://www.e-booksdirectory.com/details.php?ebook=10166
2. http://www.e-booksdirectory.com/details.php?ebook=7400re
3. https://docs.google.com/file/d/0B9aJA_iV4kHYM2dieHZhMHhyRVE/edit

MOOC Course

1. https://onlinecourses.nptel.ac.in/noc18_cs15/preview
2. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-830-database-systems-fall-2010/

ADVANCED DATA STRUCTURES

OE - I

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AITB30	Elective	3	-	-	3	30	70	100
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

Binary Search Trees - Definition, ADT, Operations - Searching, Insertion, Deletion, AVL Trees - Definition, ADT, Balance factor, Operations – Insertion, Deletion, Searching, Introduction to Red – Black and Splay Trees, B-Trees, B-Tree operations - insertion, deletion, searching, Comparison of Search Trees.

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:

1. Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran, "Fundamentals of Computer Algorithms", Universities Press Private Limited, India, 2nd Edition, 2008.
2. G.A. V.Pai, "Data Structures and Algorithms", Tata McGraw Hill, New Delhi, 1st Edition, 2008.
3. Richard F Gilberg, Behrouz A Forouzan, "Data Structures - A Pseudocode Approach with C", Cengage Learning, Thomson Press (India) Ltd, 2nd Edition, 2006.

Reference Books:

1. D. Samanta, "Classic Data Structures", Prentice Hall of India Private Limited, 2nd Edition, 2003.
2. Aho, Hop craft, Ullman, "Design and Analysis of Computer Algorithms", Pearson Education India, 1st Edition, 1998.
3. Goodman, Hedetniemi, "Introduction to Design and Analysis of Algorithms", Tata McGraw Hill, New Delhi, India, 1st Edition, 2002.
4. Adam Drozdek, "Data Structures and Algorithms in C++", Thomson Course Technology, 3rd Edition, 2005.
5. M. T. Goodrich, R. Tomassia, "Data structures and Algorithms in Java", Wiley India, 3rd Edition, 2011.

Web References:

1. https://www.tutorialspoint.com/data_structures_algorithms/data_structures_basics.htm
2. https://www.geeksforgeeks.org/data-structures/
3. http://www.nptelvideos.in/2012/11/data-structures-and-algorithms.html

E-Text Books:

1. https://pdfs.semanticscholar.org/19ec/55ed703eb24e1d98a4abd1a15387281cc0f8.pdf
2. https://www.academia.edu/35961658/Data.Structures.A.Pseudocode.Approach.with.C.2nd.edition_1_.pdf
3. https://sonucgn.files.wordpress.com/2018/01/data-structures-by-d-samantha.pdf

MOOC Course

1. https://nptel.ac.in/courses/106103069/
2. https://www.coursera.org/learn/data-structures
3. https://www.edureka.co/blog/data-structures-algorithms-in-java/
4. https://www.edx.org/micromasters/ucsandiegox-algorithms-and-data-structures

DATA COMMUNICATIONS AND NETWORKS

OE - I

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AITB31	Elective	3	-	-	3	30	70	100
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**

Introduction, Framing, and Error – Detection and Correction – Parity – LRC – CRC Hamming code, Flow and Error Control, Noiseless Channels, Noisy Channels, HDLC, Point to Point Protocols.

MODULE – IV	**THE NETWORK LAYER**	**Classes: 09**

Logical Addressing, Internetworking, Tunneling, Address mapping, ICMP, IGMP, Forwarding, Uni-Cast Routing Protocols, Multicast Routing Protocols

MODULE – V	**THE TRANSPORT AND APPLICATION LAYER**	**Classes: 09**

Introduction, client server programming, WWW (World Wide Web) and HTTP (Hyper Text Transfer Protocol), FTP (File Transfer Protocol), E-MAIL, TELNET, SECURE SHELL, DNS (Domain Naming System), SNMP (Simple Network Management Protocol). Introduction to Application Layer: HTTP (Hyper Text Transfer Protocol), DNS (Domain Naming System).

Text Books:

1. Behrouz A. Forouzan, "Data Communications and Networking", Tata McGraw Hill, 5th Edition, 2012.
2. Andrew S. Tanenbaum, David.j.Wetherall, "Computer Networks", Prentice-Hall, 5th Edition, 2010.

Reference Books:

1. Douglas E. Comer "Internetworking with TCP/IP ", Prentice-Hall, 5th Edition, 2011.
2. Peterson, Davie, Elsevier "Computer Networks", 5th Edition, 2011
3. Comer, "Computer Networks and Internets with Internet Applications", 4th Edition, 2004.
4. Chawan- Hwa Wu, Irwin, "Introduction to Computer Networks and Cyber Security", CRC publications, 2014.

Web References:

1. http://computer.howstuffworks.com/computer-networking-channel.htm
2. http://www.ietf.org
3. http://www.rfc-editor.org/
4. https://technet.microsoft.com/en-us/network/default.aspx

E-Text Books:

1. http://www.freebookcentre.net/networking-books-download/Lecture-Notes-on-Computer-Networks.html
2. http://www.freebookcentre.net/networking-books-download/Introduction-to-Computer-Networks.html

MOOC Course

1. https://www.mooc-list.com/course/networking-introduction-computer-networking-stanford-university
2. https://lagunita.stanford.edu/courses/Engineering/Networking/Winter2014/about.

NETWORK SECURITY

OE - I

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AITB32	Elective	3	-	-	3	30	70	100
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.

Hash functions: Hash functions, secure hash algorithm, digital signatures. Authentication application: Kerberos, X.509 authentication service.

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
1. William Stallings, “Cryptography and Network Security”, Pearson Education, 4th Edition, 2005. 2. Atul Kahate, “Cryptography and Network Security”, McGraw-Hill, 2nd Edition, 2009.
Reference Books
1. C K Shymala, N Harini, Dr. T R Padmanabhan, “Cryptography and Network Security”, Wiley India, 1st Edition, 2016. 2. Behrouz A. Forouzan Debdeep Mukhopadhyay, “Cryptography and Network Security”, McGraw- Hill, 2nd Edition, 2010.
Web References
1. http://bookboon.com/en/search?q=INFORMATION+SECURITY 2. 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=Bh45pU0_E_4C
E-Text Books
1. https://books.google.co.in/books/about/Information_Security.html 2. http://www.amazon.in/Cryptography-Network-Security-Behrouz-Forouzan/dp/007070208X

ENERGY FROM WASTE

OE – II

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
ACEB52	Elective	3	-	-	3	30	70	100
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 leach ate 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:

1. Nicholas P Cheremisinoff, "Handbook of Solid Waste Management and Waste Minimization Technologies", An Imprint of Elsevier, New Delhi, 2003.
2. P Aarne Vesilind, William A Worrell and Debra R Reinhart, "Solid Waste Engineering", 2nd Edition 2002.
3. M Dutta , B P Parida, B K Guha and T R Surkrishnan, "Industrial Solid Waste Management and Land filling practice", Reprint Edition New Delhi, 1999.
4. Rajya Sabha Secretariat, "E-waste in India: Research unit", Reprint Edition, June, 2011.

Reference Books:

1. C Parker and T Roberts (Ed), "Energy from Waste", An Evaluation of Conversion Technologies, Elsevier Applied Science, London, 1985.
2. KL Shah, "Basics of Solid and Hazardous Waste Management Technology", Prentice Hall, Reprint Edition, 2000.
3. M Datta, "Waste Disposal in Engineered Landfills", Narosa Publishing House, 1997.

Web References:

1. https://www.e-waste Management: From waste to Resource Klaus Hieronymi, Ramzy Kahnat, Eric williams Tech. & Engg.-2013 (Publisher: Earthscan 2013
2. https://www.What is the impact of E-waste: Tamara Thompson
3. https://www. E-waste poses a Health Hazard: Sairudeen Pattazhy

E-Text Books:

1. https://www.unep.org
2. https://www.outledge.com
3. https://www.bookdepository.com
4. https://www.ecoactiv.com

DISASTER MANAGEMENT

OE - II

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
ACEB53	Elective	3	-	-	3	30	70	100
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.

MODULE - V	EMERGING APPROACHES IN DISASTER MANAGEMENT	Classes: 09

Emerging approaches in Disaster Management, Three Stages

1. Pre, disaster stage(preparedness)
2. EmergencyStage
3. Post Disaster stage, Rehabilitation.

Text Books:

1. Pardeep Sahni, "Disaster Mitigation: Experiences and Reflections", PHI Learning Pvt. Ltd., 1st Edition, 2001.
2. J.Glynn,GaryW.HeinKe,"EnvironmentalScienceandEngineering",PrenticeHallPublishers, 2nd Edition, 1996.

Reference Books:

1. R.B.Singh (Ed), "Environmental Geography", 2nd Edition, 1990.
2. R.B. Singh (Ed), "Disaster Management", 2nd Edition, 2006.

Web References:

1. https://www.google.co.in/?gfe_rd=cr&ei=,iAwWLiDIazv8we8_5LADA#q=disater+mangement
2. http://ndma.gov.in/images/policyplan/dmplan/National%20Disaster%20Management%20Plan%20 May%202016.pdf
3. http://www.eib.europa.eu/attachments/pipeline/20080021_eia_en.pdf
4. http://www.ndmindia.nic.in/

E-Text Books:

1. https://www.google.co.in/?gfe_rd=cr&ei=,iAwWLiDIazv8we8_5LADA#q=disaster+management + e+textbooks
2. http://cbse.nic.in/natural%20hazards%20&%20disaster%20management.pdf\
3. http://www.digitalbookindex.org/_search/search010emergencydisastera.asp
4. http://www.icbse.com/books/cbse,ebooks,download

ELEMENTS OF AERONAUTICS

OE – II

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AAEB55	Elective	3	-	-	3	30	70	100
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 centreaerofoil characteristics-lift, drag curves; Different types of drag..

MODULE -III	FLIGHT VEHIVLE 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:

1. Newman D, “Interactive Aerospace Engineering and Design”, McGraw-Hill, 1st Edition, 2002.
2. Anderson J. D, “Introduction to Flight”, McGraw-Hill Education, 5th Edition,2002

Reference Books:

1. Kermode. A. C, “Flight without Formulae”, McGraw Hill, 4th Edition, 1997.
2. Barnard R.H and Philpot. D.R, “Aircraft Flight”, Pearson, 3rd Edition, 2004.
3. SwattonP.J, “Flight Planning”, Blackwell Publisher, 6th Edition, 2002.

Web References:

1. https://www.aerospaceengineering.es/book/
2. https://www.ne.nasa.gov/education/
3. https://nptel.ac.in

E-Text Books:

1. https://www.e-booksdirectory.com/
2. https://www.adl.gatech.edu/extrovert/Ebooks/ebook_Intro.pdf
3. https://www.academia.edu/7950378/Introduction_to_Flight_-_Anderson_5th_Ed

AVIATION MANAGEMENT

OE – II

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AAEB28	Elective	3	-	-	3	30	70	100
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	Classes: 10

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	Classes: 10

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	Classes: 9

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 FRAMEWWORK	Classes: 8

Role of DGCA-Slot allocation -Methodology followed by ATC & DGCA – management of bi-laterals – economic Regulations.

MODULE -V	CONTROLLING	Classes: 8

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:

1. Graham. A Managing airports - an International Perspective butterworth-heinemann, oxford 2001.
2. Wells. A. Airport Planning and Management, 4th edition McGraw-Hill, London 2000.

Reference Books:

1. Alexander t. wells, seth young, Principles of Airport management, McGraw-hill 2003Y. V. C. Rao,
2. Richard de neufille, Airport systems: Planning, Design & Management, McGraw-hill London 2007.

Web References:

1. https://memberfiles.freewebs.com/94/47/55224794/documents/airport%20planning%20and%20management.pdf
2. https://books.google.co.in/books?id=RYR6cu4YSBcC&dq=Planning%20and%20Design%20of%20Airports &source=gbs_similarbooks

E-Text Books:

1. https://accessengineeringlibrary.com/browse/airport-planning-and-management-sixth-edition
2. https://www.only4engineer.com/2014/10/planning-and-design-of-airports-by.html

INTRODUCTION TO ROBOTICS

OE – II

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AMEB56	Elective	3	-	-	3	30	70	100
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**	**Classes : 09**

Introduction: Automation and robotic, an over view 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**	**Classes : 09**

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**	**Classes: 09**

Differential kinematics: Differential kinematics of planar and spherical manipulators, Jacobians, problems.
Robot dynamics: Lagrange, Euler formulations, Newton-Euler formulations, problems on planar two link manipulators.

MODULE-IV	**TRAJECTORY PLANNING AND ACTUATORS**	**Classes: 09**

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**	**Classes : 09**

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:

1. Groover M. P, "Industrial Robotics", Tata McGraw-Hill, 1st Edition, 2013.
2. J. J Craig, "Introduction to Robotic Mechanics and Control", Pearson, 3rd Edition, 2013.

Reference Books:

1. Richard D. Klafter, "Robotic Engineering", Prentice Hall, 1st Edition, 2013.
2. Fu K S, "Robotics", McGraw-Hill, 1st Edition, 2013.

Web References:
1. https://www.doc.ic.ac.uk/~ajd/Robotics/RoboticsResources/lecture1.pdf. 2. http://opencourses.emu.edu.tr/course/view.php?id=32 3. https://www.researchgate.net/publication/277712686_Introduction_to_Robotics_class_notes_UG_level
E-Text Book:
1. http://www.robot.bmstu.ru/ 2. http://www.robotee.com/index.php/download-free-robotic-e-books/

RAPID PROTOTYPING

OE – II

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AMEB57	Elective	3	-	-	3	30	70	100
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 PRORTOTYPING	Classes: 09

Introduction: Prototype Fundamentals, Types and Roles of Prototype, Fundamentals of Rapid Prototyping, Phases of Development Leading to Rapid Prototyping, Advantages of Rapid Prototyping and Classifications of Rapid Prototyping System, Generic RP process. Rapid Product Development: An Overview virtual prototyping and testing technology, Physical Prototyping and Rapid Manufacturing technologies and Synergic Integration Technologies.

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) andCAM-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

Rapid Tooling: Introduction to rapid tooling (RT), Indirect rapid tooling methods: spray metal deposition, RTV epoxy tools, and 3D Keltool process, Direct rapid tooling methods: DTM Rapid Tool Process, EOS Direct Tool Process and Direct Metal Tooling using 3DP. Reverse engineering: Acquiring Point Data, Constructing 3D model and Applications. Virtual Augmented Reality: Requirement of devices and technologies and applications. Case Studies: Applications of Rapid Prototyping in Aerospace Industry, Automotive Industry, Biomedical Industry, Jewellery Industry, Coin Industry, Tableware Industry and Sports

Field.

Text Books:

1. Chua C K, Leong K F, Chu S L, "Rapid Prototyping: Principles and Applications in Manufacturing", World Scientific, 3rd Edition, 2008.
2. Liou W L, Liou F W, "Rapid Prototyping and Engineering applications: A Tool Box for Prototype Development", CRC Press, 1st Edition, 2007.

Reference Books:

1. Gibson D W Rosen, Brent Stucker, "Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing", Springer, 1st Edition, 2014.
2. Kamrani A K, Nasr E A, "Rapid Prototyping: Theory and practice", Springer, 1st Edition, 2006.
3. Rafiq I. Noorani, "Rapid Prototyping: Principles and Applications", John Wiley & Sons, 1st Edition, 2005.

Web References:

1.https://nptel.ac.in/courses/112102103/16
2.https://nptel.ac.in/courses/112107078/37

E-Text Book:
1.https://www.cet.edu.in/noticefiles/258_Lecture%20Notes%20on%20RP-ilovepdf-compressed.pdf

EMBEDDED SYSTEMS

OE - III

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AECB58	Elective	3	0	0	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

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-EnAnalyzed systems, design example-Elevator controller.

Text Books

1. Shibu K.V, "Introduction to Embedded Systems", Tata McGraw Hill Education Private Limited, 2nd Edition, 2009.
2. Raj Kamal, "Embedded Systems: Architecture, Programming and Design", Tata McGraw-Hill Education, 2nd Edition, 2011.
3. Andrew Sloss, Dominic Symes, Wright, "ARM System Developer's Guide Designing and Optimizing System Software", 1st Edition, 2004.

Reference Books

1. Wayne Wolf, "Computers as Components, Principles of Embedded Computing Systems Design", Elsevier, 2nd Edition, 2009.
2. Dr. K. V. K. K. Prasad, "Embedded / Real-Time Systems: Concepts, Design & Programming", Dreamtech publishers, 1st Edition, 2003.
3. Frank Vahid, Tony Givargis, "Embedded System Design", John Wiley & Sons, 3rd Edition, 2006.
4. Lyla B Das, "Embedded Systems", Pearson Education, 1st Edition, 2012.
5. David E. Simon, "An Embedded Software Primer", Addison-Wesley, 1st Edition, 1999.
6. Michael J. Pont, "Embedded C", Pearson Education, 2nd Edition, 2008.

Web References

1. https://www.smartzworld.com/notes/embedded-systems-es/
2. http://notes.specworld.in/embedded-systems-es/
3. http://education.uandistar.net/jntu-study-materials
4. http://www.nptelvideos.in/2012/11/embedded-systems.html

E-Text Books

1. https://www.scribd.com/doc/233633895/Intro-to-Embedded-Systems-by-Shibu-Kv
2. http://www.ee.eng.cmu.ac.th/~demo/think/_DXJSq9r3TvL.pdf
3. https://www.scribd.com/doc/55232437/Embedded-Systems-Raj-Kamal
4. https://docs.google.com/file/d/0B6Cytl4eS_ahUS1LTkVXb1hxa00/edit
5. http://www.ecpe.nu.ac.th/ponpisut/22323006-Embedded-c-Tutorial-8051.pdf

COGNITIVE RADIO

OE - III

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AECB59	Elective	3	-	-	3	30	70	100
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:

1. Joseph Mitola III, "Software Radio Architecture: Object-Oriented Approaches to Wireless System Engineering", John Wiley & Sons Ltd, 2000.
2. Thomas W.Rondeau, Charles W. Bostain, "Artificial Intelligence in Wireless Communication", Artech House, 2009.
3. Bruce A. Fette, "Cognitive Radio Technology", Elsevier, 2009.
4. Ian F. Akyildiz, Won – Yeol Lee, Mehmet C. Vuran, Shantidev Mohanty, "Next generation / Dynamic Spectrum access / Cognitive Radio Wireless Networks: A Survey", Elsevier Computer Networks, May 2006.

Reference Books:

1. Simon Haykin, "Cognitive Radio: Brain –Empowered Wireless Communications", IEEE Journal on selected areas in communications, Feb 2005.
2. Hasari Celebi, Huseyin Arslan, "Enabling Location and Environment Awareness in Cognitive Radios", Elsevier Computer Communications, Jan 2008.
3. Markus Dillinger, Kambiz Madani, Nancy Alonistioti, "Software Defined Radio", John Wiley, 2003.
4. Huseyin Arslan, "Cognitive Radio, SDR and Adaptive System", Springer, 2007.
5. Alexander M. Wyglinski, Maziarnekovee, Y. Thomas Hu, "Cognitive Radio Communication and Networks", Elsevier, 2010

Web References:

1. wcsp.eng.usf.edu/cognitive_radio_links.htm
2. https://en.wikipedia.org/wiki/Cognitive_radio
3. https://www.researchgate.net/.../261021527_Cognitive_radio_networks_for_Internet.
4. www.informationvine.com/Cognitive+Radio.

E-Text Books:

1. omidi.iut.ac.ir/...CognitiveRadio/.../ebook/Fette%20B.A.(ed)%20Cognitive%20Radio.
2. www.supelec.fr/d2ri/flexibleradio/pub/leonardo09.pd.
3. www.qsl.net/.../Cognitive%20Radio%20Communications%20and%20Networks%20-%2

IOT AND APPLICATIONS

OE - III

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AECB60	Elective	3	-	-	3	30	70	100
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**

IoT Architecture: State of the art introduction, state of the art; Architecture reference model: Introduction, reference model and architecture, IoT reference model. Logical design using Python: Installing Python, Python data types and data structures, control flow, functions, modules, packages, file handling

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:

1. Arshdeep Bahga, Vijay Madisetti, "Internet of Things: A Hands-on-Approach", VPT, 1st Edition, 2014.
2. Matt Richardson, Shawn Wallace, "Getting Started with Raspberry Pi", O'Reilly (SPD), 3rd Edition, 2014.

Reference Books:

1. Adrian McEwen, Hakim Cassimally, "Designing the Internet of Things", John Wiley and Sons, 1st Edition, 2014.
2. Francis Da Costa, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", Apress Publications, 1st Edition, 2013.

Web References:
1. https://www.upf.edu/pra/en/3376/22580. 2. https://www.coursera.org/learn/iot. 3. https://bcourses.berkeley.edu. 4. www.innovianstechnologies.com.
E-Text Books:
1. https://mitpress.mit.edu/books/internet-things 2. http://www.apress.com

INDUSTRIAL AUTOMATION AND CONTROL

OE - III

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AEEB58	Elective	3	-	-	3	30	70	100
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	Classes: 08

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	Classes: 10

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	Classes: 09

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	Classes: 10

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	Classes: 08

Electrical machine drives: Energy savings with variable speed drives, step motors: principles, construction and drives, electrical actuators, DC motor drives, electrical actuators: induction motor drives, electrical actuators, BLDC motor drives.

Text Books:

1. Madhu Chanda Mitra, Samarjit Sen Gupta**, "**Programmable Logic Controllers and Industrial Automation: An Introduction", Penram International Publishing (India) Pvt. Ltd**.**, 1st Edition, 2008.
2. K Krishnaswamy, S Vijayachitra, "Industrial Instrumentation", New Age Publications, 1st Edition, 2010.
3. Rajesh Mehra, Vikrant Vij**, "**PLCs & SCADA: Theory and Practice", Laxmi publications, 2nd Edition, 2016.

Reference Books:

1. AK Gupta, S K Arora**, "**Industrial Automation and Robotics", Laxmi Publications, 2nd Edition, 2013.
2. Jon Stenerson, "Industrial Automation and Process Control", Prentice Hall, 1st Edition, 2002.

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
2. https://www.noorropidah.files.wordpress.com/2012/01/plc-1-3.pdf
3. https://www.radix.co.in/families/automation?gclid=CJfW24PbjtACFUYeaAodiCQGHQ

E-Text Books:

1. https://www.plc-scada-dcs.blogspot.com/p/downloads.html
2. https://www.megawatt.com.gr/files/uploads/KATALOGOS%20PLC%20ABB.pdf

ARTIFICIAL NEURAL NETWORKS

OE - III

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AEEB59	Elective	3	-	-	3	30	70	100
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 ward.
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	Classes: 09

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	Classes: 09

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	Classes: 09

Back Propagation: Back Propagation and Differentiation, Hessian Matrix, Generalization, Cross Validation, Network Pruning Techniques, Virtues, and Limitations.

Back Propagation Learning, Accelerated Convergence, Supervised Learning

MODULE-IV	SELF-ORGANIZATION MAPS	Classes: 09

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	Classes: 09

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:

1. Simon Haykin, "Neural Networks a Comprehensive Foundations", Prentice Hall India, 2nd Edition, 2003

Reference Books:

1. B. Yegnanarayana, "Artificial Neural Networks", Prentice Hall of India Private Limited, 2005
2. Li Min Fu,"Neural Networks in Computer Intelligence", Tata McGraw Hill, 3rd Edition, 2003
3. James A Freeman David M S Kapura, "Neural Networks", Pearson Education, 2004.
4. Jacek M. Zurada,"Introduction to Artificial Neural Systems", JAICO Publishing House,1stEdition, 2006.

Web References:

1. https:// www.en.wikipedia.org/wiki/ neural networks
2. https://www.jaicobooks.com/j/PDF%20HED/J-878%20Artificial%20Neural%20Systems.pdf
3. https://www.abebooks.co.uk/book-search/title/an-introduction-to-fuzzy-control/system.pdf

E-Text Books:

1. https://www.books.google.com / Computers/ Software Development & Engineering.pdf
2. https://www.springer.com/us/book/9783319046921.pdf
3. https://www .bookboon.com/en/introduction-to-soft-computing-ebook.pdf

RENEWABLE ENERGY SOURCES

OE - III

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AEEB60	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

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

Introduction: Causes of Energy Scarcity, Solution to Energy Scarcity, Factors Affecting Energy Resource Development, Energy Resources and Classification, Renewable Energy – Worldwide Renewable Energy Availability, Renewable Energy in India.

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

Solar Thermal Energy Collectors: Types of Solar Collectors, Configurations of Certain Practical Solar Thermal Collectors, Material Aspects of Solar Collectors, Concentrating Collectors, Parabolic Dish – Stirling Engine System, Working of Stirling or Brayton Heat Engine, Solar Collector Systems into Building Services, Solar Water Heating Systems, Passive Solar Water Heating Systems, Applications of Solar Water Heating Systems, Active Solar Space Cooling, Solar Air Heating, Solar Dryers, Crop Drying, Space Cooing, Solar Cookers, Solar pond.

Solar Cells: Components of Solar Cell System, Elements of Silicon Solar Cell, Solar Cell materials, Practical Solar Cells, I – V Characteristics of Solar Cells, Efficiency of Solar Cells, Photovoltaic Panels, Applications of Solar Cell Systems

MODUEL - III	HYDROGEN, WIND AND GEO-THERMAL SYSTEMS	Classes: 09

Hydrogen Energy: Benefits of Hydrogen Energy, Hydrogen Production Technologies, Hydrogen Energy Storage, Use of Hydrogen Energy, Advantages and Disadvantages of Hydrogen Energy, Problems Associated with Hydrogen Energy. Wind Energy: Windmills, Wind Turbines, Wind Resources, Wind Turbine Site Selection.

Geothermal Energy: Geothermal Systems, Classifications, Geothermal Resource Utilization, Resource Exploration, Geothermal Based Electric Power Generation, Associated Problems, environmental Effects.
Solid waste and Agricultural Refuse: Waste is Wealth, Key Issues, Waste Recovery Management Scheme, Advantages and Disadvantages of Waste Recycling, Sources and Types of Waste, Recycling of Plastics.

MODULE- IV	BIOMASS SYSTEMS	Classes: 08
Biomass Energy: Biomass Production, Energy Plantation, Biomass Gasification, Theory of Gasification, Gasifier and Their Classifications, Chemistry of Reaction Process in Gasification, Updraft, Downdraft and Cross-draft Gasifiers, Fluidized Bed Gasification, Use of Biomass Gasifier, Gasifier Biomass Feed Characteristics, Applications of Biomass Gasifier, Cooling and Cleaning of Gasifiers. Biogas Energy: Introduction, Biogas and its Composition, Anaerobic Digestion, Biogas Production, Benefits of Biogas, Factors Affecting the Selection of a Particular Model of a Biogas Plant, Biogas Plant Feeds and their Characteristics. Tidal Energy: Introduction, Tidal Energy Resource, Tidal Energy Availability, Tidal Power Generation in India, Leading Country in Tidal Power Plant Installation, Energy Availability in Tides, Tidal Power Basin, Turbines for Tidal Power, Advantages and Disadvantages of Tidal Power, Problems Faced in Exploiting Tidal Energy		
MODULE- V	**PV WATER PUMPING AND GRID INTERFACE**	**Classes: 08**
Sea Wave Energy: Introduction, Motion in the sea Waves, Power Associated with Sea Waves, Wave Energy Availability, Devices for Harnessing Wave Energy, Advantages and Disadvantages of Wave Power. Ocean Thermal Energy: Introduction, Principles of Ocean Thermal Energy Conversion (OTEC), Ocean Thermal Energy Conversion plants, Basic Rankine Cycle and its Working, Closed Cycle, Open Cycle and Hybrid Cycle, Carnot Cycle, Application of OTEC in Addition to Produce Electricity, Advantages, Disadvantages and Benefits of OTEC		
Text Books:		
1. G.D Rai, "Non conventional Energy Sources", Khanna Publications, 3nd Edition, 2008. 2. John Twidell and Tony Weir / E & F.N.Spon, "Renewable Energy Resources", Special Indian Edition, 3rd Edition, 2007. 3. G.N.Tiwari and M.K.Ghosal , "Renewable Energy Resources Basic Principles and Applications", Narosa Edition, 2nd Edition, 2004. 4. S.P. Sukhatme, "Solar Energy - Principles of Thermal Collection and Storage," TMH, 4th Edition, 2017.		
Reference Books:		
1. Daniel, Hunt. V, "Wind Power – A Hand Book of WECS", Van Nostrend Co., Newyork, 1998. 2. K.Khendelwal & S.S. Mahdi, "Biogas Technology - A Practical Hand Book", McGraw-Hill 3. Mukund. R. Patel, "Wind and Solar Power Systems", CRC Press, 1999.		
Web References:		
NPTEL video lectures.		
E-Text Books:		
G.D. Rai, Non- Conventional Energy Resources, Khanna Publishers, 2002.		

SOFT SKILLS AND INTERPERSONAL COMMUNICATION

OE - IV

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AHSB18	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

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 Writng 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:

1. Dorch, Patricia. What Are Soft Skills? New York: Execu Dress Publisher, 2013.
2. Kamin, Maxine. Soft Skills Revolution: A Guide for Connecting with Compassion for Trainers, Teams, and Leaders. Washington, DC: Pfeiffer & Company, 2013.
3. Klaus, Peggy, Jane Rohman & Molly Hamaker. "The Hard Truth about Soft Skills", London: HarperCollins E-books, 2007.
4. Stein, Steven J. & Howard E. Book. "The EQ Edge: Emotional Intelligence and Your Success" Canada: Wiley & Sons, 2006
5. Suresh Kumar. English for Success. Cambridge University Press IndiaPvt.Ltd.2010.
6. Dorling Kindersley. Communication Skills & Soft Skills - An Integrated Approach. India Pvt. Ltd. 2013.

Web References:

1. www.edufind.com
2. www.myenglishpages.com
3. http://grammar.ccc.comment.edu
4. http://owl.english.prudue.edu

E-Text Books:

1. http://bookboon.com/en/communication-ebooks-zip
2. http://www.bloomsbury-international.com/images/ezone/ebook/writing-skills-pdf.pdf
3. https://americanenglish.state.gov/files/ae/resource_files/developing_writing.pdf
4. http://learningenglishvocabularygrammar.com/files/idiomsandphraseswithmeaningsandexamplespdf.pdf
5. http://www.robinwood.com/Democracy/General Essays/CriticalThinking.pdf

CYBER LAW AND ETHICS

OE - IV

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AHSB19	Elective	3	-	-	3	30	70	100
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

Definitions, Specificities of the Cyberspace, Dimensions of Cyber Ethics in Cyber Society, Fourth Industrial Revolution, Users' Motivations in Cyber-Space, Core Values and Virtues, Old Values or Eschatological Vision?, Cyber Ethics by Norms, Laws and Relations Artificial Intelligence Ethics: "AI for Good", Cyber-Capitalism: Cyber-Ethics as Business Ethics.

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

Principles: Ethical Values, Participation: Access to Knowledge for All, People: Community, Identity, Gender, Generation, Education, Profession: Ethics of Information Professions, Privacy: Dignity, Data Mining, Security.

Piracy: Intellectual Property, Cybercrime, Protection: Children and Young People,
Power: Economic Power of Technology, Media and Consumers, Policy: Ethics of Regulation and Freedom.

MODULE-IV	DISRUPTIVE CYBER TECHNOLOGIES AND AI ETHICS	Classes: 09

Disruptive Cyber Technologies and Ethics -I
Artificial: Negative Moral Judgment?, Artificial: Ethically Positive Innovation?, Intelligence: Action-oriented Ability, Creation Story: Human Beings Responsibility, The Commandment to Love and Artificial Intelligence; Artificial Intelligence Ethics: Top Nine Ethical Issues in Artificial Intelligence, Five Core Principles to Keep AI Ethical, Ethics Should Inform AI – But Which Ethics?

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.

Text Books:
1. Christoph Stuckelberger, Pavan Duggal, “Cyber Ethics 4.0 Serving humanity with values”, Globethics.net Global Series, 2018.
Reference Books:
1. Dr. Farooq Ahmad, Cyber Law in India, Allahbad Law Agency- Faridabad. 2. J.P. Sharma, SunainaKanojia, Cyber Laws 3. Harish Chander , Cyber Laws and IT Protection
E-Reference:
1. https://www.globethics.net/documents/4289936/13403236/Ge_Global_17_web_isbn9782889312641.pdf/

ECONOMIC POILICIES IN INDIA

OE - IV

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AHSB20	Elective	3	-	-	3	30	70	100
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:

1. The Wealth of Nations-Adam Smith, introduction by Alan B Krueger.
2. The Strength of Economic Development by Albert Hirschman.
3. Money, Banking and Public Finance by Dr. V.C.Sinha
4. Government of India, Economic Survey (Annual), Ministry of Finance, New Delhi.
5. Jain, a. K. (1986), Economic Planning in India, Ashish Publishing House, New Delhi.

Reference Books:

1. Ahluwalia, I. J. and I. M. D Little (Eds.) (1999), India's Economic Reforms and Development (Essays in honour of Manmohan Singh), Oxford University Press, New Delhi.
2. Bardhan, P. K. (9th Edition) (1999), The Political Economy of Development in India, Oxford University Press, New Delhi.
3. Bawa, R. s. and P. S. Raikhy (Ed.) (1997), Structural Changes in Indian Economy, Guru Nanak Dev University Press, Amritsar.
4. Brahmananda, P. R. and V. R. Panchmukhi (Eds.) (2001), Development Experience in the Indian Economy: Inter-State Perspectives, Book well, Delhi.
5. Chakravarty, S. (1987), Development Planning: The Indian Experience, Oxford University Press, New Delhi.
6. Dantwala, M. L. (1996), Dilemmas of Growth: The Indian Experience, Sage Publications, New Delhi.
7. Datt, R. (Ed.) (2001), Second Generation Economic Reforms in India, Deep & Deep Publications, New Delhi.

Web References:

1. Parikh, K. S. (1999), India Development Report – 1999-2000, Oxford University Press, New Delhi8.
2. Reserve Bank of India, Report on Currency and Finance, (Annual).
3. Sandesara, J. c. (1992), Industrial Policy and Planning, 1947-19919 : Tendencies, Interpretations and Issues, Sage Publications, New Delhi.

GLOBAL WARMING AND CLIMATE CHANGE

OE - IV

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AHSB21	Elective	3	0	0	3	30	70	100
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

Role of ozone in environment, Ozone layer – Ozone depleting gases, Green House Effect – Radioactive effects of Greenhouse gases, The Hydrological cycle, Green House Gases and Global Warming, Carbon Cycle.

MODULE -II	ATMOSPHERE AND ITS COMPONENTS	Classes: 09

Importance of Atmosphere – Physical and chemical characteristics of Atmosphere, Vertical structure of the atmosphere, Composition of the atmosphere,Atmospheric stability, Temperature profile of the atmosphere,Lapse rates, Temperature inversion, Effects of inversion on pollution dispersion.

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

Climate change and Carbon credits, CDM – Initiatives in India-Kyoto Protocol, Paris Convention - Intergovernmental Panel on Climate change, Climate Sensitivity and Feedbacks. The Montreal Protocol – UNFCCC – IPCC – Global Climate Models (GCM) - Evidences of Changes in Climate and Environment- on a Global scale and in India.

MODULE - V	CLIMATE CHANGE AND MITIGATION MEASURES	Classes: 09

Clean Development Mechanism, Carbon Trading – Examples of future clean technology, Biodiesel – Natural Compost, Eco-friendly plastic, Alternate Energy –Hydrogen, Bio-fules, Solar Energy, Wind and Hydroelectric Power. Mitigation Efforts in India and Adaptation funding. Key Mitigation Technologies and Practices – Energy Supply, Transport, Buildings, Industry, Agriculture, Forestry – Carbon sequestration, Carbon capture and storage (CCS), Waste (MSW & Bio-waste, Biomedical, Industrial waste) – International and Regional cooperation.

Text Books:

1. Dr. Sushil Kumar Dash, "Climate Change: An Indian Perspective (Environment and Development)", Cambridge University Press India Pvt Ltd, 2007.
2. Adaptation and mitigation of climate change – Scientific Technical Analysis, Cambridge University Press, Cambridge, 2006.

Reference Books:
1. Atmospheric Science, J.M. Wallace and P.V Hobbs, Elsevier/ Academic Press, 2006. 2. "Climate Change and Climate Variability on Hydrological Regimes", Jan C. Van Dam, Cambridge University Press, 2003.
E-Text Books:
1. https://www.worldcat.org/title/encyclopedia-of-global-warming-climate-change/oclc/805580328 2. https://libguides.nus.edu.sg/c.php?g=433566&p=2955835

INTELLECTUAL PROPERTY RIGHTS

OE: IV

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AHSB22	Elective	3	-	-	3	30	70	100
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:

1. P. K. Vasudeva,World Trade Organization: Implications on Indian Economy, Pearson Education,2015.
2. P.KrishnaRao, WTO, Text and cases, Excel Books, 2015.
3. Carlos M.Correa- Intellectual property rights, The WTO and Developing countries-Zed books.

Reference Books:

1. Caves, Frankel, Jones, World Trade and Payments-An Introduction, Pearson4. Education, 2015.
2. Carlos M.Correa- Intellectual property rights, The WTO and Developing countries-Zed books.
3. Peter-Tobias stoll, Jan busche, Katrianarend- WTO- Trade –related aspects of IPR- Library of Congress.

Web References:
1. http://www.ebooks directory.com 2. http://Campus guides.lib.utah.edu
E-Text Books:
1. http://www.bookboon.com 2. http://www.freemagagement.com 3. http://www.emeraldinsight.com

ENTREPRENEURSHIP

OE - IV

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AHSB23	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil			Total Classes: 45			

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**

The revolution impact of entrepreneurship- The evolution of entrepreneurship - Functions of Entrepreneurs – types of entrepreneurs -Approaches to entrepreneurship- Process approach- Role of entrepreneurship in economic development- Twenty first century trends in entrepreneurship.

MODULE-II	**INDIVIDUAL ENTREPRENEURIAL MIND-SET AND PERSONALITY**	**Classes: 09**

The entrepreneurial journey Stress and the entrepreneur - the entrepreneurial ego - Entrepreneurial motivations- Motivational cycle – Entrepreneurial motivational behavior – Entrepreneurial competencies. Corporate Entrepreneurial Mindset, the nature of corporate entrepreneur- conceptualization of corporate entrepreneurship Strategy-sustaining corporate entrepreneurship.

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:
1. D F Kuratko and T V Rao, "Entrepreneurship- A South-Asian Perspective", Cengage Learning, 2012. 2. Bruce R. Barringer/ R.Duane Ireland, "Entrepreneurship Successfully Launching New Ventures", Pearson, 4th Edition, 2015. 3. S.S.Khanka, Entrepreneurship Development, S. Chand Publications, 2015.
Reference Books:
1. Stuart Read, Effectual Entrepreneurship, Routledge, 2013. 2. Rajeev Roy, Entrepreneurship, Oxford publications, 2nd Edition, 2012. 3. Nandan .H, Fundamentals of Entrepreneurship, PHI, 2013.

ENVIRONMENTAL SCIENCES

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

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AHSB07	Mandatory	-	-	-	-	30	70	100
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:

1. Benny Joseph, “Environmental Studies”, Tata McGraw Hill Publishing Co. Ltd, New Delhi, 2005.
2. Erach Bharucha, “Textbook of Environmental Studies for Undergraduate Courses”, Universities Press. 2005.

Reference Books:

1. Anji Reddy .M, “Textbook of Environmental Sciences and Technology”, BS Publications, 2007.
2. Anjaneyulu, “Introduction to Environmental Sciences”, BS Publications, 2004.
3. Anubha Kaushik, Perspectives in Environmental Science, New age international. 3rd Edition, 2006.
4. Tyler Miller, Scott Spoolman, “Environmental Science”, Cengage Learning, 14th Edition, 2012.

Web References:

1. https://www.tndte.com
2. https://www.nptel.ac.in/downloads
3. https://www.scribd.com
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

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AHSB17	Mandatory	-	-	-	-	30	70	100
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);

B: The Biological Diversity Act 2002 and Rules 2004, the protection of traditional knowledge bill, 2016. Geographical indicators act 2003.

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:

1. Traditional Knowledge System in India, by Amit Jha, 2009.
2. Traditional Knowledge System and Technology in India by Basanta Kumar Mohanta and Vipin Kumar Singh Pratibha Prakashan 2012.

Reference Books:

1. Traditional Knowledge System in India by Amit Jha Atlantic publishers, 2002.
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.

$$SGPA = \sum_{i=1}^{n} (C_i G_i) / \sum_{i=1}^{n} C_i$$

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.

$$CGPA = \sum_{j=1}^{m} \left(C_j S_j \right) / \sum_{j=1}^{m} C_j$$

Where, S_j is the SGPA of the j^{th} semester and C_j is the total number of credits upto the semester and m represent the number of semesters completed in which a student registered upto the semester. CGPA is rounded to two decimal places.

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

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

4.	Smuggles in the Answer book or additional sheet or takes out or arranges to send out the question paper during the examination or answer book or additional sheet, during or after the examination.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all semester end examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
5.	Uses objectionable, abusive or offensive language in the answer paper or in letters to the examiners or writes to the examiner requesting him to award pass marks.	Cancellation of the performance in that subject.
6.	Refuses to obey the orders of the 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.	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.
7.	Leaves the exam hall taking away answer script or intentionally tears off the script or any part thereof inside or outside the examination hall.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all semester end examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.

8.	Possess any lethal weapon or firearm in the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat.
9.	If student of the college, who is not a candidate for the particular examination or any person not connected with the college indulges in any malpractice or improper conduct mentioned in clause 6 to 8.	Student of the colleges expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat. Person(s) who do not belong to the College will be handed over to police and, a police case will be registered against them.
10.	Comes in a drunken condition to the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year.
11.	Copying detected on the basis of internal evidence, such as, during valuation or during special scrutiny.	Cancellation of the performance in that subject and all other subjects the candidate has appeared including practical examinations and project work of that semester/year examinations.
12.	If any malpractice is detected which is not covered in the above clauses 1 to 11 shall be reported to the University for further action to award suitable punishment.	

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

UNDERTAKING 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