ACADEMIC REGULATIONS AND SYLLABUS

CHOICE BASED CREDIT SYSTEM

MLR18

ELECTRICAL & ELECTRONICS ENGINEERING

Bachelor of Technology (B.Tech)

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

MARRI LAXMAN REDDY
GROUP OF INSTITUTIONS

MLR Institute of Technology

(Autonomous)
Laxman Reddy Avenue, Dundigal
Hyderabad – 500043, Telangana State
www.mlrit.ac.in, Email: director@mlrinstitutions.ac.in

FOREWORD

The autonomy is conferred on MLR Institute of Technology by UGC, 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 like UGC and AICTE. It reflects the confidence of the UGC in the autonomous institution to uphold and maintain standards it expects to deliver on its own behalf and thus awards degrees on behalf of the college. 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.

MLR Institute of Technology 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 like Academic Council and Boards of Studies are constituted with the guidance of the Governing Body of the College and recommendations of the JNTU Hyderabad 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 college in order to produce quality engineering graduates to the society.

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

PRINCIPAL

INDEX

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

For pursuing four year under graduate Bachelor Degree Programme of study in Engineering (B.Tech) offered by MLR Institute of Technology under Autonomous status is herein referred to as MLRIT (Autonomous):

All the rules specified herein approved by the Academic Council will be in force and applicable to students admitted from the Academic Year 2018-19 onwards. Any reference to "Institute" or "College" in these rules and regulations shall stand for M L R Institute of Technology (Autonomous).

All the rules and regulations, specified hereafter shall be read as a whole for the purpose of interpretation as and when a doubt arises, the interpretation of the Chairman, Academic Council is final. As per the requirements of statutory bodies, the Principal, M L R Institute of Technology shall be the chairman Academic Council.

1. ADMISSION

1.1. Admission into first year of four year B. Tech. degree Programmes of study in Engineering

1.1.1. Eligibility:

A candidate seeking admission into the first year of four year B. Tech. degree Programmes should have:

(i) Passed either Intermediate Public Examination (I.P.E) conducted by the Board of Intermediate Education, Telangana, with Mathematics, Physics and Chemistry as optional subjects or any equivalent examination recognized by Board of Intermediate Education, Telangana or a Diploma in Engineering in the relevant branch conducted by the Board of Technical Education, Telangana or equivalent Diploma recognized by Board of Technical Education for admission as per guidelines defined by the Regulatory bodies of Telangana State Council for Higher Education (TSCHE) and AICTE.

(ii) Secured a rank in the EAMCET examination conducted by TSCHE for allotment of a seat by the Convener, EAMCET, for admission.

1.1.2. Admission Procedure:

Admissions are made into the first year of four year B. Tech. Degree Programmes as per the stipulations of the TSCHE.

(a) Category A seats are filled by the Convener, TSEAMCET.

(b) Category B seats are filled by the Management.

1.2. Admission into the second year of four year B. Tech. degree Program in Engineering

1.2.1 Eligibility:

A candidate seeking admission under lateral entry into the II year I Semester B. Tech. degree Programmes should have passed the qualifying exam (B.Sc. Mathematics or Diploma in concerned course) and based on the rank secured by the candidate at Engineering Common Entrance Test ECET (FDH) in accordance with the instructions received from the Convener, ECET and Government of Telangana.

1.2.2 Admission Procedure:

Admissions are made into the II year of four year B. Tech. degree Programmes through Convener, ECET (FDH) against the sanctioned strength in each Programmes of study as lateral entry students.

2. PROGRAMMES OFFERED

MLR Institute of Technology, an autonomous college affiliated to JNTUH, offers the following B. Tech. Programmess of study leading to the award of B. Tech. degree under the autonomous scheme.

1) B.Tech. - Aeronautical Engineering
2) B.Tech. - Computer Science and Engineering
3) B.Tech. - Electronics and Communication Engineering
4) B.Tech - Electrical & Electronics Engineering
5) B.Tech. - Information Technology
6) B.Tech. - Mechanical Engineering

3. DURATION OF THE PROGRAMMES

3.1 Normal Duration

3.1.1 B. Tech. degree programme extends over a period of four academic years leading to the Degree of Bachelor of Technology (B.Tech.) of the Jawaharlal Nehru Technological University Hyderabad.

3.1.2 For students admitted under lateral entry scheme, B. Tech. degree programme extends over a period of three academic years leading to the Degree of Bachelor of Technology (B. Tech.) of the Jawaharlal Nehru Technological University Hyderabad.

3.2 Maximum Duration

3.2.1 The maximum period within which a student must complete a full-time academic programme is 8 years for B. Tech. If a student fails to complete the academic programme within the maximum duration as specified above, he shall forfeit the seat in B.Tech and his admission shall stand cancelled.

3.2.2 For students admitted under lateral entry scheme in B. Tech. degree programme, the maximum period within which a student must complete a full-time academic programme is 6 years. If a student fails to complete the academic programme within the maximum duration as specified above, he shall forfeit the seat in B.Tech and his admission shall stand cancelled.

3.2.3 The period is reckoned from the academic year in which the student is admitted first time into the degree Programme.

4. AWARD OF B.Tech. DEGREE

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

4.1 The candidate shall pursue a course of study for not less than four academic years and not more than eight years.

4.2 The candidate shall register for 160 credits and secure 160 credits.

4.3 The degree will be conferred and awarded by Jawaharlal Nehru Technological University Hyderabad on the recommendations of the Chairman, Academic Council.

5. PROGRAMME STRUCTURE

5.1 UGC/AICTE specified Definitions/ Descriptions are adopted appropriately for various terms and abbreviations used in these Academic Regulations/ Norms, which are listed below.

Semester Scheme:

Each UGP is of 4 Academic Years (8 Semesters), each year divided into two Semesters of 22 weeks (≥90 working days), each Semester having - 'Continuous Internal Evaluation (CIE)' and 'Semester End Examination (SEE)'. Choice Based Credit System (CBCS) and Credit Based Semester System (CBSS) as denoted by UGC, and Curriculum/Course Structure as suggested by AICTE are followed.

5.1.2 The B.Tech. Programme of MLR Institute of Technology are of Semester pattern, with 8 Semesters constituting 4 Academic Years, each Academic Year having TWO Semesters (First/Odd and Second/Even Semesters). Each Semester shall be of 22 Weeks duration (inclusive of Examinations), with a minimum of 90 Instructional Days per Semester.

5.1.3 Credit Courses:

a) All Courses are to be registered by a student in a Semester to earn Credits. Credits shall be assigned to each Subject/ Course in a L: T: P: C (Lecture Periods: Tutorial Periods: Practical Periods : Credits) Structure, based on the following general pattern ..

- One Credit - for One hour/Week/Semester for Theory/Lecture(L)/Tutorial)T)Courses; and
- One Credit - for Two hours/Week/Semester for Laboratory/Practical (P) Courses, Mini Project...
- Mandatory Courses will not carry any Credits.

5.1.4 **Course Classification:**

All Courses offered for the UGP are broadly classified as:

- Basic Science Courses (BSC) include Mathematics, Physics, Chemistry, Biology etc
- **Engineering Science Courses (ESC)** courses include Materials, Workshop, Basics of Electrical/Electronics/ Mechanical/Computer Science & Engineering, Engineering Graphics, Instrumentation, Engineering Mechanics, Instrumentation etc.
- **Humanities and Social Science including Management Courses (HSMC)** courses include English, Communication skills, Management etc.
- Professional Core Courses(PCC) are core courses relevant to the chosen specialization/branch.
- **Professional Elective Courses (PEC)** are courses relevant to the chosen specialization/ branch offered as electives.
- **Open Elective Courses (OEC)** courses from other technical and/or emerging subject areas offered in the College by the Departments of Engineering, Science and Humanities.
- **Mandatory Course:** Course work on peripheral subjects in a programme, wherein familiarity considered mandatory. To be included as non-Credit, Mandatory Courses, with only a pass in each required to qualify for the award of degree from the concerned institution.
- **Project Work** and/or internship in industry or elsewhere, seminar.

5.1.5 **Course Nomenclature:**

The Curriculum Nomenclature or Course-Structure Grouping for the each of the UGP E&T (B.Tech. Degree Programme), is as listed below (along with AICTE specified Range of Total Credits).

S. No.	Broad Course Classification	Course Group/ Category	Course Description	Range of Credits
1)	BSC,ESC & HSMC	BSC – Basic Sciences Courses	Includes - Mathematics, Physics and Chemistry Subjects	**25***
2)		ESC - Engineering Sciences Courses	Includes fundamental engineering subjects.	**24***
3)		HSMC – Humanities and Social Sciences including Management	Includes subjects related to Humanities, Social Sciences and Management.	**12***
4)	PCC	PCC – Professional Core Courses	Includes core subjects related to the Parent Discipline/ Department/ Branch of Engg.	**48***
5)	PEC	PEC– Professional Elective Courses	Includes Elective subjects related to the Parent Discipline / Department / Branch of Engg.	**18***
6)	OEC	OEC – Open Elective Courses	Elective subjects which include inter-disciplinary subjects or subjects in an area outside the Parent Discipline/ Department / Branch of Engg.	**18***
7)	PWC	Project Work	Major Project.	**15***
8)		Industrial Training/ Mini-Project	Industrial Training/ Internship/ Mini-Project.	
9)		Seminar	Seminar / Colloquium based on core contents related to Parent Discipline/ Department/ Branch of Engg.	
10)	MC	Mandatory Courses	Mandatory Courses (non-credit)	**-**
Total Credits for UGP (B. Tech.)Programme				**160 (100%)**

- Minor variations as per AICTE guidelines

6. COURSE REGISTRATION

6.1 A 'Faculty Advisor or Counsellor' shall be assigned to each student, who advises him/her about the UGP, its Course Structure and Curriculum, Choice/Option for Subjects/Courses, based on his/her competence, progress, pre-requisites and interest.

6.2 Academic Section of the College invites 'Registration Forms' from students prior (before the beginning of the Semester), ensuring 'DATE and TIME Stamping'. The Registration Requests for any 'CURRENT SEMESTER' shall be completed BEFORE the commencement of SEEs (Semester End Examinations) of the 'PRECEDING SEMESTER'

A Student can apply for Registration, which includes approval from his faculty advisor, and then should be submitted to the College Academic Section through the Head of Department (a copy of the same being retained with Head of Department, Faculty Advisor and the Student).

6.4 A student may be permitted to register for his/her course of CHOICE with a Total of prescribed credits per Semester (permitted deviation being±12%), based on his PROGRESS and SGPA/CGPA, and completion of the 'PRE-REQUISITES' as indicated for various courses in the Department Course Structure and Syllabus contents.

6.5 Choice for 'additional Courses' must be clearly indicated, which needs the specific approval and signature of the Faculty Advisor/Counsellor.

6.6 If the Student submits ambiguous choices or multiple options or erroneous (incorrect) entries during Registration for the Course(s) under a given/specified Course Group/ Category as listed in the Course Structure, only the first mentioned Course in that Category will be taken into consideration.

6.7 Dropping of Courses or changing of options may be permitted, ONLY AFTER obtaining prior approval from the Faculty Advisor, 'within 15 Days of Time' from the commencement of that Semester. Course Options exercised through Registration are final and CAN NOT be changed, and CAN NOT be inter-changed; further, alternate choices will also not be considered. However, if the Course that has already been listed for Registration (by the Head of Department) in a Semester could not be offered due to any unforeseen or unexpected reasons, then the Student shall be allowed to have alternate choice - either for a new Subject (subject to offering of such a Subject), or for another existing Subject (subject to availability of seats), which may be considered. Such alternate arrangements will be made by Head of the Department, with due notification and time-framed schedule, within the FIRST WEEK from the commencement of Class-work for that Semester.

7. COURSES TO BE OFFERED

7.1 A typical section (or class) strength for each Semester shall be 60.

7.2 courses may be offered to the Students, only if minimum of 20 students (1/3rd of the section strength) opt for it.

7.2 More than ONE TEACHER may offer the SAME SUBJECT (Lab/Practical's may be included with the corresponding Theory Subject in the same Semester) in any Semester. However, selection choice for students will be based on - 'CGPA Basis Criterion' (i.e., the first focus shall be on early Registration in that Semester, and the second focus, if needed, will be on CGPA of the student).

7.3 If more entries for Registration of a Subject come into picture, then the concerned Head of the Department shall take necessary decision, whether to offer such a Subject/Course for TWO (or multiple) SECTIONS or NOT.

7.4 OPEN ELECTIVES will be offered by a department to the students of other departments.

8. ATTENDANCE REQUIREMENTS

a. A student will be eligible to appear for the End Semester Examinations, if he acquires a minimum of 75% of attendance in aggregate of all the Subjects/Courses (excluding Mandatory or Non-Credit Courses) for that Semester.

b. Condoning of shortage of attendance in aggregate up to 10% (65% and above, and below 75%) in each Semester may be granted by the College Academic Committee on genuine and valid grounds, based on the student's representation with supporting evidence by following the govt. rules in vogue.

c. A stipulated fee shall be payable towards condoning of shortage of attendance.

d. Shortage of Attendance below 65% in aggregate shall in No case be condoned.

e. A student shall not be promoted to the next Semester unless he/she satisfies the attendance requirements of the current Semester. The student may seek readmission for the Semester when

offered next. He / She shall not be allowed to register for the subjects of the Semester while he/she is in detention. A student detained due to shortage of attendance, will have to repeat that Semester when offered next.

f. Students whose attendance is less than 75% are not entitled to get the scholarship / fee reimbursement in any case as per the TS Govt. Rules in force.

9. ACADEMIC REQUIREMENTS FOR PROMOTION / COMPLETION OF REGULAR B.TECH PROGRAMME COURSE STUDY.

9.1 A student shall be deemed to have satisfied the Academic Requirements and earned the Credits allotted to each Course, if he secures not less than 35% marks in the End Semester Examination, and a minimum of 40% of marks in the sum Total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together; in terms of Letter Grades, this implies securing P Grade or above in that Course.

9.2 A student shall be deemed to have satisfied the Academic Requirements and earned the Credits allotted to – Internship, if he/she secures not less than 40% of the Total marks to be awarded for each. The student would be treated as failed, if he/she - (i) does not submit a report on his/her Internship, or does not make a presentation of the same before the Evaluation Committee as per the schedule, or (ii) does not present the Seminar as required in the IV year I/II Semester, or (iii) secures less than 40% of marks in Internship evaluations. He/She may reappear once for each of the above evaluations, when they are scheduled again; if he/she fails in such 'one reappearance' evaluation also, he/she has to reappear for the same in the next subsequent Semester, as per the schedule.

9.3 A Student will not be promoted from I Year to II Year, unless he/she fulfils the Attendance requirements

9.4 A Student will not be promoted from II Year to III Year, unless he/she fulfils the Attendance and Academic Requirements and (i) secures a Total 50% of Credits up to II Year II Semester from all the relevant regular and supplementary examinations.

9.5 A Student will not be promoted from III Year to IV Year, unless he/she fulfils the Attendance and Academic Requirements and (i) secures a Total 50% of Credits up to III Year II Semester, from all the regular and supplementary examinations.

9.6 After securing the necessary 160 Credits as specified for the successful completion of the entire UGP, resulting in 160 Credits for UGP performance evaluation, i.e., the performance of the Student in these 160 Credits shall alone be taken into account for the calculation of the final CGPA.

If a Student registers for some more 'extra courses' (in the parent Department or other Departments/Branches of Engg.) other than those listed courses Totalling to 160 Credits as specified in the Course Structure of his/her Department, the performances in those 'extra courses' (although evaluated and graded using the same procedure as that of the required 160 Credits) will not be taken into account while calculating the SGPA and CGPA. For such 'extra courses' registered, % marks and Letter Grade alone will be indicated in the Grade Card, as a performance measure, subject to completion of the Attendance and Academic Requirements as stated in items 8 and 9.1-9.6.

9.7 Students who fail to earn minimum of 160 Credits as per the Course Structure, and as indicated above, within 8 Academic Years from the Date of Commencement of their I Year shall forfeit their seats in B.Tech Programme and their admissions shall stand cancelled.

When a Student is detained due to shortage of attendance/lack of credits in any Semester, he may be re-admitted into that Semester, as and when offered. However the regulations at the time of admissions hold good.

10. EVALUATION - DISTRIBUTION AND WEIGHTAGE OF MARKS

10.1 The performance of a student in each Semester shall be evaluated Course-wise (irrespective of Credits assigned) with a maximum of 100 marks for Theory. The B.Tech Project Work (Major Project) will be evaluated for 100 marks in Phase-I and 200 Marks in Phase-II.

10.2 For all Theory Courses as mentioned above, the distribution shall be 30 marks for CIE, and 70 marks for the SEE.

10.3 a) For Theory Subjects (inclusive of Minor Courses), during the Semester, there shall be 2 mid-term examinations for 30 marks each. Each mid-term examination consists of one subjective paper for 25 marks, and assignment for 5 marks for each subject.

Question paper contains 2 Parts (Part-A and Part-B.) The distribution of marks for PART-A and PART-B will be 10 marks & 15 marks respectively for UG programme.

Pattern of the question paper is as follows:

PART–A

Consists of ***one compulsory question*** with five sub questions each carrying two mark. For the I-Mid examinations the sub question would be from first 2 ½ units and for the II-Mid examination the sub question would be from the remaining 2 ½ units.

PART-B

Consists of five questions (out of which students have to answer three questions) carrying five marks each. Each question there will be an "either" "or" choice (that means there will be two questions from each unit and the student should answer any one question). The questions can consist of sub questions also.

b) The first mid-term examination shall be conducted for the first 50% of the syllabus, and the second mid-term examination shall be conducted for the remaining 50% of the syllabus.

c) First Assignment should be submitted before the commencement of the first mid-term examinations, and the Second Assignment should be submitted before the commencement of the second mid-term examinations. The assignments shall be specified/given by the concerned subject teacher.

d) If any candidate is absent for the MID term examination or those who want to improve their internal marks in any subject can opt for Computer Based Test (CBT) as and when offered. The CBT is a 45 minutes duration ONLINE exam consisting of 30 objective questions from the entire syllabus of the subject. Best marks is consider as a final marks from the average of two mid examinations or CBT examination marks. The CBT can be taken after the payment of prescribed fee. There is no Internal Improvement for the courses Machine Drawing, Production Drawing, Engineering Drawing, Engineering Graphics and practical courses.

10.4 For Practical Courses, there shall be a Continuous Internal Evaluation (CIE) during the Semester for 30 internal marks, and 70 marks are assigned for Lab/Practical End Semester Examination (SEE). Out of the 30 marks for internals, day-to-day work in the laboratory shall be evaluated for 15 marks; and for the remaining 15 marks - two internal practical tests (each of 15 marks) shall be conducted by the concerned laboratory teacher and the average of the two tests is taken into account. The SEE for Practical's shall be conducted at the end of the Semester by Two Examiners appointed by the Chief Controller of Examinations in consultation with the Head of the Department.

10.5 For the Subjects having Design and/or Drawing, (such as Engineering Graphics, Engineering Drawing, Machine Drawing, Production Drawing Practice, and Estimation), the distribution shall be 30 marks for CIE (10 marks for day-to-day work and 20 marks for internal tests) and 70 marks for SEE. There shall be two internal tests in a semester and the average of the two shall be considered for the award of marks for internal tests.

10.6 **Open Elective Course:** Students can choose One Open Elective Course (OEC-I) during V Semester, one (OEC-II) during VI Semester, one (OEC-III) in VII Semester, and one (OEC-IV) in VIII Semester from the list of Open Elective Courses given. However, Students cannot opt for an Open Elective

Courses offered by their own (parent) Department, if it is already listed under any category of the Subjects offered by parent Department in any Semester.

10.7 There shall be an internship to be taken up during the vacation after II year II Semester (IV Semester) examination. However, the internship and its report shall be evaluated in III Year I Semester (VI Semester) SEE. The internship shall be submitted in a report form and presented before the committee. It shall be evaluated for 100 marks. The committee consists of head of the department, and a senior faculty member(s)(minimum Two) of the department. There shall be no internal marks for internship.

10.8 There shall be a Comprehensive Viva in VI Semester and will be conducted SEE by through a test or a committee consisting of One External Examiner, Head of the Department and two Senior faculty members of the Department. The comprehensive viva is intended to assess the student's understanding of the subjects he/she studied during the B.Tech course of study. The Comprehensive Viva is evaluated for 100 marks by the test or committee. There shall be no CIE for Comprehensive Viva.

10.9 Each Student shall start the Project Work Phase-I during the IV B.Tech I Semester(VII Semester), as per the instructions of the Project Guide/Project Supervisor assigned by the Head of Department. Total 100 marks allotted for the Project Work Stage-I. 40% of marks shall be evaluated Project Guide/Project supervisor CIE (Continuous Internal Evaluation) based on the reports submitted and conduct presentations. Remaining 60% of marks shall be evaluated by committee comprising of the Head of the Department, project supervisor and senior faculty member from concerned department based on Viva/Seminar Presentation. He/She must secure the 40% of the marks from CIE. For Project work Phase-II in IV Year II Sem. There is an internal marks of 50, the evaluation should be done by the supervisor. The There is an external marks of 150 and the same evaluated by the external examiner appointed by the Chief Controller of Examinations and he secures a minimum of 35% of marks in the Semester End Examination and a minimum aggregate of 40% of the total marks in the Semester End Examination and Continuous Internal Evaluation taken together.

10.10. **End Semester examination:**

a) Question paper contains 2 Parts (Part-A and Part-B) having the questions distributed equally among all units.

b) The distribution of marks for PART-A and PART-B will be 20 marks & 50 marks respectively for UG programmes. Pattern of the question paper is as follows:

PART–A

Consists of one question which are compulsory. The first question consists of ten sub-questions two from each unit and carry 2 marks each.

PART-B

Consists of 5 questions carrying 10 marks each. Each of these questions is from one unit and may contain sub questions. Each question there will be an "either" "or" choice (that means there will be two questions from each unit and the student should answer any one question).

10.11 For Mandatory Non-Credit Courses offered in a Semester, after securing ≥ 65% attendance and has secured not less than 35% marks in the SEE, and a minimum of 40% of marks in the sum Total of the CIE and SEE taken together in such a course, then the student is **PASS** and will be qualified for the award of the degree. No marks or Letter Grade shall be allotted for these courses/activities.However, for non credit courses '**Satisfactory'** or "**Unsatisfactory'** shall be indicated instead of the letter grade and this will not be counted for the computation of SGPA/CGPA.

10.12. For social innovation and Engineering Exploration courses, there shall be a Continuous Internal Evaluation (CIE) during the Semester for 30 internal marks, and 70 marks are assigned End Semester Examination (SEE). Internal evaluations done through presentations in CIE-1 & CIE-2. The SEE for

shall be conducted at the end of the Semester by Two Examiners appointed by the Chief Controller of Examinations in consultation with the Head of the Department.

11. AWARD OF DEGREE

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

Table: **Declaration of Class based on CGPA (Cumulative Grade Point Average)**

Class Awarded	Grade to be Secured
First Class with Distinction	CGPA ≥ 8.00
First Class	≥ 6.50 to < 8.00 CGPA
Second Class	≥ 5.50 to < 6.50 CGPA
Pass Class	≥ 5.00 to < 5.50 CGPA
FAIL	CGPA < 5

a) **Improvement of Grades and Completion of the Course**

i) Candidates who have passed in a theory course in a Semester are allowed to appear for improvement of Grade in the next immediate supplementary examination for a maximum of three subjects only. Candidates will not be allowed to improve grade in the Laboratory, Seminars, Internships and Project Work.

ii) Improved grade will not be counted for the award of prizes/medals and Rank. However the previous grade will be considered for the award of prizes/medals and rank in case of toppers.

iii) If the candidate does not show improvement in the grade, his/her previous grade will be taken into consideration.

12. LETTER GRADE AND GRADE POINT

12.1 Marks will be awarded to indicate the performance of each student in each Theory Subject, or Lab/Practical's, or Seminar, or Project, or Internship*/Mini-Project, Minor Course etc., based on the %marks obtained in CIE+SEE (Continuous Internal Evaluation + Semester End Examination, both taken together), and a corresponding Letter Grade shall be given.
* For internship only SEE will be taken into consideration. There is no CIE for Internship.

12.2 As a measure of the student's performance, a 10-point Absolute Grading System using the following Letter Grades (UGC Guidelines) and corresponding percentage of marks shall be followed...

% of Marks Secured (Class Intervals)	*Letter Grade (UGC Guidelines)*	*Grade Points*
90% and above (≥ 90% , ≤ 100%)	O (Outstanding)	10
Below 90% but not less than 80% (≥ 80% , < 90%)	A^+ (Excellent)	9
Below 80% but not less than 70% (≥ 70% , < 80%)	A (Very Good)	8
Below 70% but not less than 60% (≥ 60% , < 70%)	B^+ (Good)	7
Below 60% but not less than 50% (≥ 50% , < 60%)	B (above Average)	6
Below 50% but not less than 40% (≥ 40% , < 50%)	C (Average)	5
Below 40% (< 40%)	F (FAIL)	0
Absent	AB	0

12.3 A student obtaining F Grade in any Subject shall be considered 'failed' and will be required to reappear as 'Supplementary Candidate' in the End Semester Examination (SEE), as and when offered. In such cases, his Internal Marks (CIE Marks) in those Subject(s) will remain same as those he obtained earlier.

12.4 A Letter Grade does not imply any specific % of Marks.

12.5 In general, a student shall not be permitted to repeat any Subject/Course (s) only for the sake of 'Grade Improvement' or 'SGPA/CGPA Improvement'. However, he has to repeat all the Subjects/Courses pertaining to that Semester, when he is detained.

12.6 A student earns Grade Point (GP) in each Subject/Course, on the basis of the Letter Grade obtained by him in that Subject/Course (excluding Mandatory non-credit Courses). Then the corresponding 'Credit Points' (CP) are computed by multiplying the Grade Point with Credits for that particular Subject/Course.

Credit Points (CP) = Grade Point (GP) x Credits …. For a Course

12.7 The Student passes the Subject/Course only when he gets GP ≥ 4 (P Grade or above).

12.8 The Semester Grade Point Average (SGPA) is calculated by dividing the Sum of Credit Points (ΣCP) secured from ALL Subjects/Courses registered in a Semester, by the Total Number of Credits registered during that Semester. SGPA is rounded off to TWO Decimal Places. SGPA is thus computed as

SGPA = $\{\sum_{i=1}^{N} C_i G_i\} / \{\sum_{i=1}^{N} C_i\}$ …. For each Semester,

where 'i' is the Subject indicator index (takes into account all Subjects in a Semester), 'N' is the no. of Subjects 'REGISTERED' for the Semester (as specifically required and listed under the Course Structure of the parent Department), C_i is the no. of Credits allotted to that ix Subject, and G_i represents the Grade Points (GP) corresponding to the Letter Grade awarded for that i Subject.

Illustration of Computation of SGPA Computation

Course	Credit	Grade Letter	Grade Point	Credit Point (Credit x Grade)
Course1	3	A	8	3 x 8 = 24
Course2	4	B+	7	4 x 7 = 28
Course3	3	B	6	3 x 6 = 18
Course4	3	O	10	3 x10= 30
Course5	3	C	5	3 x 5 = 15
Course6	4	B	6	4 x 6 = 24

Thus, **SGPA =139/20 =6.95**

12.9 The Cumulative Grade Point Average (CGPA) is a measure of the overall cumulative performance of a student over all Semesters considered for registration. The CGPA is the ratio of the Total Credit Points secured by a student in ALL registered Courses in ALL Semesters, and the Total Number of Credits registered in ALL the Semesters. CGPA is rounded off to TWO Decimal Places. CGPA is thus computed from the I Year Second Semester onwards, at the end of each Semester, as per the formula

CGPA = $\{\sum_{j=1}^{M} C_j G_j\} / \{\sum_{j=1}^{M} C_j\}$ … for all S Semesters registered

(i.e., up to and inclusive of S Semesters, S ≥ 2),

where 'M' is the TOTAL no. of Subjects (as specifically required and listed under the Course Structure of the parent Department) the Student has 'REGISTERED' from the 1st Semester onwards up to and inclusive of the Semester S (obviously M > N), 'j' is the Subject indicator index (takes into account all Subjects from 1 to S Semesters), C_j is the no. of Credits allotted to the jth Subject, and G_j represents the Grade Points (GP) corresponding to the Letter Grade awarded for that jth Subject. After registration and completion of I Year I Semester however, the SGPA of that Semester itself may be taken as the CGPA, as there are no cumulative effects.

For CGPA Computation

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

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

12.10 For Merit Ranking or Comparison Purposes or any other listing, ONLY the 'ROUNDED OFF' values of the CGPAs will be used.

12.11 For Calculations listed in Item 12.6–12.10, performance in failed Subjects/Courses (securing F Grade) will also be taken into account, and the Credits of such Subjects/Courses will also be included in the multiplications and summations. However, Mandatory Courses will not be taken into consideration.

12.12 Conversion formula for the conversion of GPA into indicative percentage is

[CGPA Earned-0.50]x10= % of marks scored

13. DECLARATION OF RESULTS

Computation of SGPA and CGPA are done using the procedure listed in 12.6– 2.10.

No SGPA/CGPA is declared, if a candidate is failed in any one of the courses of a given Semester.

14. WITH HOLDING OF RESULTS

If the student has not paid fees to College at any stage, or has pending dues against his name due to any reason what so ever, or if any case of indiscipline is pending against him, the result of the student may be withheld, and he will not be allowed to go into the next higher Semester. The Award or issue of the Degree may also be withheld in such cases.

15. REVALUATION

Students shall be permitted for revaluation after the declaration of end Semester examination results within due dates by paying prescribed fee. After revaluation if there is any betterment in the grade, then improved grade will be considered. Otherwise old grade shall be retained.

16. SUPPLEMENTARY EXAMINATIONS

16.1 Supplementary examinations for the odd Semester shall be conducted with the regular examinations of even Semester and vice versa, for those who appeared and failed or absent in regular examinations. Such candidates writing supplementary examinations may have to write more than one examination per day.

16.2 **ADVANCED SUPPLEMENTARY EXAMINATION**

Advanced supplementary examinations will be conducted for IV year II Semester after announcement of regular results.

17. TRANSCRIPTS

After successful completion of prerequisite credits for the award of degree a Transcript containing performance of all academic years will be issued as a final record. Duplicate transcripts will also be issued if required after the payment of requisite fee and also as per norms in vogue.

18. RULES OF DISCIPLINE

18.1 Any attempt by any student to influence the teachers, Examiners, faculty and staff of controller of Examination for undue favours in the exams, and bribing them either for marks or attendance will be treated as malpractice cases and the student can be debarred from the college.

18.2 When the student absents himself, he is treated as to have appeared and obtained zero marks in that course(s) and grading is done accordingly.

18.3 When the performance of the student in any subject(s) is cancelled as a punishment for indiscipline, he is awarded zero marks in that subject(s).

18.4 When the student's answer book is confiscated for any kind of attempted or suspected malpractice the decision of the Examiner is final.

19. MALPRACTICE PREVENTION COMMITTEE

A malpractice prevention committee shall be constituted to examine and punish the students who involve in malpractice / indiscipline in examinations. The committee shall consist of:

a) Controller of examinations - Chairman
b) Addl. Controller of examinations.- Member Convenor
c) Subject expert - member
d) Head of the department of which the student belongs to. - Member
e) The invigilator concerned - member

The committee shall conduct the meeting after taking explanation of the student and punishment will be awarded by following the malpractice rules meticulously.

Any action on the part of candidate at the examination like trying to get undue advantage in the performance at examinations or trying to help another, or derive the same through unfair means is punishable according to the provisions contained hereunder. The involvement of the Staff who are in charge of conducting examinations, valuing examination papers and preparing / keeping records of documents relating to the examinations, in such acts (inclusive of providing incorrect or misleading information) that infringe upon the course of natural justice to one and all concerned at the examination shall be viewed seriously and will be recommended for appropriate punishment after thorough enquiry.

20. TRANSITORY REGULATIONS

Student who has discontinued for any reason, or has been detained for want of attendance or lack of required credits as specified, or who has failed after having undergone the Degree Programme, may be considered eligible for readmission to the same Subjects/Courses (or equivalent Subjects/Courses, as the case may be), and same Professional Electives/Open Electives (or from set/category of Electives or equivalents suggested, as the case may be) as and when they are offered (within the time-frame of 8 years from the Date of Commencement of his I Year I Semester).

21. AMENDMENTS TO REGULATIONS

The Academic Council of MLR Institute of Technology reserves the right to revise, amend, or change the regulations, scheme of examinations, and / or syllabi or any other policy relevant to the needs of the society or industrial requirements etc., without prior notice.

22. STUDENT TRANSFERS

There shall be no Branch transfers after the completion of Admission Process. Transfer of students from other colleges or universities are permitted subjected to the rules and regulations of TSCHE (TE Department) and JNTUH in vogue.

23. GRADUATION DAY

The College shall have its own Annual Graduation Day for the award of Degrees issued by the College/University.

24. AWARD OF MEDALS

Institute will award Medals to the outstanding students who complete the entire course in the first attempt within the stipulated time.

25. SCOPE

i) Where the words “he”, “him”, “his”, occur in the write-up of regulations, they include “she”, “her”.
ii) Where the words “Subject” or “Subjects”, occur in these regulations, they also imply “Course” or “Courses”.
iii) The Academic Regulations should be read as a whole, for the purpose of any interpretation.
iv) In case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Chairman of the Academic Council is final.

Academic Regulations for B. Tech. (Lateral Entry Scheme)

(Effective for the students getting admitted into II year from the Academic Year 2018-2019 on wards)

1. The Students have to acquire 120 credits from II to IV year of B.Tech Programme (Regular) for the award of the degree.
2. Students, who fail to fulfil the requirement for the award of the degree in 6 consecutive academic years from the year of admission, shall forfeit their seat.
3. The same attendance regulations are to be adopted as that of B. Tech. (Regular)
4. **Promotion Rule:**
5. A Student will not be promoted from III Year to IV Year, unless he/she fulfils the Attendance and Academic Requirements and (i) secures a Total of 50% Credits up to III Year II Semester, from all the regular and supplementary examinations.
6. **Award of Class:**

   After the student has satisfied the requirements prescribed for the completion of the programme and is eligible for the award of B. Tech. Degree, he/she shall be placed in one of the following four classes: The marks obtained for 120 credits will be considered for the calculation of CGPA and award of class shall be shown separately.

   Table: **Declaration of Class based on CGPA (Cumulative Grade Point Average)**

Class Awarded	Grade to be Secured
First Class with Distinction	CGPA ≥ 8.00
First Class	≥ 6.50 to < 8.00 CGPA
Second Class	≥ 5.50 to < 6.50 CGPA
Pass Class	≥ 5.00 to < 5.50 CGPA
FAIL	CGPA < 5

7. All other regulations as applicable for B. Tech. Four-year degree course (Regular) will hold good for B.Tech (Lateral Entry Scheme).

MALPRACTICES RULES - DISCIPLINARY ACTION FOR /IMPROPER CONDUCT IN EXAMINATIONS

S. No	Nature of Malpractices / Improper Conduct	Punishment
1 (a)	Possesses or keeps accessible in examination hall, any paper, note book, programmable calculators, Cell phones, pager, palm computers or any other form of material concerned with or related to the subject of the examination (theory or practical) in which he is appearing but has not made use of (material shall include any marks on the body of the candidate which can be used as an aid in the subject of the examination)	Expulsion from the examination hall and cancellation of the performance in that subject only.
(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 Principal.
3	Impersonates any other candidate in connection with the examination.	The candidate who has impersonated shall be expelled from examination hall. The candidate is also debarred and forfeits the seat. The performance of the original candidate who has been impersonated, shall be cancelled in all the subjects of the examination (including practical's and 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 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 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 Addl. 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 addl. Controller of examinations 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 addl. Controller of examinations, or any person on duty in or outside the examination hall or any of his relations, or indulges in any other act of misconduct or mischief which result in damage to or destruction of property in the examination hall or any part of the College	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.

	campus or engages in any other act which in the opinion of the officer on duty amounts to use of unfair means or misconduct or has the tendency to disrupt the orderly conduct of the examination.	
7	Leaves the exam hall taking away answer script or intentionally tears of the script or any part thereof inside or outside the examination hall.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that Semester/year. The candidate is also debarred for two consecutive Semesters from class work and all 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 principal for further action to award suitable punishment.	

COURSE STRUCTURE

I B.Tech.- I-Semester									
Course Code	Course Title	Course Area	Hours per Week			Credits	Scheme of Examination Maximum Marks		
			L	T	P		Internal (CIE)	External (SEE)	Total
A4BS01	Calculus and Applications	BSC	3	1	-	4	30	70	100
A4BS11	Chemistry	BSC	4	-	-	4	30	70	100
A4CS01	Programming for Problem Solving	ESC	3	-	-	3	30	70	100
A4HS01	English	HSMC	2	-	-	2	30	70	100
A4CS02	Programming for Problem Solving Lab	ESC	-	-	4	2	30	70	100
A4BS12	Chemistry Lab	BSC	-	-	3	1.5	30	70	100
A4HS02	English Language and Communication Skills Lab	HSMC	-	-	2	1	30	70	100
A4HS03	Social Innovation	HSMC	-	-	2	1	30	70	100
Total			**12**	**1**	**11**	**18.5**	**240**	**560**	**800**
Mandatory Course (Non-Credit)									
A4MC04	Technical Seminar-I	MC	-	-	2	-	30	70	100

I B.Tech.- II-Semester									
Course Code	Course Title	Course Area	Hours per Week			Credits	Scheme of Examination Maximum Marks		
			L	T	P		Internal (CIE)	External (SEE)	Total
A4BS03	Integral Calculus and Transforms	BSC	3	1	-	4	30	70	100
A4BS08	Semiconductor Physics	BSC	3	1	-	4	30	70	100
A4EE01	Basic Electrical Engineering	ESC	3	1	-	4	30	70	100
A4ES02	Engineering Graphics and Design	ESC	1	-	4	3	30	70	100
A4BS10	Physics Laboratory	BSC	-	-	3	1.5	30	70	100
A4EE02	Basic Electrical Engineering Lab	ESC	-	-	2	1	30	70	100
A4AE63	Workshop Practices	ESC	-	-	4	2	30	70	100
A4HS04	Engineering Exploration	HSMC	-	-	2	1	30	70	100
Total			**10**	**3**	**15**	**20.5**	**240**	**560**	**800**
Mandatory Course (Non-Credit)									
A4MC05	Technical Seminar-II	MC	-	-	2	-	30	70	100

II B.Tech.- I-Semester

Course Code	Course Title	Course Area	Hours per Week			Credits	Scheme of Examination Maximum Marks		
			L	T	P		Internal (CIE)	External (SEE)	Total
A4EE03	Electrical Circuit Analysis	BSC	3	-	-	3	30	70	100
A4EC01	Electronic Devices and circuits	ESC	3	-	-	3	30	70	100
A4EE04	Electrical Machines – I	PCC	3	1	-	4	30	70	100
A4EE05	Electromagnetic Field	PCC	3	-	-	3	30	70	100
A4EE06	Electrical Measurements and Instrumentation	PCC	3	-	-	3	30	70	100
A4EC07	Electronic Devices and circuits Lab	ESC	-	-	3	1.5	30	70	100
A4EE07	Electrical Machines Lab – I	PCC	-	-	3	1.5	30	70	100
A4EE08	Electrical Circuits and Simulation Lab	BSC	-	-	3	1.5	30	70	100
Total			**15**	**1**	**9**	**20.5**	**240**	**560**	**800**
Mandatory Course (Non-Credit)									
A4MC02	Gender sensitization	MC	-	-	2	-	30	70	100

II B.Tech.- II-Semester

Course Code	Course Title	Course Area	Hours per Week			Credits	Scheme of Examination Maximum Marks		
			L	T	P		Internal (CIE)	External (SEE)	Total
A4EC03	Digital logic Design	PCC	3	-	-	3	30	70	100
A4EE09	Electrical Machines – II	PCC	3	-	-	3	30	70	100
A4EE10	Power Systems – I	PCC	3	-	-	3	30	70	100
A4EC23	Control Systems	PCC	3	-	-	3	30	70	100
A4BS07	Numerical Methods and Complex Analysis	BSC	3	-	-	3	30	70	100
A4EC06	Digital logic Design Lab	PCC	-	-	3	1.5	30	70	100
A4EE11	Electrical Machines Lab – II	PCC	-	-	3	1.5	30	70	100
A4EE12	Electrical Measurements and Instrumentation Lab	PCC	-	-	3	1.5	30	70	100
Total			**15**	**1**	**9**	**19.5**	**240**	**560**	**800**
Mandatory Course (Non-Credit)									
A4MC01	Environmental Studies	MC	2	-	-	-	30	70	100

III B.Tech.- I-Semester

Course Code	Course Title	Course Area	Hours per Week			Credits	Scheme of Examination Maximum Marks		
			L	T	P		Internal (CIE)	External (SEE)	Total
A4EE13	Power Electronics	PCC	3	-	-	3	30	70	100
A4EC05	Signals and Systems	PCC	3	-	-	3	30	70	100
A4EC17	Microprocessors and Microcontrollers	PCC	3	-	-	3	30	70	100
	Professional Elective –1	PEC	3	-	-	3	30	70	100
	Open Elective – I	OEC	3	-	-	3	30	70	100
A4EE14	Control System Lab	PCC	-	-	3	1.5	30	70	100
A4EE15	Power Electronics Lab	PCC	-	-	3	1.5	30	70	100
A4EC19	Microprocessors and Microcontrollers Lab	PCC	-	-	3	1.5	30	70	100
A4EE16	Summer internship	PWC	-	-	-	2	--	100	100
Total			**15**	**-**	**8**	**21.5**	**240**	**660**	**900**
Mandatory Course (Non-Credit)									
A4MC06	Essence of Indian Traditional Knowledge	MC	2	-	-	-	30	70	100

III B.Tech.- II-Semester

Course Code	Course Title	Course Area	Hours per Week			Credits	Scheme of Examination Maximum Marks		
			L	T	P		Internal (CIE)	External (SEE)	Total
A4EE17	Power Systems – II	PCC	3	-	-	3	30	70	100
A4EE18	Electrical Drives and control	PCC	3	-	-	3	30	70	100
A4EE19	Power Quality	PCC	3	-	-	3	30	70	100
	Professional Elective –2	PEC	3	-	-	3	30	70	100
	Open Elective – 2	OEC	3	-	-	3	30	70	100
A4EE20	Power Systems Lab	PCC	-	-	3	1.5	30	70	100
A4HS07	Advanced English Communication Skills lab	HSMC	-	-	3	1.5	30	70	100
A4EE25	Electric Drives Lab	PCC			3	1.5			
A4EE21	Comprehensive viva	PWC	-	-	-	1	--	100	100
Total			**15**	**0**	**6**	**20.5**	**210**	**590**	**800**
Mandatory Course (Non-Credit)									
A4MC03	Constitution of India	MC	2	-	-	-	30	70	100

IV B.Tech.- I-Semester									
Course Code	Course Title	Course Area	Hours per Week			Credits	Scheme of Examination Maximum Marks		
			L	T	P		Internal (CIE)	External (SEE)	Total
A4EE22	Power System Operation and Control	PCC	3	-	-	3	30	70	100
A4EE23	Switch Gear and Protection	PCC	3	-	-	3	30	70	100
	Professional Elective – 3	PEC	3	-	-	3	30	70	100
	Professional Elective – 4	PEC	3	-	-	3	30	70	100
	Open Elective – 3	OEC	3	-	-	3	30	70	100
A4EE24	Electrical and Electronics Design Lab	PCC	-		3	1.5	30	70	100
A4EE65	Power System Computer Aided Design Lab	PCC	-	-	3	1.5	30	70	100
A4EE26	Project Phase-I	PWC	-	-	8	4	100	--	100
Total			**15**	**-**	**14**	**22**	**310**	**490**	**800**

IV B.Tech.- II-Semester									
Course Code	Course Title	Course Area	Hours per Week			Credits	Scheme of Examination Maximum Marks		
			L	T	P		Internal (CIE)	External (SEE)	Total
	Professional Elective -5	PEC	3	-	-	3	30	70	100
	Professional Elective -6	PEC	3	-	-	3	30	70	100
	Open Elective-4	OEC HSMC	3	-	-	3	30	70	100
A4EE27	Project Phase-II	PWC	-	-	16	8	50	150	200
Total			**9**	**-**	**16**	**17**	**140**	**360**	**500**

PROFESSIONAL ELECTIVES			
PE-I		PE-II	
A4EE28	Wind and Solar Energy Systems	A4EE32	Electrical Machine Design
A4EE29	Line Commutated and Active Rectifiers	A4EE33	Control System Design
A4EE30	Power System Dynamics and Control	A4EE34	HVDC Transmission Systems
A4EE31	Electrical and Hybrid Vehicles	A4EE35	Industrial Automation
PE-III		PE-IV	
A4EE36	High Voltage Engineering	A4EE40	Digital Control Systems
A4EE37	Electrical Energy Conservation and Auditing	A4EE41	Digital Signal Processing
A4EE38	Industrial Electrical Systems	A4EE42	Computer Architecture
A4EE39	Electrical Distribution Systems	A4EE43	Renewable Energy Sources

PE-V		PE-VI	
A4EE44	Computational Electromagnetic	A4EE48	Special Electrical Machines
A4EE45	Computer networks	A4EE49	Advanced Control Systems
A4EE46	Advanced Electric Drives	A4EE50	Modelling and Analysis of Electrical Machines
A4EE47	Flexible Alternating Current Transmission Systems	A4EE51	Smart Grid Technologies

OPEN ELECTIVE COURSES

OPEN ELECTIVE COURSE-I			
S. No.	**Course Code**	**Course Name**	**Offering Department**
1	A4AE17	Fabrication Processes	Aeronautical Engineering
2	A4AE18	Fundamentals of Avionics	
3	A4AE19	Introduction to jets and rockets	
4	A4CS43	Fundamentals of Databases	Computer Science and Engineering
5	A4CS44	Introduction to C++	
6	A4CS45	Core Java Programming	
7	A4EC59	Logic Design	Electronics & Communication Engineering
8	A4EC60	Principles of Communications	
9	A4EC61	Measurements and Instruments	
10	A4EE52	Electrical Wiring and Safety Measures	Electrical &Electronics Engineering
11	A4EE53	Electrical Materials	
12	A4EE54	New trends Electrical Energy	
13	A4IT11	Fundamentals of Data Structures	Information Technology
14	A4IT12	Software Engineering Principles	
15	A4IT13	Computer Organization and Operating Systems	
16	A4ME60	Elements Of Mechanical Engineering	Mechanical Engineering
17	A4ME61	Fundamentals Of Engineering Materials	
18	A4ME62	Fundamentals Of Theory Of Machines	
19	A4SH06	Business Economics and Financial Analysis	MBA
20	A4HS51	Basics of Entrepreneurship	
21	A4HS52	Human Values and Professional Ethics	

OPEN ELECTIVE COURSE-II			
S. No.	**Course Code**	**Course Name**	**Offering Department**
1	A4AE25	Introduction to aircraft Industry	Aeronautical Engineering
2	A4AE26	Non destructive testing Methods	
3	A4AE27	Fundamentals of Finite element method	
4	A4CS46	Introduction to Computer Networks	Computer Science and Engineering
5	A4CS47	Introduction to Linux Programming	
6	A4CS48	Fundamentals of Artificial Intelligence	

7	A4EC62	Fundamentals of Integrated Circuits	Electronics & Communication Engineering
8	A4EC63	Signal Transmission through linear systems	
9	A4EC64	Fundamentals of VLSI Design	
10	A4EE55	Power Plant Engineering	Electrical &Electronics Engineering
11	A4EE56	Analysis of Linear Systems	
12	A4EE57	Neural Networks and Fuzzy Logic	
13	A4IT14	Basics of Python Programming	Information Technology
14	A4IT15	Human Computer Interaction	
15	A4IT16	Software Testing Fundamentals	
16	A4ME60	Fundamentals of Mechatronics	Mechanical Engineering
17	A4ME61	Basics Of Thermodynamics	
18	A4ME62	Fundamentals of Smart Materials	
19	A4HS52	Advanced Entrepreneurship	HSM

OPEN ELECTIVE COURSE-III			
S. No.	**Course Code**	**Course Name**	**Offering Department**
1	A4AE40	Guidance and control of aerospace vehicles	Aeronautical Engineering
2	A4AE41	Wind tunnel Techniques	
3	A4AE42	Introduction to Aerospace Technology	
4	A4CS49	Soft Computing	Computer Science and Engineering
5	A4CS50	Introduction to Cloud Computing	
6	A4CS51	Web Programming	
7	A4EC65	Introduction of Microprocessors and Microcontrollers	Electronics & Communication Engineering
8	A4EC66	Fundamentals of Image processing	
9	A4EC67	TV Engineering	
10	A4EE58	Electrical Engineering Materials	Electrical &Electronics Engineering
11	A4EE59	Non-Conventional Power Generation	
12	A4EE60	Solar Energy and Applications	
13	A4IT17	E- Commerce	Information Technology
14	A4IT18	Cyber Forensics	
15	A4IT19	Discrete Structures	
16	A4ME63	Fundamentals of Operation Research	Mechanical Engineering
17	A4ME64	Fundamentals of Energy Sources and Applications	
18	A4ME65	Basics of Robotics	
19	A4HS53	Indian Ethos & Business Ethics	HSM

OPEN ELECTIVE-IV			
S. No.	**Course Code**	**Course Name**	**Offering Department**
1	A4HS54	Management Science	HSM
2	A4HS55	Intellectual Property Rights	
3	A4HS56	Number Theory	
4	A4HS57	Physics and Technology of Thin films	

5	A4HS58	Polymer chemistry	
7	A4CS52	Introduction to Network Security	Computer Science and Engineering
8	A4CS53	Data Analytics	
9	A4CS54	.NET & C# Programming	
10	A4EC68	Introduction to signal Processing	Electronics & Communication Engineering
11	A4EC69	Introduction to mobile communication	
12	A4EC70	Basic Embedded systems Design	
13	A4EE61	Instrumentation and Control	Electrical &Electronics Engineering
14	A4EE62	Energy Audit and Management Systems	
15	A4EE63	Energy Storage Systems	
16	A4IT20	Introduction to Mobile Application Development	Information Technology
17	A4IT21	Distributed Databases	
18	A4IT22	Big Data	
19	A4ME66	Introduction to Material Handling	Mechanical Engineering
20	A4ME67	Non Conventional Energy Sources	
21	A4ME68	Aspects of Heat Transfer	

I B.TECH I SEMESTER SYLLABUS

CALCULUS AND APPLICATIONS

Course Code:	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A4BS01	BSC	3	1	-	4	30	70	100

OBJECTIVES:

To learn

1. Concept of Rank of a matrix, Consistency and solving system of linear equations.
2. The concept of differential equations and solve them using appropriate methods.
3. Usage of the appropriate test to find the convergence and divergence of the given series.
4. Evaluation of length, areas& volumes of different curves of revolution.
5. The partial derivatives of several variable functions.

OUTCOMES:

Upon successful completion of the course, the student is able to

1. Solve the system of linear equations using rank of the matrices.
2. Identify the different types of differential equations and solve those using appropriate methods.
3. Apply the appropriate test to find the convergence and divergence of the given series.
4. Evaluate the improper integrals using beta and gamma functions.
5. Find the Maxima and Minima of several variable functions.

UNIT-I THEORY OF MATRICES Classes: 10

Finding rank of a matrix by reducing to Echelon form, Consistency of system of linear equations (homogeneous and non-homogeneous) using the rank of a matrix, Eigen values and Eigen vectors and its properties(with out proof),Cayley-Hamilton theorem (Statement and verification)-Finding inverse and powers of a matrix by Cayley-Hamilton theorem, Diagonalisation of matrices.

UNIT-II ORDINARY DIFFERENTIAL EQUATIONS Classes: 10

Introduction- Exact and reducible to Exact differential equations -Equations not of first degree: Equations solvable for p-equations, solvable for y- equations and solvable for x and Clairaut's type. Linear differential equations of second and higher order with constant coefficients - Non-Homogeneous term of the type Q(x) = e^{ax}, Sin ax, Cosax, $e^{ax}v(x)$, $x^{n}v(x)$ - Method of variation of parameters.

UNIT-III SEQUENCES AND SERIES Classes: 08

Basic definitions of Sequences and series – Convergence and divergence –Comparison Test- Ratio Test – Raabe's Test-Integral Test – Cauchy's n^{th} root Test –Absolute and Conditional convergence – Power Series.

UNIT-IV BETA GAMMA FUNCTIONS AND APPLICATIONS OF DEFINITE INTEGTALS Classes: 10

Beta- Gamma Functions and their Properties-Relation between them- Evaluation of improper integrals using Gamma and Beta functions.

Application of definite integrals: Lengths, evaluate surface areas and volumes of revolution of curves (only in Cartesian co-ordinates).

UNIT-V CALCULUS OF SEVERAL VARIABLES Classes: 10

Limit, Continuity - Partial derivative- Partial derivatives of higher order -Total derivative – Chain rule, Jacobians -functional dependence & independence.

Applications: Maxima and Minima of functions of two variables without constraints and Lagrange's method (with constraints)

Text Books

1. Ervin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. B.S.Grewal, Higher Engineering Mathematics, Khanna publishers, 36th Edition, 2010.

Reference Books:

1. G.B.Thomas, calculus and analytical geometry,9th Edition, Pearson Reprint 2006.
2. N.P Bali and Manish Goyal
3. A Text of Engineering Mathematics,Laxmi publications,2008.
4. E.L.Ince, Ordinary differential Equations, Dover publications,1958.

Web references:

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

E -Text Books:

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

MOOCS Course:

1. https://swayam.gov.in/
2. https://onlinecourses.nptel.ac.in/

CHEMISTRY

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A4BS11	BSC	4	-	-	4	30	70	100

OBJECTIVES:

Student will be able to:

1. Bring adaptability to the concepts of chemistry and to acquire the required skills to become a perfect engineer.
2. To impart the basic knowledge of atomic, molecular and electronic modifications which makes the student to understand the technology based on them.
3. To acquire the knowledge of electrochemistry, corrosion and water treatment which are essential for the Engineers and in industry
4. To acquire the skills pertaining to spectroscopy and to apply them for medical and other fields.
5. To impart the knowledge of stereochemistry and synthetic aspects useful for understanding reaction pathways.

OUTCOMES:

The basic concepts included in this course will help the student to gain:

1. The knowledge of atomic, molecular and electronic changes, band theory related to conductivity.
2. The required principles and concepts of electrochemistry, corrosion and in understanding the problem of water and its treatments.
3. The required skills to get clear concepts on basic spectroscopy and application to medical and other fields.
4. The knowledge of configurational and conformational analysis of molecules and reaction mechanisms.

UNIT-I MOLECULAR STRUCTURE AND THEORIES OF BONDING Classes: 10

Atomic and Molecular orbitals. Linear Combination of Atomic Orbitals (LCAO), molecular orbitals of diatomic molecules, molecular orbital energy level diagrams of N_2, O_2 and F_2 molecules. π molecular orbitals of butadiene and benzene.

Crystal Field Theory (CFT): Salient Features of CFT – Crystal Field Splitting of transition metal ion d- orbitals in Tetrahedral, Octahedral and square planar geometries. Band structure of solids and effect of doping on conductance.

UNIT-II WATER AND ITS TREATMENT Classes: 12

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.

UNIT-III ELECTROCHEMISTRY AND CORROSION Classes: 12

Electro chemical cells – electrode potential, standard electrode potential, types of electrodes – calomel, Quinhydrone and glass electrode. Nernst equation Determination of pH of a solution by using quinhydrone and glass electrode. Electrochemical series and its applications. Numerical problems. Potentiometric titrations. Batteries – Primary (Lithium cell) and secondary batteries (Lead – acid storage battery).

Corrosion: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

cathodic methods. Surface coatings – metallic coatings –Hot dipping , metal cladding and electro plating(copper plating).

.

UNIT-IV STEREOCHEMISTRY, REACTION MECHANISM AND SYNTHESIS OF DRUG MOLECULES Classes: 10

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

UNIT-V SPECTROSCOPIC TECHNIQUES AND APPLICATIONS Classes:8

Principles of spectroscopy, selection rules and applications of electronic spectroscopy, vibrational and rotational spectroscopy. Basic concepts of Nuclear magnetic resonance Spectroscopy, chemical shift. Introduction to Magnetic resonance imaging. Fluorescence and its applications in medicine.

Text Books:

Engineering Chemistry 14th edition by P.C.Jain&M.Jain; DhanpatRai Publishing Company (P) Ltd., New Delhi.
2. Fundamentals of Molecular Spectroscopy 5th edition by C.N. BanwellMc.Graw-Hills book company.

Reference Books:

Organic Chemistry 7th Edition, Robert Thornton Morrison, Robert Neilson Boyd, SaibalKantiBhattacharjee Pearson Education Singapore Pvt.Ltd.
Engineering Chemistry (NPTEL Web-book), 11thedition by B.L. Tembe, Kamaluddin and M.S. Krishnan.
Physical Chemistry 11thedition by P.W. Atkins OUP Oxford.

Web References:

https://www.scribd.com/document/23180395/Engineering-Chemistry-Unit-I-Water-Treatment
https://chem.libretexts.org/Core/Inorganic_Chemistry/Descriptive_Chemistry/Periodic_Trends_of_Elemental_Properties/Periodic_Properties_of_the_Elements
https://www.khanacademy.org/science/biology/chemistry--of-life/chemical-bonds-and-reactions/v/intermolecular-forces-and-molecular-bonds
https://study.com/academy/lesson/the-relationship-between-free-energy-and-the-equilibrium-constant.html

E-Text Books:

http://www.freebookcentre.net/Chemistry/Chemistry-Books-Online.html
https://www.sdu.dk/en/om_sdu/institutter_centre/fysik_kemi_og_farmaci

MOOC Course

http://nptel.ac.in/courses/122101001/34
https://ocw.mit.edu/courses/chemistry/

PROGRAMMING FOR PROBLEM SOLVING

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A4CS01	ESC	3	-	-	3	30	70	100

OBJECTIVES:

1. To impart basic knowledge about simple algorithms for arithmetic and logical problems.
2. To understand how to write a program, syntax and logical errors.
3. To enable them how to implement conditional branching, iteration and recursion.
4. To understand how to decompose a problem into functions and synthesize a complete program.
5. To enable them to use arrays, pointers, strings and structures in solving problems.
6. To understand how to solve problems related to matrices, Searching and sorting.
7. To make them to understand the use files to perform read and write operations.

OUTCOMES

At the end of the course, student will be able to:

1. Formulate simple algorithms for arithmetic and logical problems.
2. Test and execute the programs and correct syntax and logical errors.
3. Implement conditional branching, iteration and recursion.
4. Decompose a problem into functions and synthesize a complete program.
5. Use arrays, pointers, strings and structures to formulate algorithms and programs.
6. Apply programming to solve problems related to matrices, Searching and sorting.
7. Use files to perform read and write operations.

UNIT-I INTRODUCTION Classes: 12

Introduction to Programming: Computer system, components of a computer system, computing environments, computer languages, creating and running programs, Algorithms, flowcharts.
Introduction to C language: 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, I/O statements.

UNIT-II OPERATORS, EXPRESSIONS AND CONTROL STRUCTURES Classes: 15

Operators and expressions: Operators, arithmetic, relational and logical, assignment operators, increment and decrement operators, bitwise and conditional operators, special operators, operator precedence and associativity, evaluation of expressions, type conversions in expressions.
Control structures: Decision statements; if and switch statement; Loop control statements: while, for and do while loops, jump statements, break, continue, go to statements.

UNIT-III ARRAYS AND FUNCTIONS Classes: 17

Arrays: Concepts, One dimensional array, declaration and initialization of one dimensional arrays, two dimensional arrays, initialization and accessing, multi dimensional arrays, Basic Algorithms: Searching, Basic Sorting Algorithms- Bubble sort, Insertion sort and Selection sort.
Functions: User defined and built-in Functions, storage classes, Parameter passing in functions, call by value, Passing arrays to functions: idea of call by reference, Recursion, as a different way of solving problems. Example programs, such as Finding Factorial, Fibonacci series, Ackerman function etc, Quick sort or Merge sort.

UNIT-IV STRINGS AND POINTERS Classes: 10

Strings: Arrays of characters, variable length character strings, inputting character strings, character library functions, string handling functions.
Pointers: Pointer basics, pointer arithmetic, pointers to pointers, generic pointers, array of pointers, functions returning pointers, Dynamic memory allocation.

UNIT-V STRUCTURES AND FILE HANDLING Classes: 10

Structures and unions: Structure definition, initialization, accessing structures, nested structures, arrays of structures, structures and functions, self referential structures, unions, typedef, enumerations.
File handling: command line arguments, File modes, basic file operations read, write and append, example programs

Text Books:

1.Byron Gottfried, "Programming with C", Schaum's Outlines Series, McGraw Hill Education, 3rded 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. YashavantKanetkar, "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.

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.imada.sdu.dk/~svalle/courses/dm14-2005/mirror/c/
2. http://www.enggnotebook.weebly.com/uploads/2/2/7/1/22718186/ge6151-notes.pdf

MOOC Course

1. https://onlinecourses.nptel.ac.in/noc18_cs33/preview

2. https://www.alison.com/courses/Introduction-to-Programming-in-c

3. http://www.ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-s096-effective-programming-in-c-and-c-january-iap-2014/index.htm

ENGLISH

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A4HS01	HSMC	2	-	-	2	30	70	100

OBJECTIVES:

The course should enable the students to:

1. Improve language proficiency with emphasis on Vocabulary, Grammar, Reading and Writing skills.
2. Apply the theoretical and practical components of English syllabus to study academic subjects more effectively and critically.
3. Analyze a variety of texts and interpret them to demonstrate in writing or speech.
4. Write clearly and creatively, and adjust writing style appropriately to the content, the context, and nature of the subject.
5. Develop language components to communicate effectively in formal and informal situations.

OUTCOMES:

At the end of the course, student will be able to:

1. Improve language proficiency with emphasis on Vocabulary, Grammar, Reading and Writing skills.
2. Apply the theoretical and practical components of English syllabus to study academic subjects more effectively and critically.
3. Analyze a variety of texts and interpret them to demonstrate in writing or speech.
4. Write clearly and creatively, and adjust writing style appropriately to the content, the context, and nature of the subject.
5. V. Develop language components to communicate effectively in formal and informal situations.

UNIT-I THE RAMAN EFFECT **Classes: 12**

Chapter entitled 'The Raman Effect' from the prescribed textbook, 'English for Engineers' published by Cambridge University Press.
V- The concept of Word Formation, Root Words and their use in English
G- Types of Sentences, Parts of Speech, Nouns, Pronouns, Adjectives
R- Reading and its importance
W- Sentence Structures, Punctuation, Writing Introductions and Conclusions

UNIT-II LETTER WRITING **Classes: 12**

Letter Writing.
V- Synonyms and Antonyms, Standard Abbreviations
G- Verbs, Modal Auxiliaries, Adverbs, Prepositions, Conjunctions
R- Improving Comprehension Skills, Reading and Comparing Two Articles
W- Writing Paragraphs, Letter Writing- Letters of Request, Apology and Complaint- Letter of Application with Resume.

UNIT-III BLUE JEANS **Classes: 12**

Chapter entitled 'Blue Jeans' from the prescribed textbook, 'English for Engineers' published by Cambridge University Press.
V- Prefixes and Suffixes, Idioms and Phrasal verbs
G- Articles, Tenses and its forms
R- Sub skills of Reading- Skimming and Scanning
W- Essay writing and Describing Objects, Places and Events

UNIT-IV WHAT SHOULD YOU BE EATING Classes: 12

Chapter entitled 'What Should You Be Eating' from the prescribed textbook, 'English for Engineers' published by Cambridge University Press.
V- One word Substitutes, Words often confused
G- Active and passive Voice Subject Verb Agreement (Concord)
R- Reading Comprehension- Intensive and Extensive
W- Technical Report Writing, E-mail writing, Picture Essay

UNIT-V HOW A CHINESE BILLIONARE BUILT HER FORTUNE Classes: 12

Chapter entitled 'How a Chinese Billionaire Built Her Fortune' from the prescribed textbook, 'English for Engineers' published by Cambridge University Press.
V- Technical Vocabulary and their Usage, Misplaced Modifiers, Redundancies
G- Direct and Indirect Speech, Degrees of Comparison, Common Errors in English
R-Effective Reading and Exercises for Practice
W- Memo, Précis and Resume Writing

Text Books:

1. Sudarshan, N. P. and Savitha, C. (2018). English for Engineers. Cambridge University Press.

2. Wren & Martin. (2017). High School English Grammar and Composition Book. S Chand Publishing.

Reference Books:

1. Murphy, R. (2015). Essential Grammar in Use. Cambridge University Press.
2. Wood, F.T. (2007).Remedial English Grammar. Macmillan.
3. Swan, M. (2016). Practical English Usage. Oxford University Press.
4. Kumar, S and Lata, P. (2018). Communication Skills. Oxford University Press.
5. Zinsser, William. (2001). On Writing Well. Harper Resource Book.
6. Hamp-Lyons, L. (2006).Study Writing. Cambridge University Press.
7. Exercises in Spoken English. Parts I –III. CIEFL, Hyderabad. Oxford University Press.

Web References:

1. https://www.oxfordlineenglish.com
2. https://www.bbclearningenglish.com
3. https://www.learnenglish.britishcouncil.org
4. https://www.fluentu.com/english

E-Text Books:

1. https://www.uop.edu.jo/download/research/members/oxford_guide_to_english_grammar.pdf
2. http://www.espressoenglish.net/wp-content/uploads/2012/07/Free-Grammar-Ebook-Level-2.pdf
3. https://update24hour.com/2018/03/wren-and-martin-english-grammar-pdf

MOOC Course

http://www.cambridgeenglish.org/learning-english/free-resources/mooc/
https://www.britishcouncil.org.tr/en/english/mooc
https://mooec.com

PROGRAMMING FOR PROBLEM SOLVING LAB

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A4CS02	ESC	-	-	4	2	30	70	100

OBJECTIVES:

1. To understand how to formulate the algorithms for simple problems
2. To be able to translate given algorithms to a working and correct program
3. To make them understand how to correct syntax errors as reported by the compilers
4. To be able to identify and correct logical errors encountered at run time
5. To understand how to write iterative as well as recursive programs
6. To enable them to represent data in arrays, strings and structures
7. To impart the knowledge of declare pointers of different types and their usage.
8. To understand how to create, read and write to and from simple text files.

OUTCOMES:

At the end of the course, student will be able to

9. Formulate the algorithms for simple problems
10. Translate given algorithms to a working and correct program
11. Correct syntax errors as reported by the compilers
12. Identify and correct logical errors encountered at run time
13. Write iterative as well as recursive programs
14. Represent data in arrays, strings and structures and manipulate them through a program
15. Declare pointers of different types and use them in defining self-referential structures.
16. Create, read and write to and from simple text files.

LIST OF EXPERIMENTS

Week-1 INTRODUCTION TO LINUX COMMANDS

a. Basic Linux commands
b. Write a C program to use printf() and scanf() functions
c. Write C programs to implement basic arithmetic operations – sum, average, product, difference, quotient and remainder of given numbers etc.

Week-2 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-3 CONDITIONAL STATEMENTS

a. Write a C program to find largest and smallest of given numbers.
b. Write a C program to find roots of a quadratic equation.
c. Write a C program which takes two integer operands and one operator form the user(+,-,*,/,% use switch)

Week-4 LOOPING STATEMENTS

a. Write a C program to find Sum of individual digits of given integer
b. Write a C program to generate first n terms of Fibonacci series
c. Write a C program to generate prime numbers between 1 and n

Week-5 LOOPING STATEMENTS

a. Write a C Program to find the Sum of Series SUM=1-x2/2! +x4/4!-x6/6!+x8/8!-x10/10!
b. Write a C program to generate Pascal's triangle.
c. Write a C program to generate pyramid of numbers.

```
        1
    1   3   1
1   3   5   3   1
```

Week-6 ARRAYS

a. Write a C Program to implement following sorting methods
   i. Bubble sort
   ii. Selection sort
   iii. Insertion sort
b. Write a C program to find largest and smallest number in a list of integers

Week-7 ARRAYS

a. Write a C program
   i. To add two matrices
   ii. To multiply two matrices
b. Write a C program to find Transpose of a given matrix

Week-8 FUNCTIONS

a. Write a C program to find the factorial of a given integer using functions
b. Write a C program to find GCD of given integers using functions
c. Write a C Program to find the power of a given number using functions

Week-9 RECURSION

a. Write a C Program to find binary equivalent of a given decimal number using recursive functions.
b. Write a C Program to print Fibonacci sequence using recursive functions.
c. Write a C Program to find LCM of 3 given numbers using recursive functions

Week-10 STRINGS

a. Write a C program using functions to
    a. Insert a sub string into a given main string from a given position
    b. Delete n characters from a given position in a string
b. Write a C program to determine if given string is palindrome or not

Week-11 POINTERS AND STRUCTURES

a. Write a C program to print 2-D array using pointers
b. Write a C program to allocate memory dynamically using memory allocation functions (malloc, calloc, realloc, free)
c. Write a C Program using functions to
    a. Reading a complex number
    b. Writing a complex number
    c. Add two complex numbers
    d. Multiply two complex numbers

    Note: represent complex number using structure.

Week-12 FILES

a. Write a C program to copy one file to other
b. Write a C program to copy one file to other
c. Write a C Program to merge two files into a third file

Text Books:

1. YashavantKanetkar, "Let Us C", BPB Publications, New Delhi, 13th Edition, 2012.
2. Oualline Steve, "Practical C Programming", O'Reilly Media, 3rd Edition, 1997.

Reference Books:

1. King KN, "C Programming: A Modern Approach", Atlantic Publishers, 2nd Edition, 2015.
   Kochan Stephen G, "Programming in C: A Complete Introduction to the C Programming Language", Sam's Publishers, 3rd Edition, 2004.
2. Linden Peter V, "Expert C Programming: Deep C Secrets", Pearson India, 1st Edition, 1994.

Web References:

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

CHEMISTRY LAB

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A4BS12	BSC	-	-	3	1.5	30	70	100

OBJECTIVES:

The course should enable the students to:

I. Estimation of hardness and chloride content in water to check its suitability for drinking purpose.
II. To determine the rate constant of reactions from concentrations as a function of time.
III. The measurement of physical properties like adsorption and viscosity.
IV. To synthesize the drug molecules and check the purity of organic molecules by thin layer chromatographic (TLC) technique.

OUTCOMES:

At the end of the course, student will be able to

I. Determination of parameters like hardness and chloride content in water.
II. Estimation of rate constant of a reaction from concentration – time relationships.
III. Determination of physical properties like adsorption and viscosity.
IV. Calculation of R_f values of some organic molecules by TLC technique

LIST OF EXPERIMENTS

Week-1 **Determination of total hardness of water by complexometric method using edta**

Week-2 **Estimation of an hcl by conductometric titrations**

Week-3 **Estimation of acetic acid by conductometric titrations**

Week-4 **Estimation of hcl by potentiometric titrations**

Week-5 **Estimation of acetic acid by potentiometric titrations**

Week-6 **Determination of rate constant of acid catalysed hydrolysis of methyl acetate**

Week-7 **Synthesis of aspirin**

Week-8 **Thin layer chromatography calculation of r_f values. Eg ortho and para nitro phenols**

Week-9 **Verification of freundlich adsorption isotherm-adsorption of acetic acid on charcoal**

Week-10 **Determination of viscosity of castor oil and ground nut oil by using ostwald's viscometer**

Week-11 **Determination of surface tension of a give liquid using stalagmometer**

Week-12 **Synthesis of thiokol rubber**

Week-13 **Determination of chloride content of water using argentometric method**

Week-14 **Determination of rate constant of acid catalysed hydrolysis of methyl acetate**

Reference Books:

1. Senior practical physical chemistry, B.D. Khosla, A. Gulati and V. Garg (R. Chand & Co., Delhi).
2. An introduction to practical chemistry, K.K. Sharma and D. S. Sharma (Vikas publishing, N. Delhi).
3. Vogel's text book of practical organic chemistry 5th edition.
4. Text book on Experiments and calculations in Engineering chemistry – S.S. Dara.

Web References:

1. http://amrita.olabs.edu.in/?sub=73&brch=8&sim=153&cnt=2
2. https://chem.libretexts.org/Textbook_Maps/Analytical_Chemistry_Textbook_Maps/Map%3A_Analytical_Chemistry_2.0_(Harvey)/11_Electrochemical_Methods/11.2%3A_Potentiometric_Methods
3. http://fch.upol.cz/skripta/fcc_and_zvem_english/FCH/Adsorption%20of%20oxalic%20acid%20on%20activated%20charcoal.htm
4. https://www.askiitians.com/iit-jee-chemistry/physical-chemistry/electrolytic-conductance-molar-conductance-and-specific-conductance.aspx
5. https://owlcation.com/stem/tlc-thin-layer-chromatography-Principle-Procedure

ENGLISH LANGUAGE AND COMMUNICATION SKILLS LAB

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A4HS02	HSMC	0	0	2	1	30	70	100

OBJECTIVES:

The course should enable the students to:

1. Facilitate computer-assisted multi-media instruction enabling individualized and independent language learning.
2. Enhance English language skills, communication skills and to practice soft skills.
3. Improve fluency and pronunciation intelligibility by providing an opportunity for practice in speaking.
4. Train students in different interview and public speaking skills such as JAM, debate, role play, group discussion etc.

OUTCOMES:

At the end of the course, student will be able to

1. Better perception of nuances of English language through audio- visual experience
2. Neutralization of accent for intelligibility
3. Take part in group activities
4. IV. Speaking skills with clarity and confidence which in turn enhances their employability

LIST OF ACTIVITIES

Week-1 GENERAL INTRODUCTIONS AND FORMAL GREETINGS

a. Introductions and greetings in formal and informal situations
b. Worksheets to extract information
c. Questionnaires to enquire about the expressions used during formal introductions
d. Ice Breaking activity by preparing and asking five questions each
e. Creation of dialogues using greetings, leave- taking and introductions

Week-2 JAM- JUST A MINUTE

a. Strengthen the ability to analyze a topic and logical organization of thoughts.
b. Logically starting with introductory sentence, points of discussion and closing sentence.
c. Practicing to speak within one minute
d. Activity based on JAM on a familiar topic
e. Planning and executing JAM considering the parameters

Week-3 PHONETICS

a. Speech sounds and their prominence in pronunciation
b. Understanding and practicing word stress
c. Neutralizing the accent and practicing the right intonation
d. Knowing the differences between different accents
e. Increase fluency with the help of Phonetics

Week-4 LISTENING SKILLS

a. Developing good listening skills for effective communication
b. Enhancing listening skills through audio tracks and oral conversation
c. Empathizing others point of view while they speak
d. Incorporating non verbal communications while listening
e. Improving overall performance listening to the audio tracks

Week-5 SITUATIONAL DIALOGUES AND GIVING DIRECTIONS

a. Creating dialogues in any given situations
b. Framing and choosing appropriate words to frame the dialogues in any situation
c. Guiding and giving directions using appropriate expressions
d. Activities on how to make polite requests, offers, rejections etc
e. Practicing to speak confidently in different situations

Week-6 ROLE PLAY

a. Understanding a Role play and its procedure
b. Planning and Executing a Role Play accordingly
c. Practicing to get into the role and perform within stipulated time
d. Activities based on Role Play with different situations
e. Performing a Role Play considering the parameters

Week-7 GROUP DISCUSSIONS

a. Understanding a Group Discussion (GD) and its procedure
b. Following the rules of a GD
c. Planning and Executing a GD within the stipulated time
d. Activities based on GD
e. Performing a GD considering the parameters

Week-8 DEBATE

a. Understanding the procedure of a Debate
b. Planning and executing a Debate following its rules
c. Strengthen the ability to analyze a topic and logical organization of thoughts.
d. Logically arranging the arguments
e. Performing a Debate considering the parameters

Week-9 TELEPHONIC ETIQUETTES

a. Understanding basic Telephonic Etiquettes
b. The approach one needs to follow while making and answering a call
c. Making a formal telephonic conversation
d. Activities based on modulating voice and tone

Week-10 PRESENTATION SKILLS

a. Planning a Presentation
b. Enhancing skills required for making effective presentations
c. Usage of different tools that help us to give effective presentations
d. Executing a presentation effectively

Week-11 ORAL PRESETATIONS AND EXTEMPORE

a. Planning an oral presentation or an Extempore
b. Preparing good PPT
c. Using appropriate body language in public speaking domain
d. Planning and Executing oral presentation
e. Activities based on oral presentations and extempore

Week-12 INTERVIEW SKILLS

a. Preparing to succeed in Interviews
b. Preparing a strong Resume for interviews
c. Practicing different techniques to overcome nervousness in interviews
d. Using appropriate body language in interviews
e. Activities based on Interviews skills

Week-13 INFORMATION TRANSFER

a. Extracting Information Transfer from different kinds of representation
b. Reading and decoding the information given in various types
c. Representing the information in charts or graphs in a written document
d. Developing writing skills from these aspects
e. Activity on transferring given data into graphs or charts for presentation skills

Reference Books:

1. E. Suresh Kumar. A Handbook for English Language Laboratories (with CD) Revised Edition
2. Normal Whitby. Business Benchmarch. Cambridge University Press(with CD) 2nd Edition
3. Liz Hamp-Lyons and Ben Heasly. Study Writing.Cambridge University Press. 2006.
4. Sanjay Kumar and PushpLata.Communication Skills. Oxford University Press. 2011.
5. Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press
6. Raman Sharma, Technical Communications, Oxford Publication, London, 2004.
7. Dale Jungk, Applied Writing for Technicians, McGraw Hill, New York, 2004.
8. T. Balasubramanian, A Text book of English Phonetics for Indian Students, Macmillan, 2008.

Websites:

https://www. britishcouncil.org
https://www. bbc.co.uk
https://www. grammarly.com
https://www. fluentu.com
https://www.cambridgeenglish.org/exams-and-tests/business-preliminary
https://www.cambridgeenglish.org/exams-and-tests/business-vantage

SOCIAL INNOVATION

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A4HS03	HSMC	0	0	2	1	30	70	100

OBJECTIVES:

The course should enable the students to:

1. Understand social innovation concepts and approaches.
2. Understand the community problems, social and economical change.
3. Identify new and unaddressed social needs.
4. Analysis of social innovation disclosures in different sectors.
5. Design innovative solutions with Social impact through application of new models of leadership, collective intelligence and creativity techniques.

OUTCOMES:

At the end of the course, student will be able to

1. Understand social innovation concepts and approaches.
2. Understand the community problems, social and economical change.
3. Identify new and unaddressed social needs.
4. Analysis of social innovation disclosures in different sectors.
5. Design innovative solutions with Social impact through application of new models of leadership, collective intelligence and creativity techniques.

UNIT-I INTRODUCTION TO SOCIAL INNOVATION Classes: 06

Core definitions, core elements and common features of social innovation, a topology of social innovations, history of social innovation, social and economic change, Swachh Bharat, Unnat Bharat Abhiyan, National Service Scheme (NSS).

UNIT-II INTERACTION AND ENGAGEMENT WITH SOCIETY Classes: 06

Engage with community; interact with them to understand the community problems, Understanding social and economical change – individuals, organizations and movements.

UNIT-III PROCESS OF SOCIAL INNOVATION Classes: 06

Understanding the pain/need, description and problem definition, social and economic constraints for affordable and appropriate technology.

UNIT-IV **SOCIAL INNOVATION ACROSS FOUR SECTORS IN INDIA AND GLOBAL SCENARIO** **Classes: 06**

The four sectors – the non-profit sector, public sector, the private sector, the informal sector, links between and cross sectors.

UNIT-V **SOCIAL INNOVATION – CASE STUDIES** **Classes: 08**

Designing and implementing social innovations, report writing and documentation, presentation of the case studies with a focus on impact and vision on society.

Text Books:

1. The Power of Social Innovation: How Civic Entrepreneurs Ignite Community Networks for Good 1st Edition by Stephen Goldsmith, Michael R. Bloomberg, Gigi Georges, Tim Glynn Burke.

2. The Open Book of Social Innovation: Ways to Design, Develop and Grow Social Innovation Paperback – March, 2010 by Robin Murray, Julia Caulier-Grice, Geoff Mulgan.

Reference Books:

1. Social innovator series: ways to design, develop and grow social innovation, the open book of social innovation

by robin murrayjuliecaulier-gricegeoffmulgan.

2. The International Handbook on Social Innovation: Collective Action, Social Learning and Transdisciplinary Research Paperback by Frank Moulaert , Diana MacCallum**.**

Web References:

1. http://s3platform.jrc.ec.europa.eu/documents/20182/84453/Guide_to_Social_Innovation.pdf

2. https://www.si-drive.eu/wp-content/uploads/2016/12/SI-DRIVE-CA-short-2016-11-30-Druckversion.pdf

E-Text Books:

1.https://epdf.tips/the-power-of-social-innovation-how-civic-entrepreneurs-ignite-community-networks.html

2. https://youngfoundation.org/wp-content/uploads/2012/10/The-Open-Book-of-Social-Innovationg.pdf
3. http://www.idmais.org/desislab/wp-content/media/social.pdf

MOOC Course

1. https://iversity.org/en/courses/social-innovation-101-en
2. https://www.class-central.com/tag/social%20innovation
3. https://www.mooc-list.com/tags/social-innovation

I B.TECH II SEMESTER SYLLABUS

INTEGRAL CALCULUS AND TRANSFORMS

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A4BS03	BSC	3	1	0	4	30	70	100

OBJECTIVES:

The course should enable the students to:

1. Evaluation of the multiple integrals.
2. Finding the integrals in two and three dimensional space over given curve and surface.
3. Concept and application of Laplace transforms.
4. Fourier series for periodic functions.
5. Classification of second order partial differential equations.

OUTCOMES:

Upon successful completion of the course, the student is able to

1. Evaluate multiple integrals.
2. Verify vector integral theorems.
3. Solve the differential equations using Laplace transform techniques.
4. Find the Fourier transforms of the given functions.
5. Solve one dimensional heat equation, wave equation using method of separation of variables.

UNIT-I MULTIPLE INTEGRALS **Classes: 10**

Double and triple integrals (Cartesian and polar), Change of order of integration in double integrals, Change of variables (Cartesian to polar) in double integrals. Finding the area and volume of a region using double, centrefof mass and gravity.

UNIT-II VECTOR CALCULUS **Classes: 11**

Scalar and vector point functions - Gradient, divergence, curl and their related properties -Solenoidal and irrotational vector point functions - Scalar potential function - Laplacian operator - Line integral - work done - surface integrals - volume integral - Vector integral theorems - Green's theorem in a plane - Stoke's theorem - Gauss divergence theorem (all theorem statements and their verification).

UNIT-III LAPLACE TRANSFORM S **Classes: 12**

Laplace transforms of elementary functions- First shifting theorem - Change of scale property – Multiplication by t^n- Division by t – Laplace transforms of derivatives and integrals – Unit step function – Second shifting theorem – Periodic function – Evaluation of integrals by Laplace transforms – Inverse Laplace transforms- Method of partial fractions – Other methods of finding inverse transforms – Convolution theorem – Applications of Laplace transforms to ordinary differential equations.

UNIT-IV FOURIER SERIES AND FOURIER TRANSFORMS **Classes:11**

Periodic function-Determination of Fourier Coefficients-Fourier Series-Even and Odd functions-Fourier series in arbitrary interval-Even Odd periodic continuation-Half range Fourier sine and cosine expansions.

Fourier integral theorem (statement)-Fourier sine and cosine integrals –Fourier transforms –Fourier sine and cosine transforms-properties- Inverse transforms-Finite Fourier transforms.

UNIT-V PARTIAL DIFFERENTIAL EQUATIONS AND APPLICATIONS **Classes: 08**

Method of separation of variables. Classification of second order partial differential equations.

Applications of Partial differential equations- one dimensional wave equation, Heat equation.

Text Books:

1. Ervin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. B.S.Grewal, Higher Engineering Mathematics, Khanna publishers, 36th Edition, 2010.

Reference Books:

1. G.B.Thomas, calculus and analytical geometry,9th Edition, Pearson Reprint 2006.
2. N.P Bali and Manish Goyal ,A Text of Engineering Mathematics,Laxmi publications,2008.
3. E.L.Ince, Ordinary differential Equations,Dover publications,1958.

Web references:

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

E -Text Books:

.https://www.e-booksdirectory.com/details.php?ebook=10166
2.https://www.e-booksdirectory.com/details.php?ebook=10166

MOOCS Course:

1. https://swayam.gov.in/
2. https://onlinecourses.nptel.ac.in/

SEMICONDUCTOR PHYSICS

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A4BS08	BSC	3	1	0	4	30	70	100

OBJECTIVES:

The course should enable the students to:

1. Learn the behaviour of matter waves and applications of Schrodinger wave equations in periodic potential energy of electron
2. Understand the formation of energy bands in solids.
3. Gain the knowledge of carrier concentration and recombination process of semiconductor materials.
4. Learn the basic principles of laser and optical fiber.
5. Understand the development of nano technology and synthesis of nano materials by using different techniques.

OUTCOMES:

Upon successful completion of the course, the student is able to

1. Conclude the dual nature of material particles and able to explain how moving particles are associated with its energies
2. Analyze the energy bands in solids and accordingly classify the materials
3. Evaluate the mobility of charge carrier concentration of a given semiconductor material.
4. Justify how the graded index optical fiber is more efficient than step index optical fiber in fiber optic communication system.
5. Recommend appropriate synthesis method and explain the characterization techniques.

UNIT-I QUANTUM MECHANICS Classes: 08

Introduction to quantum physics: Black body radiation, Planck's law, photoelectric effect, Compton effect, Waves and Particles, de Broglie Hypothesis, Matter Waves, Davisson and Germer's Experiment, Heisenberg's Uncertainty Principle, Schrodinger's Time Independent Wave Equation-Physical Significance of the wave Function, Particle in One Dimensional Potential Box.

UNIT-II INTRODUCTION TO ELECTRONIC MATERIALS Classes: 07

Band theory - Free electron theory, Origin of Energy Band formation in Solids, Estimation of Fermi energy level, Density of states and energy band diagrams, Kronig-Penny model (to introduce origin of band gap), Energy bands in solids, E-k diagram, Direct and indirect band gaps.

Classification of Materials: Conductors, Semiconductors & Insulators, Effective mass of an Electron. Fermi-Dirac Statistics (Qualitative treatment).

UNIT-III SEMICONDUCTORS AND OPTOELECTRONICS Classes: 08

Semiconductors: Intrinsic and extrinsic semiconductors, Dependence of Fermi level on carrier-concentration and temperature (equilibrium carrier statistics). Carrier generation and recombination, Carrier transport: diffusion and drift, Hall effect and its applications.

Semiconductors design- PN junction-diode, Zener diode, fabrication and characterization techniques-Hetero junctions and associated band-diagrams.

Optoelectronic devices: properties of photo detectors, solar cells, Semiconductor laser, Four-point probe measurement for carrier density.

UNIT-IV LASER & OPTICAL FIBER Classes: 08

Laser: Characteristics of Laser beams, Energy levels in atoms, Einstein's theory of matter radiation interaction and A and B coefficients; amplification of light by population inversion, different types of lasers: gas lasers -He-Ne, solid-state lasers -ruby, Nd-YAG, Applications of Lasers.

Fiber Optic Communication: Structure of Optical fibers, Basic principle of fibers, Acceptance angle and Numerical aperture, Types of Optical Fibers-Step Index and Graded Index fibers; Modes of fibers-SMSI, MMSI, MMGI.,Optical fiber Communication System with block diagram. Applications of fibers, fiber optic sensors – Basic principle, Intrinsic, Extrinsic sensors. Working of Pressure and Temperature Sensors.

UNIT-V INTRODUCTION TO ENGINEERED MATERIALS Classes: 08

Fundamentals of nano particles, nano scale, properties, Techniques for synthesis of nano materials -Sol-gel, Chemical vapor deposition (CVD) methods.

Characterization of nano materials: Imaging methods- SEM, TEM, Scanning Probe Microscopy: STM.

Fabrication method- quantum wire, Applications of Nano materials in engineering and Biomedical fields.

Text Books:

1. Engineering Physics, B.K. Pandey, S. Chaturvedi – Cengage Learing
2. Haliday and Resnick, Physics – wiley
3. R. Robinett, "Quantum Mechanics", OUP Oxford, 2006.IIndEdn.
4. P.K Palanisamy, Engineering Physics, Sitech Publications, 2013, IVthEdn.
5. Essentials of NanoTecnology by Jeremy Ramsden.

Reference Books:

1. E. Hecht, “Optics”, Pearson Education, 2008.
2. J. Singh, Semiconductor Optoelectronics: Physics and Technology, Mc Graw-Hill inc. (1995)
3. R. Robinett, “Quantum Mechanics”, OUP Oxford, 2006.
4. O. 1Svelto, “Principles of Lasers”, Springer Science & Business Media, 2010.
5. D. A. Neamen, “Semiconductor Physics and Devices”, Times Mirror High Education Group, Chicago, 1997.

Web References:

1. https://www.edx.org/course?search_query=semiconductor+physics
2. https://www.edx.org/course/nanotechnology-fundamentals-purduex-nano530x
3. https://www.edx.org/course/physics-electronic-polymers-pep-purduex-nano600

E-Text Books:

1. http://www.phys.sinica.edu.tw/TIGP-NANO/Course/2010_Fall/classnotes/NanoB_week14.pdf
2. https://www.scribd.com/document/70908178/Semiconductor-Devices-Basic-Principles-Jasprit-Singh
3. https://www.scribd.com/doc/105174065/Fundamentals-of-Photonics
4. ftp://nozdr.ru/biblio/kolxo3/P/PE/PEo/Thyagarajan%20K.,%20Ghatak%20A.%20Lasers..%20Fundamentals%20and%20Applications%20(2ed.,%20GTP,%20Springer,%202010)(ISBN%20144196441X)(O)(674s)_PEo_.pdf
5. https://subodhtripathi.files.wordpress.com/2012/01/optical-fiber-communications-by-gerd-keiser_2.pdf
6. http://www.hailienene.com/resources/nano-technology.pdf

MOOC Course

1. http://nptel.ac.in/courses/115103030/(Four-point probe measurement for carrier density)
2. http://nptel.ac.in/courses/115102025/ (Fundamental concepts of semiconductors)
3. http://nptel.ac.in/courses/118104008/1 (Fundamentals of Nano technology)
4. http://nptel.ac.in/courses/118104008/13 (Nano structures, synthesis and characterization)
5. http://nptel.ac.in/courses/104104085/2(Lasers and its applications)

BASIC ELECTRICAL ENGINEERING

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A4EE01	ESC	3	1	0	4	30	70	100

OBJECTIVES:

The course should enable the students to:

1. To understand and analyze basic electric and magnetic circuits
2. To study the working principles of electrical machines
3. To introduce the components of low voltage electrical installations

OUTCOMES:

Upon successful completion of the course, the student is able to

1. Understand and analyze basic electric and magnetic circuits
2. Study the working principles of electrical machines
3. III. Introduce the components of low voltage electrical installations

UNIT-I DC CIRCUITS Classes: 10

Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff current and voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton Theorems. Time-domain analysis of first-order RL and RC circuits.

UNIT-II AC CIRCUITS Classes: 10

Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Three-phase balanced circuits, voltage and current relations in star and delta connections.

UNIT-III TRANSFORMERS & ELECTRICAL INSTALLATIONS Classes: 12

Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections.

Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries

UNIT-IV DC MACHINES **Classes: 10**

Principle and operation of DC Motor, Construction of DC machine. Types of DC motor, losses and Torque equation. DC generator construction, working principle and its EMF equation. Types of dc generators, efficiency of dc generator, problems on Emf equation. Applications.

UNIT-V AC MACHINES **Classes: 08**

Generation of rotating magnetic fields, Construction and working of a three-phase induction Motor, Significance of torque-slip characteristic. Loss components and efficiency, starting and Speed control of induction motor. Construction, working of Single-phase induction motor. Construction and working of synchronous generators, Emf equation and problems.

Text Books:

1. D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 2010.
2. D. C. Kulshreshtha, "Basic Electrical Engineering", McGraw Hill, 2009.
3. Basic Electrical Engineering by M.S. Naidu and S. Kamakshaiah TMH
4. Mehta V K, ―Principles of Electrical Engineering‖, S. Chand & Company

Reference Books:

1. L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2011.
2. E. Hughes, "Electrical and Electronics Technology", Pearson, 2010.
3. V. D. Toro, "Electrical Engineering Fundamentals", Prentice Hall India, 1989.
4. Nagsarkar T K and Sukhija M S, ―Basics of Electrical Engineering‖, Oxford press. Basic concepts of Electrical Engineering, P.S. Subramanyam, BS Publications.

Web References:

1.www.pa.msu.edu
2.www.tutorvista.com
3.www.globalspec.com

E-Text Books:

http://www.cl.cam.ac.uk/teaching/1011/SysOnChip/socdam-notes1011.pdf
https://www.doc.ic.ac.uk/~wl/teachlocal/cuscomp/notes/cc11.pdf
https://www.cs.ccu.edu.tw/~chen/arch/SOC-design.pdf

MOOC Course

https://onlinecourses.nptel.ac.in/noc18_ee33/preview
https://onlinecourses.nptel.ac.in/noc18_ee34/preview

ENGINEERING GRAPHICS & DESIGN

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A4ESC02	ESC	1	0	4	3	30	70	100

OBJECTIVES:

The course should enable the students to:

1. Create awareness and emphasize the need for Engineering Drawing in various branches of engineering.
2. Enable the student with various concepts of dimensioning, conventions and standards related to engineering drawings.
3. Follow the basic drawing standards and conventions.
4. Develop skills in three-dimensional visualization of engineering component.

OUTCOMES:

Upon successful completion of the course, the student is able to

1. Create awareness and emphasize the need for Engineering Drawing in various branches of engineering.
2. Enable the student with various concepts of dimensioning, conventions and standards related to engineering drawings.
3. Follow the basic drawing standards and conventions.
4. Develop skills in three-dimensional visualization of engineering component.

UNIT-I **INTRODUCTION** **Classes: 7**

Introduction to Engineering Drawing covering: 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.

UNIT-II **DRAWING OF PROJECTIONS OR VIEWS: ORTHOGRAPHIC PROJECTION IN FIRST ANGLE PROJECTION ONLY** **Classes: 10**

Principles of orthographic projections – conventions – first and third angle projections. Projections of points- Projection of lines inclined to both the planes.

PROJECTIONS OF PLANES: Projections of regular planes, inclined to both planes.

UNIT-III **INTRODUCTION TO COMPUTER AIDED DRAFTING** **Classes: 8**

INTRODUCTION TO COMPUTER AIDED DRAFTING: Generation of points, lines, curves, polygons, simple solids, dimensioning. LAYERS: Concept of layers, working with layers, creating, display, locking, unlocking, and delete commands, Coordinate system in AutoCAD, UCS, WCS, MCS

PROJECTION OF SOLIDS-Solids inclined to both planes(Auxiliary plane method)

DEVELOPMENT OF SURFACES OF SOLIDS: Theory of development, development of lateral surface along with base

UNIT-IV **ISOMETRIC DRAWINGS** **Classes: 05**

Divisions of pictorial projection, theory of Isometric Drawing- Isometric view and Isometric projections; Drawing Isometric circles, Dimensioning Isometric Objects; Conversion of Isometric view to Orthographic views and Orthographic to isometric views

UNIT-V **3D MODELING** **Classes: 04**

Types of 3D models, 3D Coordinate Systems, basic commands in 3D, PEDIT command. CREATING SOLID MODELS: creating pre-defined Solid Primitives, Dynamic UCS, methods of creating solids by - Extrude, Revolve, Swept, Loft, &Presspull, in 3Dcreating solid models, Dynamic UCS. MODIFYING 3D OBJECTS: Fillet, Chamfer, Rotate, Mirror, Array, Slicing solid Models. EDITING 3D OBJECTS: SOLVIEW, SOLDRAW, SOLPROF,

Text Books:

1. Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House
2. Shah, M.B. &Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education
3. Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication
4. Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, ScitechPublishers .
5. D.M. Kulkarni,A.P.Rastogi,A.K. Sarka “Engineering Graphics with AutoCAD” PHI publications, 2013

Reference Books:

1. Johle (2009), Engineering Drawing, Tata Mc Graw Hill, New Delhi, India.
2. Trymbaka Murthy (2007), Computer Aided Engineering Drawing, I.K. International Publishers, New Delhi.
3. Sham Tickoo, D. saravanan, “AutoCAD 2010 for engineers and designers” Dreamtech Press, 2010 2.
4. Sham Tickoo“ AutoCAD 2011: A Problem solving approach” Autodesk Press, USA

Web References:

1. nptel.ac.in/courses/112103019/
2. web.iitd.ac.in/~achawla/public_html/201/lectures/sp46.pdf

E-Text Books

https://www.researchgate.net/publication/305754529_A_Textbook_of_Engineering_Drawing_

PHYSICS LABORATORY

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A4BS10	BSC	0	0	3	1.5	30	70	100

OBJECTIVES:

The course should enable the students to:

1. To provide an experimental foundation for the theoretical concepts introduced in the lectures.
2. To teach how to make careful experimental observations and how to think about and draw conclusions from such data.
3. To help students understand the role of direct observation in physics and to distinguish between inferences based on theory and the outcomes of experiments.
4. To introduce the concepts and techniques which have a wide application in experimental science but have not been introduced in the standard courses.
5. To teach how to write a technical report which communicates scientific information in a clear and concise manner.

OUTCOMES:

Upon successful completion of the course, the student is able to

1. Provide an experimental foundation for the theoretical concepts introduced in the lectures.
2. Teach how to make careful experimental observations and how to think about and draw conclusions from such data.
3.Help students understand the role of direct observation in physics and to distinguish between inferences based on theory and the outcomes of experiments
4. Introduce the concepts and techniques which have a wide application in experimental science but have not been introduced in the standard courses

5.. To teach how to write a technical report which communicates scientific information in a clear and concise manner

LIST OF EXPERIMENTS

Week-1 LIGHT EMITTING DIODE (LED)

a. Analyze the V-I characteristics of GREEN LED Source by varying input voltage from zero to two volts. Analyze the graph obtained.
b. Analyze the results obtained for V-I characteristics of RED LED Source by varying input voltage with interval 0.2 volts.
c. Analyze the V-I characteristics of YELLOW LED Source for the resistance of 100Ω. What is the Effect of doubling the resistance on the V-I characteristics.

Week-2 SOLAR CELL

a. Study the V-I characteristics of a solar cell for the voltage interval of 0.4 V when the given electric bulb is at a distance of 10cm. Will there be any change if the distance is doubled?

b. Study the P-V characteristics of a solar cell for the voltage interval of 0.3 V for four different distances of the given electric bulb. Discuss your observations.

c. Study the P-I characteristics of a solar cell for the given electric bulb for the distances 30 cm. What is expected if the distance is doubled?

Week-3 OPTICAL FIBER

To determine the numerical aperture and acceptance angle of an optical fiber.

Week-4 HALL EFFECT

a. Investigate the deflection of the carriers in the conductor under the function of the magnetic field.

Based on this measurement, calculate the density of the carriers and the sign of the charges in the

Conductor.

b. Verify the Hall effect in extrinsic semiconducting samples and determine the type of given

Semiconductor and density of majority charge carriers.

Week-5 ENERGY GAP OF PN JUNCTION DIODE

a. Using PN junction diode, determine the energy gap of a semiconductor by applying 2V of reverse bias by increasing the temperature from 30-70 degree centigrade. Analyze the obtained results.

b. Evaluate the energy gap of Si PN junction diode by applying 1.5V of reverse bias for values of Temperature 70,60,50,40,30 centigrade.

c. Evaluate the energy gap of a semiconductor by applying 0.5V of reverse bias for temperatures at 75, 65, 55,45,35 centigrade

Week-6 THERMISTER

a. Study the variation of Resistance versus Temperature using Thermister. Plot graph between Resistance vs Temperature and analyze the results.

b. Evaluate the Temperature dependent resistance of a given material by using Thermister.

Week-7 LCR CIRCUIT

i. To determine the Resonance frequency and Quality factor of a LCR Circuit
j. Study the Resonance frequency of an electrical circuit by varying values of inductance, Capacitance and resistors and analyze the results.

Week-8 PIN PHOTO DIODE

To determine the V-I characteristics of PIN photo diode.

Week-9 RC CIRCUIT

a. Analyze the time constant of R-C circuit by varying Resistance and Capacitance values in a electrical circuit.
b. Determine the time constant of a given RC circuit by plotting a graph between Charging current versus time.

Week-10 TORSIONAL OSCILLATOR

a. Making use of a torsional oscillator of 300gms circular disc, determine the rigidity modulus of given steel wire for 65 cm &55 cm lengths. Analyze the results obtained.

b. Determine the rigidity modulus of the given copper wire for 50,40,30 lengths by using torsional oscillator of 400gms circular disc. Analyze the results obtained.

c. Give your analysis of $L\&T^2$ behavior of a torsional oscillator. You may pick your own values for the analysis.

Week-11 LASER - DIFFRACTION GRATTING

a. Using a diffraction grating element of 2500 LPI determine the wavelength of LASER source for first

and second order diffraction when the distance between the screen and grating is 50cm. What is your analysis?

b. Determine the wavelength of a LASER source for first three orders of diffraction by maintaining a distance of 30 cms between grating material and the screen. Use diffraction grating element of 15000 LPI. What differences do you observe for the three orders.

Week-12 MELDE'S EXPERIMENT

a. Determine the longitudinal frequency of tuning fork by using 100cm length of the thread by varying masses of 5gms, 10gms. Discuss your findings.
b. Find out the transverse frequency of tuning fork by using 80cm length of the thread and by varying masses of 10gms and 40gms. Analyze the results obtained.

Reference Books:

1. "Semiconductor Physics and Devices: Basic Principles" by Donald ANeamen.
2. "Optics, Principles and Applications" by K K Sharma.
3. "Principles of Optics" by M Born and E Wolf.
4. "Oscillations and Waves" by Satya Prakash and Vinay Dua.
5. "Waves and Oscillations" by N Subrahmanyam and BrijLal.

Web References:

1. **http://www.*arxiv.org/pdf/1510.00032***
2. http://www nptel.ac.in/courses/122103010/
3. http://www. researchgate.net/.../276417736_Video_Presentations_in_Engineering-Ph...
4. http://www. wileyindia.com/engineering-physics-theory-and-practical.html

1

Note: Students can perform any 8 experiments

BASIC ELECTRICAL ENGINEERING LAB

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A4EE02	ESC	0	0	2	1	30	70	100

OBJECTIVES:

The course should enable the students to:

1. Get an exposure to common electrical components and their ratings.
2. Make electrical connections by wires of appropriate ratings.
3. Understand the usage of common electrical measuring instruments.
4. Understand the basic characteristics of transformers and electrical machines.

OUTCOMES:

Upon successful completion of the course, the student is able to

1. Get an exposure to common electrical components and their ratings.
2. Make electrical connections by wires of appropriate ratings.
3. Understand the usage of common electrical measuring instruments.

LIST OF EXPERIMENTS

Week-1 INTRODUCTION AND USE OF MEASURING INSTRUMENTS & SAFETY PRECAUTIONS

TO STUDY THE USAGE OF ELCTRICAL INSTRUMENTS AND THE REQUIRED PRECAUTIONS TO BE TAKEN.

Week-2 KIRCHOFF'S LAWS(KVL & KCL)

TO VERIFY KVL AND KCL

Week-3 SUPERPOSITION THEOREM

TO VERIFY SUPERPOSITION THEOREM

Week-4 THEVENIN'S AND NORTON'S THEOREM

TO OBTAIN EQUIVALENT CIRCUIT OF A COMPLEX NETWORK

Week-5 STEADY STATE AND TRANSIENT RESPONSE OF R-L, R-C & R-L-C CIRCUITS

TO FIND THE STEADY AND TRANSIENT RESPONSE OF R-L, R-C & R-L-C CIRCUITS FOR STEP INPUT.

Week-6 OPEN CIRCUIT, SHORT CIRCUIT & LOAD TEST ON SINGLE PHASE TRANSFORMER

TO CALCULATE THE EFFICIENCY OF SINGLE PHASE TRANSFORMER.

Week-7 CUT OUT VIEW OF DC MACHINE

DEMONSTRATION ON CONSTRUCTIONAL AND CUT OUT VIEW OF DC MACHINE

Week-8 CUT OUT VIEW OF INDUCTION MOTOR

DEMONSTRATION ON CONSTRUCTIONAL AND CUT OUT VIEW OF SINGLE PHASE INDUCTION MOTOR

Week-9 MAGNETIZATION CHARACTERISTICS OF DC SHUNG GENERATOR

TO FIND THE MAGNETIZATION CHARACTERISTICS OF DC SHUNT GENERATOR

Week-10 BRAKE TEST ON DC SHUNT MOTOR

TO FIND THE TORQUE-SPEED CHARACTRISTICS OF DC SHUNT MOTOR.

Week-11 THREE PHASE TRANSFORMER CONNECTIONS

TO CALCULTE THE RELATION BETWEEN PHASE AND LINE VOLTAGES

Week-12 BRAKE TEST ON 3-PHASE INDUCTION MOTOR

TO FIND THE TORQUE-SLIP CHARACTERISTICS OF INDUCTION MOTOR

Reference Books:

1. Department Lab Manual
2. A. Chakrabarthi, " Circuit Theory", DhanpatRai Publications, 6th Edition,2006
3. V K Mehta, Rohit Mehta, "Principles of Electrical Machines", S Chand Publications, 1st Edition,2006
4. I Nagrath& DP Kothari, "Electrical Machines", Mcgraw Hill Education Publications, 4th Edition, 2010.

Web References:

1. http://www.ee.iitkgp.ac.in
2. http://www.citchennai.edu.in

WORKSHOP PRACTICES

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A4AE63	ESC	1	0	2	2	30	70	100

COURSE OBJECTIVES:

Student will be able to:

1. Fabricate components with their own hands
2. Get practical knowledge of the dimensional accuracies and tolerances possible with different manufacturing processes
3. Assemble different components
4. Produce small devices of their interest

OUTCOMES:

Upon successful completion of the course, the student is able to

1. Fabricate components with their own hands
2. Get practical knowledge of the dimensional accuracies and tolerances possible with different manufacturing processes
3. Assemble different components
4. Produce small devices of their interest

VIDEO LECTURES

Week-1 Carpentry

Week-2 Fitting operations & Power Tools

Week-3 Casting

Week-4 Forming

Week-5 Machining

Week-6 Joining – Bolted & Riveted Joints

Week-7 Arc welding & Gas welding

Week-8 Brazing& Soldering

Week-9 Advanced Manufacturing methods

Week-10 CNC Machining

Week-11 Additive manufacturing

Week-12 Electrical & Electronics

Week-13 Plastic moulding, Glass cutting

Week-14 Metal casting

LIST OF EXPERIMENTS

WEEKS	BASIC TRADES	BASIC MANUFACTURING
	Fitting	**Machine Shop**
Week 1	Filing Four Sides of Work piece	Facing & Step Turning on Lathe
Week 2	L Fit	Milling and Drilling
	Carpentry	**Black Smithy**
Week 3	Half Lap Joint	Convert round rod to S-hook
Week 4	Dove Tail Joint	Convert round rod to Chisel
	Tin Smithy	**Casting**
Week 5	Tin Smithy- Prepare a Rectangular Tray	Preparation of Mould Cavity for Multi Piece Pattern
Week 6	Prepare A Square Tin	Casting of Simple pattern
	Electrical	**Welding Shop**
Week 7	House Wiring Parallel and Series Connection	Lap/Butt joint Using Arc Welding
Week 8	House Wiring Two Way Switch	Lap/Butt joint Using Gas Welding
	Electronics	**Plastic Moulding & Glass Cutting**
Week 9	Soldering Parallel Connection	Injection moulding of Simple Components
Week 10	Soldering Series Connection	Glass Cutting
Week 11	Revision/Practice	Revision/Practice

Text Books:

1. Workshop Manual by P. Kannaiah and K. L. Narayana.

2. Rao P.N., "Manufacturing Technology", Tata McGraw Hill House, Vol. I and Vol. II.

Reference Books:

1. HajraChoudhury S.K., HajraChoudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology", Media promoters and publishers private limited, Mumbai, Vol. I 2008 and Vol. II 2010.
2. H. S. Bawa, "Workshop Practice", Tata McGraw-Hill Publishing Company Limited, New Delhi, (2007).
3. Kalpakjian S. and Steven S. Schmid, "Manufacturing Engineering and Technology", Pearson Education India Edition, 4th edition,2002.

E-Text Books:

1. https://blogpuneet.files.wordpress.com/2013/07/introduction-to-basic-manufacturing-processes-and-workshop-technology.pdf
2. https://soaneemrana.org/onewebmedia/Manufacturing%20Processes%20By%20H.N.%20Gupta.pdf

MOOC Course:

1. https://www.class-central.com/course/edx-fundamentals-of-manufacturing-processes-7224

ENGINEERING EXPLORATION

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A4HS04	HSMC	0	0	2	1	30	70	100

OBJECTIVES:

The course should enable the students to:

1. Understand the Engineering attributes and Ethics.
2. Identify the community problem and its stakeholder.
3. Examine required specifications and gap in existing and required product.
4. Build sustaining interactions among people that create social value by transforming ideas into tangible products, services, or initiatives.
5. Develop skills to work collaboratively, reports and progress updates throughout the lifecycle of the project.

OUTCOMES:

Upon successful completion of the course, the student is able to

1. Understand the Engineering attributes and Ethics.
2. Identify the community problem and its stakeholder.
3. Examine required specifications and gap in existing and required product.
4. Build sustaining interactions among people that create social value by transforming ideas into tangible products, services, or initiatives.
5. Develop skills to work collaboratively, reports and progress updates throughout the lifecycle of the project.

UNIT-I INTRODUCTION TO ENGINEERING AND ENGINEERING EXPLORATION Classes: 06

Engineering Projects in Community Service, Design Thinking Process-Empathize, Define, Ideate, Prototype, Test.

Engineering Ethics: Introduction to ethics, moral values, significance of professional ethics, code of conduct for engineers, identify ethical dilemmas in different tasks of engineering, applying moral theories and codes of conduct for resolution of ethical dilemmas.

UNIT-II PROBLEM IDENTIFICATION Classes: 06

Authentic need in the community or society. Identify a real user or stake holder, Interaction with Stakeholders, Viewpoints, Interviewing, and Scenario.

UNIT-III SPECIFICATION DEVELOPMENT Classes: 06

Clear and measurable requirements, criteria for success, Identifying relevant benchmarks, identifying the gap between the available and required products, requirements documentation.

UNIT-IV CONCEPTUAL DESIGN **Classes: 06**

Ideation-generated multiple ideas, evaluation of ideas, systems model, Architectural Design, prototype development, testing – real/simulated users, feedback.

UNIT-V PROJECT MANAGEMENT **Classes: 08**

Importance of team work, importance of project life cycle, project management, tools, various tools used in electronics documentation, importance of communication, usage of communication media.

Text Books:

1. Software Engineering: A Practitioner's Approach, Roger S. Pressman, 7th Edition, Mc Graw Hill Educatic (India) Pvt. Ltd.
2. Software Engineering, Sommerville Ian, 7th Edition, Pearson Education.
3. EPICS Design Process https://sharepoint.ecn.purdue.edu/epics/teams/Public%20Documents/EPICS_Design_Process.pdf
4. Examples of good practice in Special Needs Education & Community Based Programs, UNESCO PRESS.
5. Project Management, GRY r. Heerkens, McGraw-Hill

Web References:

1. **http://www.purdue.edu/epics**
2. http://epics.ieee.org/
3. https://www.uninettunouniversity.net/en/epics.aspx

E-Text Books:

1. http://www.uoitc.edu.iq/images/documents/informatics-institute/exam_materials/Software%20Engineering%20(9th%20Edition)%20by%20Ian%20Sommerville.pdf
2. https://engineering.purdue.edu/EPICS/k12/resources/1.6%20Teacher%20Toolbox%20EPICS%20High%20Design%20Process%20and%20Cycle.pdf
3. https://launchschool.com/books/agile_planning/read/epics_and_stories http://www.enggnotebook.weebly.com/uploads/2/2/7/1/22718186/ge6151-notes.pdf

MOOC Course

1. https://www.mooc-list.com/tags/design-thinking
2. https://www.class-central.com/tag/design%20thinking

II B.TECH I SEMESTER SYLLABUS

ELECTRICAL CIRCUITS ANALYSIS

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P		CIA	SEE	Total
A4EE03	BSC	3	0	0	3	30	70	100

OBJECTIVES:

The course should enable the students to:

1. **Analyze the star and delta connected circuits**
2. **Understand the response of network theorems with DC &AC excitations**
3. **Discuss the concept of network functions and calculate network parameters.**
4. **Understand the design of various types of network topologies**
5. **Analyze the three phase circuits**

COURSE OUTCOMES:

At the end of the course Student can able to

1. Analyze the star and delta connected circuits
2. Understand the response of network theorems with DC &AC excitations
3. Discuss the concept of network functions and calculate network parameters.
4. Understand the design of various types of network topologies
5. Analyze the three phase circuits

UNIT-I ANALYSIS OF ELECTRICAL CIRCUITS AND NETWORK THEOREMS Classes: 09

Nodal and Mesh Analysis. Super node and super mesh, inspection method. Star to delta and delta to star transformation**.**

Superposition theorem, Thevenin and Norton's theorem, Maximum power transfer theorem, Reciprocity theorem, Millimans theorem, Tellegans theorem and Compensation Theorem with AC & DC excitation.

UNIT-II

DC AND AC TRANSIENT ANALYSIS: 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.

LOCUS DIAGRAMS: Locus diagrams: Elementary treatment of locus diagrams of RL, RC and RLC circuits (series and parallel combinations).

UNIT-III TWO PORT NETWORK PARAMETERS Classes: 09

Impedance Parameters, Admittance Parameters, Hybrid Parameters, Transmission (ABCD) Parameters, Conversion of one Parameter to another, Conditions for Reciprocity, and Symmetry, Interconnection of Two Port networks in Series, Parallel and Cascaded configurations, Image Parameters.. Illustrative problems.

UNIT-IV MAGNETIC CIRCUITS AND NETWORK TOPOLOGY Classes: 09

Faraday's laws of electromagnetic induction - concept of self and mutual inductance - dot convention in coupled circuits - coefficient of coupling, Mutual coupled circuits. Series, parallel and composite magnetic

circuits.

Network topology: definitions, incidence matrix, basic tie set and basic cut set matrices for planar networks, duality and dual networks**.**

UNIT-V THREE PHASE CIRCUITSS Classes: 09

Star and delta connections, phase sequence, relation between line and phase voltages and currents in balanced star and delta circuits, three phase three wire and three phase four wire systems, shifting of neutral point, analysis of balanced and unbalanced three phase circuits, measurement of active and reactive power**.**

Text Books:

1. M. E. Van Valkenburg, “Network Analysis”, Prentice Hall, 2006.
2. D. Roy Choudhury, “Networks and Systems”, New Age International Publications,1998.
3. W. H. Hayt and J. E. Kemmerly, “Engineering Circuit Analysis”, McGraw Hill Education, 2013.
4. Network analysis by Sudhakar shyammohan S Palli

Reference Books:

1. C. K. Alexander and M. N. O. Sadiku, “Electric Circuits”, McGraw Hill Education, 2004.
2. K. V. V. Murthy and M. S. Kamath, “Basic Circuit Analysis”, Jaico Publishers, 1999.
3. Chakrabarthy (2005), Circuit Theory, 4th Edition, Dhanpat Rai & Sons Publications,

Web References:

- **www.wikipedia.org**
- **www.pa.msu.edu**
- **www.tutorvista.com**
- **www.globalspec.com**
- **www.ee.bilkent.edu.tr**

E-Text Books:

- **http://www.cl.cam.ac.uk/teaching/1011/SysOnChip/socdam-notes1011.pdf**
- **https://www.doc.ic.ac.uk/~wl/teachlocal/cuscomp/notes/cc11.pdf**
- **https://www.cs.ccu.edu.tw/~chen/arch/SOC-design.pdf**

MOOC Course

- **https://onlinecourses.nptel.ac.in/noc18_ee33/preview**
- **https://onlinecourses.nptel.ac.in/noc18_ee34/preview**

ELECTRONIC DEVICES & CIRCUITS

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A4EC01	ESC	3	0	0	3	30	70	100

OBJECTIVES:

The course should enable the students to:

I. To impart the knowledge of construction, principle of operation and working of various semi conductor devices.
II. To analyze the volt-ampere characteristics of various semi conductor devices.
III. To facilitate students in understanding various biasing methods for stability.
IV. To provide the concepts involved in design of electronic Circuits.

OUTCOMES

At the end of the units students will be able to

I. To impart the knowledge of construction, principle of operation and working of various semi conductor devices.
II. To analyze the volt-ampere characteristics of various semi conductor devices.
III. To facilitate students in understanding various biasing methods for stability.
IV. To provide the concepts involved in design of electronic Circuits

UNIT-I P-N JUNCTION DIODE **Classes: 12**

Introduction to Semiconductor Physics: Qualitative Theory of P-N Junction, P-N Junction as a Diode, Diode Equation, Volt-Ampere Characteristics, Temperature dependence of VI characteristic, Ideal versus Practical – Resistance levels (Static and Dynamic), Transition and Diffusion Capacitances, Diode Equivalent Circuits, Load Line Analysis, Breakdown Mechanisms in Semiconductor Diodes, Zener Diode Characteristics.

Special Purpose Electronic Devices: Principle of Operation and Characteristics of Tunnel Diode (with the help of Energy Band Diagram), Varactor Diode, SCR and Semiconductor Photo Diodes.

UNIT-II RECTIFIERS AND FILTERS **Classes: 12**

The P-N junction as a Rectifier, Half wave Rectifier, Full wave Rectifier, Bridge Rectifier, Harmonic components in a Rectifier Circuit, Inductor Filters, Capacitor Filters, L Section Filters, π- Section Filters, Comparison of Filters, Voltage Regulation using Zener Diode**.**

UNIT-III BIPOLAR JUNCTION TRANSISTOR AND UJT **Classes: 15**

The Junction Transistor, Transistor Current Components, Transistor as an Amplifier, Transistor Construction, BJT Operation, BJT Symbol, Common Base, Common Emitter and Common Collector Configurations, Limits of Operation , BJT Specifications, BJT Hybrid Model, Determination of h-parameters from Transistor Characteristics, Comparison of CB, CE, and CC Amplifier Configurations, UJT and Characteristics.

UNIT-IV TRANSISTOR BIASING AND STABILIZATION **Classes: 15**

Operating Point, The DC and AC Load lines, Need for Biasing, Fixed Bias, Collector Feedback Bias, Emitter Feedback Bias, Collector - Emitter Feedback Bias, Voltage Divider Bias, Bias Stability, Stabilization Factors, Stabilization against variations in VBE and β, Bias Compensation using Diodes and Transistors, Thermal Runaway, Thermal Stability, Analysis of a Transistor Amplifier Circuit using h-Parameters.

UNIT-V FIELD EFFECT TRANSISTOR AND AMPLIFIERS Classes: 11

The Junction Field Effect Transistor (Construction, principle of operation symbol) – Pinch-off Voltage - Volt-Ampere characteristics, The JFET Small Signal Model, MOSFET (Construction, principle of operation, symbol), MOSFET Characteristics in Enhancement and Depletion modes.
FET Amplifiers: FET Common Source Amplifier, Common Drain Amplifier, Generalized FET Amplifier, Biasing FET, FET as Voltage Variable Resistor, Comparison of BJT and FET.

Text Books:

1. Jacob Milliman, Christos C .Halkias, Satyabrata Jit (2015), *Electronic Devices and Circuits*, 3rd edition, Tata McGraw Hill, New Delhi.
2. G. K. Mittal (1999), *Electronic Devices and Circuits*, 22nd edition, Khanna Publications, New Delhi.
3. Robert Boylestad, Lowis Nashelsky (1993), *Electronic Devices and Circuit Theory*, 5th edition, Prentice Hall of India, New Delhi, India.

Reference Books:

1. David. A. Bell (1986), *Electronic Devices and Circuits,* 4th edition, Prentice Hall of India, New Delhi.
2. S. Shalivahanan, N. Suresh Kumar, A. Vallavaraj (2007), *Electronic Devices and Circuits*, 3rd edition, McGraw Hill, New Delhi, India.
3. Theodore. F. Bogart Jr, Jeffrey S. Beasley, Guillermo Rico (2004), *Electronic Devices and Circuits*, 6th edition PearsonEducation,India.

Web References:

1. https://unacademy.com/course/electronic-devices-gate-ece/JTIAAKX1
2. https://freevideolectures.com/course/2261/basic-electronics-and-lab/2
3. https://unacademy.com/lesson/build-in-potential-and-depletion-width/ALHF5QVM

E-Text Books:

1. http://www.freebookcentre.net/electronics-ebooks-download/Electronic-Devices-and-Circuits-(PDF-313p).html
2. https://www.goodreads.com/book/show/25345857-electronic-devices-and-circuits
3. https://thebookee.net/el/electronic-devices-and-circuits-by-jb-gupta-pdf

ELECTRICAL MACHINES – I

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	TOTAL
A4EE04	PCC	3	0	0	3	30	75	100

COURSE OVERVIEW:
The course content should be taught and with the aim to develop different types of skills so that students are able to acquire maintain various types of DC machines and single phase transformers safely.

PRE-REQUISITIES: Basic Electrical Engineering

COURSE OBJECTIVES:
At the end of the course, students are expected to
1. Illustrate the theory of electromechanical energy conversion and the concept of co energy.
2. Demonstrate the working principle of different types of dc machines and transformers.
3. Analyze the losses in dc machines to improve the efficiency by conducting various tests.
4. Outline the principle of operation, construction and testing of single phase transformers

COURSE OUTCOMES:
Upon successful completion of this course, student will be able to
1. Be able to understand the concept of energy conversion and demonstrate the parts of dc machine.
2. Understand the principle operation and characteristics of DC machines.
3. Understand the operation and efficiency of transformers.
4. Understand the concept of mutual induction and operation of transformer.

SYLLABUS

UNIT – I **DC GENERATORS:** DC generators: Principle of operation, construction, armature windings, lap and wave windings, simplex and multiplex windings, use of laminated armature, commutator, Emf equation, types of DC generators, voltage buildup, critical field resistance and critical speed, causes for failure to self-excited and remedial measures; Armature reaction: Cross magnetization and demagnetization, ampere turns per pole, compensating winding, commutation, reactance voltage, methods of improving commutation; Characteristics: Principle of parallel operation load sharing, use of equalizer bars and cross connection of field windings problems.

UNIT – II **DC MOTORS :** 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.

UNIT-III **Testing and Speed control of dc machines**: Swinburne's test, brake test, regenerative testing, Hopkinson's test, fields test, retardation test and separation of stray losses, problems.
Speed control of DC Motors: Armature voltage and field flux control methods. Ward-Leonard system. Principle of 3 point and 4 point starters- types of starters – protective devices

UNIT – IV **SINGLE PHASE TRANSFORMERS:** 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 transformer: objective of testing, polarity test, measurement of resistance, OC and SC tests, back to back test, heat run test, parallel operation, problems. .

UNIT – V **THREE PHASE TRANSFORMERS:** 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, problems.

TEXT BOOKS:

1. J Nagrath, D P Kothari, —Electrical Machines‖, Tata Mc Graw Hill publication, 3rd Edition, 2010.
2. P S Bimbra, —Electrical Machines‖, Khanna Publishers, 2nd Edition, 2008.

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. 3.Ian McKenzie Smith, Edward Hughes, —Electrical Technology‖, Prentice Hall, 10thEdition, 2015
4. J B Gupta, —Theory and Performance of Electrical Machines‖, S K Kataria& Sons Publication, 14th Edition, 2010.
5. A E Fitzgerald, Charles Kingsley, JR., Stephen D Umans, —Electric Machinery‖, McGraw Hill,6th Edition, 1985.

ELECTROMAGNETIC FIELDS

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	TOTAL
A4EE05	PCC	3	0	0	3	25	70	100

OBJECTIVES:

The course should enable the students to:

1. Demonstrate the concept of electrostatic field intensity and electric potential.
2. Illustrate polarization of dielectrics and the behaviour of conductors and dielectrics in Electric field.
3. Understand the concept of magnetic field intensity and flux density.
4. Discuss forces in magnetic fields and low of electromagnetic induction.

OUTCOMES :

1. Apply the concept of electrostatic field intensity and electric potential and be able to calculate the specified values.
2. Illustrate polarization of dielectrics and the behaviour of conductors and dielectrics in electric field.
3. Be able to define the concept of magnetic field intensity and flux density.
4. Discuss forces in magnetic fields and low of electromagnetic induction.

UNIT-I ELECTROSTATICS Classes: 09

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.

UNIT-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, behaviour 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.

UNIT-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.

UNIT-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.

UNIT-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; Numerical methods: Finite difference method (FDM), finite element method (FEM), charge simulation method (CSM), boundary element method, application of finite element method to calculate electrostatic and magneto static fields.

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.
1. 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:

- www.wikipedia.org
- www.pa.msu.edu
- www.tutorvista.com
- www.globalspec.com

1. www.ee.bilkent.edu.tr

E-Text Books:

- http://www.cl.cam.ac.uk/teaching/1011/SysOnChip/socdam-notes1011.pdf
- https://www.doc.ic.ac.uk/~wl/teachlocal/cuscomp/notes/cc11.pdf
- https://www.cs.ccu.edu.tw/~chen/arch/SOC-design.pdf

MOOC Course

- https://onlinecourses.nptel.ac.in/noc18_ee33/preview
- https://onlinecourses.nptel.ac.in/noc18_ee34/preview

ELECTRICAL MEASUREMENTS & INSTRUMENTATION

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	TOTAL
A4EE06	PCC	3	0	0	3	30	70	100

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.

OUTCOMES :

At the end of course students will able to

1. Understand the basic definition of electrical instruments.
2. Be able to calculate the value of error in an instrument and measure the accuracy.
3. Be able to find the value of unknown resistance by using bridge circuits.
4. Explain how to measure the power in a three phase circuit.
5. Understand the working of energy meter and calculate the energy consumed

UNIT-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 an compensation extension of range using shunts and series resistance; Electro static voltmeter, electro type an attracted type, disc type, extension of range of ES voltmeters.

UNIT-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 transformer: CT and PT, ratio and phase angle error.

UNIT-III MEASUREMENT OF POWER AND ENERGY **Classes: 09**

Measurement of Power: single phase dynamometer type wattmeter, LPF and UPF, double elements and thre elements dynamometer wattmeter; Expression for deflection and control torque, extension of range of wattmete by using instrument transformers, measurement of active and reactive power for balanced and unbalance Systems Measurement of Energy: Single phase induction type energy meter, driving and braking torques, error and compensations, testing by phantom loading using RSS meter, three phase energy meter, Introduction to ne energy metering (web ref: 4,5), maximum demand meters.

UNIT-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.

UNIT-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, Thermistor, 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.

Text Books:

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

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 Mc Graw Hill Edition, 1st Edition 1995

Web References:

- www.wikipedia.org
- www.pa.msu.edu
- www.tutorvista.com
- www.globalspec.com
- www.ee.bilkent.edu.tr

E-Text Books:

- http://www.cl.cam.ac.uk/teaching/1011/SysOnChip/socdam-notes1011.pdf
- https://www.doc.ic.ac.uk/~wl/teachlocal/cuscomp/notes/cc11.pdf
- https://www.cs.ccu.edu.tw/~chen/arch/SOC-design.pdf

MOOC Course

- https://onlinecourses.nptel.ac.in/noc18_ee33/preview
- https://onlinecourses.nptel.ac.in/noc18_ee34/preview

ELECTRONIC DEVICES & CIRCUITS LAB

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A4EC07	ESC	0	0	3	1.5	30	70	100

OBJECTIVES:

The course should enable the students to:

1. To identify various components and testing of active devices.
2. To operate various equipments like millimeter, function generators, regulated power supplies and CRO
3. To analyze the characteristics of various active devices.
4. To provide the concepts involved in design of electronic Circuits.

OUTCOMES:

The course should enable the students to:

1. Calculate various parameters of semi conductor devices from their characteristics.
2. Know the role of semi conductor devices in real time applications.
3. Calculate h-parameters of BJT under various configurations.
4. Compute frequency response of various amplifiers.

LIST OF EXPERIMENTS

Week-1

a. Identification, Specifications, Testing of R, L, C Components (Color Codes), Potentiometers, Switches (SPDT, DPDT, and DIP), Coils, Relays, Bread Boards, PCB‘s.
b. Identification, Specifications and Testing of Active Devices: Diodes, BJTs, JFETs, MOSFETs, Power Transistors, LED‘s, LCD‘s, SCR, UJT.
c. Study and operation of Multimeter (Analog and Digital) Function Generator Regulated Power Supply (RPS) CRO
d. Soldering Practice.

Week-2

Forward and Reverse Bias Characteristics of PN junction diode.

Week-3

Zener Diode Characteristics and Zener diode as voltage regulator

Week-4

Half wave rectifier with and without filters

Week-5

Full wave rectifier with and without filters.

Week-6

Input & output characteristics of transistor in CB configuration.

Week-7

Input & output characteristics of transistor in CE configuration

Week-8

Input & output characteristics of transistor in CC configuration

Week-9

Drain and Transfer characteristics of JFET

Week-10

Voltage divider bias using BJT.

Week-11

UJT characteristics

Week-12

SCR characteristics

Reference Books:

1. Jacob Milliman, Christos C .Halkias, Satyabrata Jit (2015), *Electronic Devices and Circuits*, 3rd edition, Tata McGraw Hill, New Delhi.
2. G. K. Mittal (1999), *Electronic Devices and Circuits*, 22nd edition, Khanna Publications, New Delhi.
3. Robert Boylestad, Lowis Nashelsky (1993), *Electronic Devices and Circuit Theory*, 5th edition, Prentice Hall of India, New Delhi, India.

Web References:

1. https://unacademy.com/course/electronic-devices-gate-ece/JTIAAKX1
2. https://freevideolectures.com/course/2261/basic-electronics-and-lab/2
3. https://unacademy.com/lesson/build-in-potential-and-depletion-width/ALHF5QVM

ELECTRICAL MACHINES LAB -1

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A2EE07	PCC	0	0	3	1.5	30	70	100

OBJECTIVES:

The course should enable the students to:

I. Conduct various load tests on DC identical machines.

II. Develop procedure for speed control of DC machines.

III. Simulate DC machine to study the characteristics by using digital simulation.

OUTCOMES:

At the end of the lab the students will be able to learn:

I. Conduct various load tests on DC identical machines.

II. Develop procedure for speed control of DC machines.

III. Simulate DC machine to study the characteristics by using digital simulation

1	OPEN CIRCUIT CHARACTERISTICS OF DC SHUNT GENERATOR AND DETERMINATION OF CRITICAL FIELD RESISTANCE AND CRITICAL SPEED.	Classes: 3
2	LOAD TEST ON DC SHUNT GENERATOR	Classes: 3
3	LOAD TEST ON DC SERIES GENERATOR	Classes: 3
4	LOAD TEST ON DC COMPOUND GENERATOR	Classes: 3
5	FIELD TEST ON DC SERIES MACHINES	Classes: 3
6	SWINBURNE'S TEST ON DC SHUNT MOTOR	Classes: 3
7	BRAKE TEST ON DC COMPOUND MOTOR	Classes: 3

		Classes: 3
8	RETARDATION TEST ON DC SHUNT MOTOR	
9	SEPARATIONS OF LOSSES IN DC SHUNT MOTOR	Classes: 3
10	SSPEED CONTROL OF DC SHUNT MOTOR	Classes: 3
11	HOPKINSONS TEST	Classes: 3
12	PERFORMANCE CHARACTERISTICS OF DC SHUNT MOTOR	Classes: 3

Text Books:

1. I J Nagrath, D P Kothari, "Electrical Machines", Tata Mc Graw Hill publication, 3rd Edition, 2010.
2. P S Bimbra, "Electrical Machines", Khanna Publishers, 2nd Edition, 2008.

Reference Books:

1. J B Gupta, "Theory and Performance of Electrical Machines", S K Kataria& Sons Publication, 14th Edition, 2010.
2. A E Fitzgerald, Charles Kingsley, JR., Stephen D Umans, "Electric Machinery", McGraw Hill,6th Edition, 1985.

Web References:

1.www.wikipedia.org
2.www.pa.msu.edu

E-Text Books:

1.http://www.cl.cam.ac.uk/teaching/1011/SysOnChip/socdam-notes1011.pdf

2.https://www.doc.ic.ac.uk/~wl/teachlocal/cuscomp/notes/cc11.pdf

MOOC Course

1.https://onlinecourses.nptel.ac.in/noc18_ee33/preview
2.https://onlinecourses.nptel.ac.in/noc18_ee34/preview

ELECTRICAL CIRCUITS AND SIMULATION LAB

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A2EE08	BSC	0	0	3	1.5	30	70	100

OBJECTIVES:

The course should enable the students to:

I. Apply different techniques used in electric circuit analysis to calculate circuit parameters and two port network parameters.

II. Demonstrate the applications of Fourier transforms in electric circuits.

III. Design filters and analyze through digital simulation in electrical circuits.

OUTCOMES:

At the end of the lab the students will be able to :

I. Apply different techniques used in electric circuit analysis to calculate circuit parameters and two port network parameters.

II. Demonstrate the applications of Fourier transforms in electric circuits.

III. Design filters and analyze through digital simulation in electrical circuits.

1	Verification of Compensation Theorem and Reciprocity theorems	Classes: 3
2	Verification of and Maximum Power Transfer and Milliman's Theorems	Classes: 3
3	Locus Diagrams of RL and RC Series Circuits	Classes: 3
4	Series and Parallel Resonance	Classes: 3
5	Determination of Self, Mutual Inductances and Coefficient of coupling	Classes: 3
6	Determination of Z and Y Parameters	Classes: 3
7	Determination of Transmission and Hybrid parameters	Classes: 3
8	Measurement of Active Power for Star and Delta connected balanced loads	Classes: 3

9	Measurement of Reactive Power for Star and Delta connected balanced loads	**Classes: 3**
10	Measurement of 3-phase Power by two Wattmeter Method for unbalanced loads	**Classes: 3**
11	Simulation of dc circuits	**Classes :3**
12	Simulation of Mesh and Nodal analysis.	**Classes:3**

Text Books

1. M. E. Van Valkenburg, "Network Analysis", Prentice Hall, 2006.
2. D. Roy Choudhury, "Networks and Systems", New Age International Publications,1998.

Reference Books:

1. W. H. Hayt and J. E. Kemmerly, "Engineering Circuit Analysis", McGraw Hill Education, 2013.
2. A E Fitzgerald, Charles Kingsley, JR., Stephen D Umans, "Electric Machinery", McGraw Hill,6th

Web References:

1.www.wikipedia.org
2.www.pa.msu.edu

E-Text Books:

1.http://www.cl.cam.ac.uk/teaching/1011/SysOnChip/socdam-notes1011.pdf
2.https://www.doc.ic.ac.uk/~wl/teachlocal/cuscomp/notes/cc11.pdf

MOOC Course

1.https://onlinecourses.nptel.ac.in/noc18_ee33/preview
2.https://onlinecourses.nptel.ac.in/noc18_ee34/preview

GENDER SENSATIZATION

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A4MC02	MC	0	0	2	-	30	70	100

COURSE OBJECTIVES:

- To provide a critical perspective on the socialization of men and women.
- To introduce students to information about some key biological aspects of genders. To expose the students to debates on the politics and economics of work.
- To help students reflect critically on gender violence.
- To expose students to more egalitarian interactions between men and women.

COURSE OUTCOMES:

- Students will have developed a better understanding of important issues related to gender in contemporary India.
- Students will be sensitized to basic dimensions of the biological, sociological, psychological and legal aspects of gender. This will be achieved through discussion of materials derived from research, facts, everyday life, literature and film.
- Students will attain a finer grasp of how gender discrimination works in our society and how to counter it.
- Students will acquire insight into the gendered division of labour and its relation to politics and economics.
- Men and women students and professionals will be better equipped to work and live together as equals.
- Students will develop a sense of appreciation of women in all walks of life.

  Through providing accounts of studies and movements as well as the new laws that provide protection and relief to women, the textbook will empower students to understand and respond to gender violence.

UNIT-I UNDERSTANDING GENDER Classes: 03

Gender: Why Should We Study It? (*Towards a World of Equals*: Unit -1) **Socialization:** Making Women, Making Men (*Towards a World of Equals*: Unit -2) Introduction. Preparing for Womanhood. Growing up Male. First lessons in Caste. Different Masculinities.

UNIT-II GENDER AND BIOLOGY Classes: 03

Missing Women: Sex Selection and Its Consequences (*Towards a World of Equals*: Unit -4) Declining Sex Ratio. Demographic Consequences.

Gender Spectrum: Beyond the Binary (*Towards a World of Equals*: Unit -10) Two or Many? Struggles with Discrimination.

UNIT-III GENDER AND LABOUR Classes:03

Housework: the Invisible Labour (*Towards a World of Equals*: Unit -3)

"My Mother doesn't Work." "Share the Load."

Women's Work: Its Politics and Economics (*Towards a World of Equals*: Unit -7)

Fact and Fiction. Unrecognized and Unaccounted work. Additional Reading: Wages and Conditions of Work.

UNIT-IV ISSUES OF VIOLENCE Classes:04

Sexual Harassment: Say No! (*Towards a World of Equals*: Unit -6)

Sexual Harassment, not Eve-teasing- Coping with Everyday Harassment- Further Reading: "*Chupulu".*

Domestic Violence: Speaking Out (*Towards a World of Equals*: Unit -8)

Is Home a Safe Place? -When Women Unite [Film]. Rebuilding Lives. Additional Reading:

New Forums for Justice.

Thinking about Sexual Violence (*Towards a World of Equals*: Unit -11)

Blaming the Victim-"I Fought for my Life…." - Additional Reading: The Caste Face of

Violence.

UNIT-V GENDER: CO - EXISTENCE Classes:03

Just Relationships: Being Together as Equals (*Towards a World of Equals*: Unit -12)

Mary Kom and Onler. Love and Acid just do not Mix. Love Letters. Mothers and Fathers.

Additional Reading: Rosa Parks-The Brave Heart.

Text Books:

All the five Units in the Textbook**, "*Towards a World of Equals: A Bilingual Textbook on Gender*"** written by A. Suneetha, Uma Bhrugubanda, Duggirala Vasanta, Rama Melkote, Vasudha Nagaraj, Asma Rasheed, Gogu Shyamala, Deepa Sreenivas and Susie Tharu and published by **Telugu Akademi, Hyderabad**,Telangana State in the year **2015**.

Reference Books:

1. Menon, Nivedita. Seeing like a Feminist. New Delhi: Zubaan-Penguin Books, 2012
2. Abdulali Sohaila. "*I Fought For My Life…and Won*."Available online at: http://www.thealternative.in/lifestyle/i-fought-for-my-lifeand-won-sohaila-abdulal/

Web references:

1.http://www.thealternative.in/lifestyle/i-fought-for-my-lifeand-won-sohaila-abdulal/

E -Text Books:

1.http://www.thealternative.in/lifestyle/i-fought-for-my-lifeand-won-sohaila-abdulal/

II B.TECH II SEMESTER SYLLABUS

DIGITAL LOGIC DESIGN

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A4EC03	PCC	3	0	0	3	30	70	100

OBJECTIVES:

At the end of the course, students are expected to

1. To discuss about the number system and Boolean algebra which are applicable in various switching functions

2. To describe the common forms of number representation in digital electronic circuits and to be able to convert between different representations

3. To discuss the combinational circuit's using simple logical operations

4. To illustrate the concepts of sequential circuits , enabling students to analyze sequential systems in terms of state machines

5. To explore the techniques to implement synchronous state machines using flip-flops

OUTCOMES:

Upon successful completion of this course, student will be able to

1. Understand the basic digital logic fundamentals such as numbering systems, binary codes and

Boolean algebra.

2. Understand the basic building blocks of digital systems like gates and minimization of Boolean

expressions using K-map method

3. Design counters with the knowledge of combinational and sequential circuits.

4. Design the state diagrams with the knowledge of Mealy and Moore circuits and algorithmic state

machines for binary multipliers

UNIT-I REVIEW OF NUMBER SYSTEMS: Classes: 10

Representation of numbers of different radix, conversion of numbers from one radix to another radix, r-1s complement and r‗s complement of unsigned numbers subtraction, problem solving .Signed binary numbers, different forms, problem solving for subtraction. 4- bit codes: BCD, EXCESS 3, alphanumeric codes,9‗s complement

UNIT-II LOGIC OPERATION, ERROR DETECTION AND CORRECTION CODES: Classes: 10

Basic logic operations NOT,OR, AND, Boolean theorems, Complement and dual of logical expressions, NAND and NOR Gates, EX-OR, EX-NOR Gates, standard SOP and POS, Minimization of logic functions using theorems, Generation of self dual functions. Gray code, error detection and error correction codes, parity checking even parity, odd parity, Hamming code, multi level AND-NOR Realizations. Two level NAND-NAND and NOR-NOR realizations. Degenerative forms and multi level realizations.

UNIT-III SEQUENTIAL MACHINES FUNDAMENTALS: Classes: 10

Introduction, Basic Architectural Distinctions between Combinational and Sequential circuits, The Binary Cell, Fundamentals of Sequential Machine Operation, The Flip-Flop, The D-Latch Flip-Flop, The Clocked T Flip-Flop, The — Clocked J-Kll Flip-Flop, Design of a Clocked Flip-Flop, Conversion from one type of Flip-Flop to another, Timing and Triggering Consideration, Clock Skew.

UNIT-IV SEQUENTIAL CIRCUIT DESIGN AND ANALYSIS: Classes: 10

Introduction, State Diagram, Analysis of Synchronous Sequential Circuits, Approaches to the Design of Synchronous Sequential Finite State Machines, Design Aspects, State Reduction, Design Steps, Realization using Flip-Flops Counters - Design of Single mode Counter, Ripple Counter, Ring Counter, Shift Register, Shift Register Sequences, Ring Counter Using Shift Register.

UNIT-V SEQUENTIAL CIRCUITS AND ALGORITHMIC STATE MACHINES: Classes: 10

Finite state machine capabilities and limitations, Mealy and Moore models minimization of completely specified and in completely specified sequential machines, Partition techniques and Merger chart methods-concept of minimal cover table. Salient features of the ASM chart-Simple examples-System design using data path and control subsystems control implementations-examples of weighing machine and Binary multiplier.

Text Books:

1. Switching and Finite Automata Theory- ZviKohavi&Niraj K. Jha, 3rd Edition, Cambridge.

2. Digital Design- Morris Mano, PHI, 3rd Edition

Reference Books:

1. Introduction to Switching Theory and Logic Design – Fredriac J. Hill, Gerald R. Peterson, 3rd Ed,John Wiley &SonsInc

2. Digital Fundamentals – A Systems Approach – Thomas L. Floyd, Pearson, 2013.

3. Digital Logic Design - Ye Brian and Holds Worth, Elsevier

4. Fundamentals of Logic Design-CharlesH. Roth, Cengage Learning, 5th, Edition, 2004.

Web References:

www.pa.msu.edu
www.tutorvista.com
www.globalspec.com
www.tutorvista.com
www.globalspec.com

E-Text Books:

http://www.cl.cam.ac.uk/teaching/1011/SysOnChip/socdam-notes1011.pdf
https://www.doc.ic.ac.uk/~wl/teachlocal/cuscomp/notes/cc11.pdf
https://www.cs.ccu.edu.tw/~chen/arch/SOC-design.pdf

MOOC Course
https://onlinecourses.nptel.ac.in/noc18_ee33/preview
https://onlinecourses.nptel.ac.in/noc18_ee34/preview

ELECTRICAL MACHINES -II

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	TOTAL
A4EE09	PCC	3	0	0	3	30	70	100

COURSE OBJECTIVES:

At the end of the course, students are expected to
1. Discuss the construction, working and characteristics of three phase induction motor and synchronous motor.
2. Illustrate the equivalent circuit and speed control methods of three phase induction motors.
3. Outline the working and parallel operation of alternators.
4. Evaluate synchronous impedance and voltage regulation of synchronous machine.

COURSE OUTCOMES:

Upon successful completion of this course, student will be able to:
1. Understand the concept of rotating magnetic field in an Induction motor.
2. Able to demonstrate why the rotor rotates in the direction of magnetic field and cannot catch the speed of Synchronous speed
3. Understand how the winding are wound in an Alternator.
4. Able to explain what are harmonics and methods to reduce the harmonics
5. Explain the concept of Pitch factor and distribution factor.

SYLLABUS

UNIT – I THREE PHASE INDUCTION MOTORS

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.

UNIT – II TESTING AND SPEED CONTROL OF INDUCTION MOTORS

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, circle diagram, determination of induction motor parameters from circle diagram, problems

UNIT – III ALTERNATORS

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

UNIT – IV SYNCHRONOUS MOTORS

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.

UNIT – V SINGLE PHASE INDUCTION MOTOR

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

TEXT BOOKS:

1. P S Bimbra, —Electrical Machines‖, Khanna Publishers, 2nd Edition, 2008.
2. I J Nagrath, D P Kothari, —Electrical Machines‖, TMH publication, 3rd Edition, 2010.

REFERENCE BOOKS:

1. A. E Fitzgerald, Charles Kingsley JR., Stephen D Umans, —Electric Machinery‖, Mc Graw Hill,6th Edition, 1985.
2. M G Say, —Alternating Current Machines‖, Pitman Publishing Ltd, 4th Edition, 1976.
3. Bhattacharya, —Electrical Machines‖, TMH publication, 2nd Edition,
4. J B Gupta, —Theory and Performance of Electrical Machines‖, S K Kataria& Sons Publication, 14thEdition, 2010

POWER SYSTEMS -I

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	TOTAL
A4EE10	PCC	3	0	0	3	30	70	100

OBJECTIVES:

The course should enable the students to:

1. To understand the development of electrical energy needs of various consumer areas and the relative mathematical analysis of it,
2. To describe and use from technical point of view the various methods of electrical energy production and to classify and use them from economic and operational point of view,
3. To understand the relationship between the electrical loads and the respective power production installations on the base of economic and technological criteria,
4. To use the methods and criteria of forming the selling price list of electrical energy

OUTCOMES:

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

1.Understand the development of electrical energy needs of various consumer areas and the relative mathematical analysis of it,
2.Describe and use from technical point of view the various methods of electrical energy production and to classify and use them from economic and operational point of view,
3.Understand the relationship between the electrical loads and the respective power production installations on the base of economic and technological criteria,
4.Use the methods and criteria of forming the selling price list of electrical energy

UNIT-I HYDROELECTRIC POWER STATION Classes: 10

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 catchments area, Heads and efficiencies Thermal power stations: 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

UNIT-II NUCLEAR AND GAS POWER STATIONS Classes: 10

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).

UNIT-III TRANSMISSION LINE PARAMETERS Classes: 10

Types of conductors - calculation of resistance for 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, 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.

UNIT-IV PERFORMANCE OF TRANSMISSION LINES Classes: 10

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 & Asymmetrical Networks, Numerical Problems. Mathematical Solutions to estimate regulation and efficiency of all types of lines - Numerical Problems. Long Transmission Line-Rigorous Solution, evaluation of A,B,C,D Constants, Interpretation of the Long Line Equations, Surge Impedance and SIL of Long Lines, Wave Length and Velocity of Propagation of Waves - Representation of Long Lines - Equivalent-T and Equivalent Pie network models (numerical problems).

UNIT-V OVERHEAD LINE INSULATORS Classes: 10

Types of Insulators, String efficiency and Methods for improvement, Numerical Problems – voltage distribution, calculation of string efficiency, Capacitance grading and Static Shielding.

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. Skin and Proximity effects - Description and effect on Resistance of Solid Conductors - Ferranti effect - Charging Current - Effect on Regulation of the Transmission Line, Shunt Compensation. Corona - Description of the phenomenon, factors affecting corona, critical voltages and power loss, Radio Interference.

Text Books:

1. C L Wadhawa, —Generation, Distribution and Utilization of Electrical Energy‖, New

AgeInternational Limited, New Delhi, 3rd Edition, 2010.

2. G D Rai, —Non-Conventional Energy Sources‖, Khanna Publishers, 1st Edition, 2011

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,

NewDelhi, 1st Edition, 1992.

3. Mukund R Patel, —Wind and Solar Power Systems‖, CRC Press, 1st Edition, 1999

4. G N Tiwari, M K Ghosal, —Fundamentals of Renewable Energy Sources‖, Narosa Publications,

NewDelhi, 1st Edition, 2007.

Web References:

www.pa.msu.edu
www.tutorvista.com
www.globalspec.com
www.tutorvista.com
www.globalspec.com

E Text Book-

http://www.cl.cam.ac.uk/teaching/1011/SysOnChip/socdam-notes1011.pdf
https://www.doc.ic.ac.uk/~wl/teachlocal/cuscomp/notes/cc11.pdf
https://www.cs.ccu.edu.tw/~chen/arch/SOC-design.pdf

MOOC Course:

https://onlinecourses.nptel.ac.in/noc18_ee33/preview
https://onlinecourses.nptel.ac.in/noc18_ee34/preview

CONTROL SYSTEMS

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	TOTAL
A4EC23	PCC	3	0	0	3	30	70	100

OBJECTIVES:

At the end of the course, students are expected to:

1. Organize modeling and analysis of electrical and mechanical systems.
2. Analyze control systems by block diagrams and signal flow graph technique.
3. Demonstrate the analytical and graphical techniques to study the stability.
4. Illustrate the frequency domain and state space analysis

OUTCOMES:

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

1. Understand the basic definition of control systems.
2. Explain the concept of Serve mechanism and different translational and rotational motions.
3. Understand the concept of order of a system and finding the response.
4. Able to find the steady state and transient state response of first and second order systems.
5. Explain the concept of relative stability and root locus, Nyquist plots.

UNIT-I INTRODUCTION: Classes: 10

Concepts of Control Systems- Open Loop and closed loop control systems and their differences- Classification of control systems, Feed-Back Characteristics, Effects of feedback. Mathematical models – Differential equations, Impulse Response and transfer functions – Translational and Rotational mechanical systems

Transfer function representation: Transfer Function of Synchro transmitter and Receiver, Block diagram representation of systems considering electrical systems as examples -Block diagram algebra – Representation by Signal flow graph - Reduction uses Mason's gain formula.

UNIT-II TIME RESPONSE ANALYSIS: Classes: 10

Standard test signals - Time response of first order systems – Characteristic Equation of Feedback control systems, Transient response of second order systems - Time domain specifications – Steady state response - Steady state errors and error constants – Effects of proportional derivative, proportional integral systems, PID controllers.

UNIT-III STABILITY ANALYSIS IN S-DOMAIN: Classes: 10

The concept of stability – Routh's stability criterion – qualitative stability and conditional stability – limitations of Routh's stability. Root Locus Technique: The root locus concept - construction of root loci-effects of adding poles and zeros to G(s)H(s) on the root loci.

UNIT-IV FREQUENCY RESPONSE ANALYSIS: Classes: 10

Introduction, Frequency domain specifications-Bode diagrams-Determination of Frequency domain specifications and transfer function from the Bode Diagram-Phase margin and Gain margin-Stability Analysis from Bode Plots.

UNIT-V STABILITY ANALYSIS IN FREQUENCY DOMAIN: Classes: 10

Polar Plots-Nyquist Plots-Stability Analysis. CLASSICAL CONTROL DESIGN TECHNIQUES: Compensation techniques – Lag, Lead, Lead-Lag Controllers design in frequency Domain.

STATE SPACE ANALYSIS OF CONTINUOUS SYSTEMS: Concepts of state, state variables and state model, derivation of state models from block diagrams, Diagonalization Solving the Time invariant state Equations- State Transition Matrix and its Properties

Text Books:

1.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

Reference Books:

1. AAnand 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
4. N C Jagan, —Control Systems , BS Publications, 1st Edition, 2007.

Web References:

www.pa.msu.edu
www.tutorvista.com
www.globalspec.com
www.tutorvista.com
www.globalspec.com

E Text Book -

http://www.cl.cam.ac.uk/teaching/1011/SysOnChip/socdam-notes1011.pdf
https://www.doc.ic.ac.uk/~wl/teachlocal/cuscomp/notes/cc11.pdf
https://www.cs.ccu.edu.tw/~chen/arch/SOC-design.pdf

MOOC Course:

https://onlinecourses.nptel.ac.in/noc18_ee33/preview
https://onlinecourses.nptel.ac.in/noc18_ee34/preview

NUMERICAL METHODS AND COMPLEX ANALYSIS

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A4BS07	BSC	3	0	0	3	30	70	100

COURSE OBJECTIVES:

To learn

1. The concepts of finite differences, operators and relations between them.

2. Evaluation of integrals by using numerical methods.

3. Evaluation of the line integrals along piece wise smooth paths, interpret such quantities as work

Done by a force.

4. Concepts of Taylors and Maclaurin's series.

5. Finding Residues using Laurent series.

6. Concept of bilinear transformation and mapping it to the given points.

COURSE OUTCOMES:

Upon successful completion of the course, the student is able to

1. Find Interpolating polynomial for the given tabular data.

2. Solve the first order ordinary differential equations using numerical techniques.

3. Calculate line integrals along piece wise smooth paths, interpret such quantities as work done by a force.

4. Express the given complex function as a power series using Taylor's series and Maclaurin's series.

5. Evaluate Residues by Laurent series

6. Find the bilinear transformation mapping to three given points.

UNIT-I INTERPOLATION AND CURVE FITTING Classes: 10

INTERPOLATION: Finite differences: Forward, Backward and Central differences - Other difference operators and relations between them - Difference of a polynomial – Missing terms - Newton's forward interpolation, Newton's backward interpolation, Gauss's forward and backward interpolation formulae and Stirling's formula. Interpolation with unequal intervals – Lagrange's interpolation.

CURVE FITTING: Method of least squares - Fitting a straight line, second degree parabola and non-linear curves of the form $y= a e^{bx}$, $y= a x^{b}$, $y = a b^{x}$ by the method of least squares.

UNIT-II NUMERICAL TECHNIQUES Classes: 08

ROOT FINDING TECHNIQUES :

Bisection method-Iteration method and Newton Raphson method.

NUMERICAL INTEGRATION :

Newton-cotes quadrature formula - Trapezoidal rule - Simpson's one-third rule - Simpson's three-eighth rule.

NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS: Taylor's series method – Picard'smethod - Euler's - modified Euler's Method – Runge-Kutta method.

UNIT-III FUNCTIONS OF COMPLEX VARIABLES AND COMPLEX INTEGRATION Classes: 08

Complex functions and its representation on Argand plane, Concepts of limit &Continuity, Differentiability, Analyticity and Cauchy-Riemann conditions, Harmonic functions- Milne-Thompson method.

Line integral-Evaluation along a path and by indefinite integration-Cauchy's integral theorem- Cauchy's integral formula -Generalized integral formula.

UNIT-IV COMPLEX POWER SERIES AND CONTOUR INTEGRATION Classes:08

Radius of convergence-expansion in Taylor's series - Maclaurin's series and Laurent series - Singular point - Isolated singular point-pole of order m - essential singularity.

Residue- Evaluation of residue by formula and by Laurent's Series- Residue Theorem. Evaluation of integrals of the type

(a) Improper real integral $\int_{-\infty}^{+\infty} f(x)dx$ (b) $\int_{c}^{c+2\pi} f(\cos\theta, \sin\theta)d\theta$

UNIT-V CONFORMAL MAPPING Classes: 08

Transformation by e^{z}, $\log z, z^{2}, z^{n}$ (n is a positive integer), $\sin z, \cos z, \frac{z+a}{z}$, Translation, rotation, inversion and bilinear transformation – fixed point – cross ratio properties – invariance of circles and cross ratio – determination of bilinear transformation mapping three given points.

Text Books:

1. Ervin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.

2. B.S.Grewal, Higher Engineering Mathematics, Khanna publishers, 36th Edition, 2010.

Reference Books:

1. G.B.Thomas, calculus and analytical geometry, 9th Edition, Pearson Reprint 2006.

2. N.P Bali and Manish Goyal, A Text of Engineering Mathematics, Laxmi publications, 2008.

3.E.L.Ince, Ordinary differential Equations, Dover publications, 1958.

Web references:

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

E -Text Books:

1.https://www.e-booksdirectory.com/details.php?ebook=10166

2. https://www.e-booksdirectory.com/details.php?ebook=10166

DIGITAL LOGIC DESIGN LAB

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A4EC06	PCC	0	0	3	1.5	30	70	100

OBJECTIVES:

The course should enable the students to:

1. Study of logic gates and verify their truth tables.
2. Implementation of the given Boolean function using logic gates.
3. Use K-Map for simplification.
4. Design the combinational and sequential circuits

COURSE OUTCOMES:

The course should enable the students to:

1. Study of logic gates and verify their truth tables.
1. Implementation of the given Boolean function using logic gates.
2. Use K-Map for simplification.

Design the combinational and sequential circuits

LIST OF EXPERIMENTS

Week-1 TO STUDY OF LOGIC GATES AND VERIFY THEIR TRUTH TABLES

Verification and interpretation of truth tables for AND, OR, NOT, NAND, NOR Exclusive OR (EX-OR), Exclusive NOR (EX-NOR) Gates.

Week-2 TO IMPLEMENT BOOLEAN FUNCTION USING AOI LOGIC

Implement Exclusive-OR gate using AOI logic and to implement Boolean function F=xy+x'y'+y'z using AOI logic

Week-3 VERIFICATION OF K-MAP

To Simplify the Boolean function **F(w, x, y, z) = Σ (0, 1,2,4,5,6,8,9, 12, 13, 14)** using 4-variable K-Map, implement it and verify it using truth-table.

Week-4 ADDER AND SUBTRACTORS

To design and construct half adder, full adder half subtractor and full subtractor circuits using logic gates and verify the truth table.

Week-5 BCD TO EXCESS-3 CONVERTER

To Design and Implement BCD TO EXCESS-3, 4-bit Binary to gray code converter/ 4-bit Gray to Binary code converter and verify the truth table.

Week-6 BINARY TO GRAY /GRAY TO BINARY CODE CONVERTER

To Design and Implement 4-bit Binary to gray code converter/ 4-bit Gray to Binary code converter and verify the truth table.

Week-7 VERIFICATION OF TRUTH TABLES OF R-S FLIP-FLOP , J - K FLIP-FLOP , T FLIP-FLOP AND D FLIP-FLOP USING NAND AND NOR GATES

To Verify the truth tables of RS Flip Flop, JK Flip flop, T Flip flop and D Flip Flop using NAND and NOR gates

Week-8 **IMPLEMENTATION AND VERIFICATION OF DECODER, DE-MULTIPLEXER AND ENCODER USING LOGIC GATES**

To Implement and verify truth tables of decoder, de-multiplexer and encoder, using logic gates.

Week-9 **IMPLEMENTATION OF 4X1 MULTIPLEXER, USING LOGIC GATES**

To Implement and verify truth tables of 4x1 multiplexer, using logic gates

Week-10 **IMPLEMENTATION OF 4-BIT PARALLEL ADDER, USING 7483 IC**

To Implement and verify the truth table of 4-bit parallel adder, using 7483 IC.

Week-11 **DESIGN AND VERIFY THE 4-BIT SYNCHRONOUS COUNTER.**

To Design, and verify the 4-bit synchronous counter.

Week-12 **TO DESIGN AND VERIFY 4 BIT RIPPLE (ASYNCHRONOUS COUNTER)**

To design and verify a 4 bit ripple (asynchronous counter).

Reference Books:

1. R.P. Jain, “Modern digital Electronics”, Tata McGraw Hill, 4th edition, 2009.
2. W.H. Gothmann, “Digital Electronics- An introduction to theory and practice”, PHI, 2nd edition, 2006.
3. D.V. Hall, “Digital Circuits and Systems”, Tata McGraw Hill, 1989

Web References:

1. https://www.youtube.com/watch?v=M0mx8S05v60&list=PLBlnK6fEyqRjMH3mWf6kwqiTbT798eAOm
2. https://www.youtube.com/watch?v=CeD2L6KbtVM&list=PL018B3BB2E6FE781D
3. https://www.youtube.com/watch?v=CeD2L6KbtVM&list=PL803563859BF7ED8C

ELECTRICAL MACHINES LAB -II

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A2EE11	PCC	0	0	3	1.5	30	70	100

COURSE OBJECTIVES:

The course should enable the students to:

1. Evaluate losses and determine the efficiency of single phase and three phase electrical machines.
2. Determine the voltage regulation, efficiency and temperature rise in various transformers.
3. Apply PLC and digital simulation software to gain practical knowledge

LIST OF EXPERIMENTS

1	Load Test on Single phase Transformer	Classes: 3
2	Sumpner's test on a pair of single phase transformers	Classes: 3
3	Scott connection of transformers	Classes: 3
4	No-load & Blocked rotor tests on three phase Induction motor	Classes: 3
5	Regulation of a three –phase alternator by synchronous impedance &m.m.f. methods	Classes: 3
6	Heat run test on single phase transformers	Classes: 3
7	Equivalent Circuit of a single phase induction motor	Classes: 3
8	Determination of Xd and Xq of a salient pole synchronous machine	Classes: 3
9	Parallel operation of Single phase Transformers	Classes: 3
10	Separation of core losses of a single phase transformer	Classes: 3
11	Polarity test on Transformer.	Classes: 3

OUTCOMES:

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

1. Understand the concept of rotating magnetic field in an Induction motor.

2. Able to demonstrate why the rotor rotates in the direction of magnetic field and cannot catch the speed of Synchronous speed

3. Understand how the winding are wound in an Alternator.

4. Able to explain what are harmonics and methods to reduce the harmonics

5. Explain the concept of Pitch factor and distribution factor

Text Books:

1. ELECTRICAL MACHINES –P.S.BIMBHRA

Reference Books:

1. ELECTRICAL TECHNOLOGY – V.K.MEHTA

Web References:

- www.pa.msu.edu
- www.tutorvista.com
- www.globalspec.com

E Text Book -

- http://www.cl.cam.ac.uk/teaching/1011/SysOnChip/socdam-notes1011.pdf
- https://www.doc.ic.ac.uk/~wl/teachlocal/cuscomp/notes/cc11.pdf

MOOC Course:

- https://onlinecourses.nptel.ac.in/noc18_ee33/preview
- https://onlinecourses.nptel.ac.in/noc18_ee34/preview

ELECTRICAL MEASUREMENTS AND INSTRUMENTATION LAB

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A4EE12	PCC	0	0	3	1.5	30	70	100

COURSE OBJECTIVES:

The course should enable the students to:

1. Understand various measurement techniques used in electrical engineering.

2. Analyze waveforms using LabVIEW to measure various parameters.

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

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

1	Calibration and Testing of single phase energy Meter.	Classes: 3
2	Calibration of dynamometer power factor meter.	Classes: 3
3	Crompton D.C. Potentiometer – Calibration of PMMC ammeter and PMMC voltmeter.	Classes: 3
4	Kelvin‘s double Bridge – Measurement of resistance – Determination of Tolerance.	Classes: 3
5	Dielectric oil testing using H.T. testing Kit.	Classes: 3
6	Schering bridge& Anderson bridge.	Classes: 3
7	Measurement of 3 – Phase reactive power with single-phase wattmeter.	Classes: 3
8	Measurement of parameters of a choke coil using 3 – voltmeter and 3 – ammeter methods	Classes: 3
9	Calibration LPF wattmeter – by Phantom testing.	Classes: 3
10	Measurement of 3-phase power with single watt meter	Classes: 3
11	Resistance strain gauge – strain measurements and Calibration.	Classes: 3
12	Transformer turns ratio measurement using AC bridges. &LVDT Trainer kit	Classes: 3

OUTCOMES:

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

1. Understand the basic definition of electrical instruments.

2. Be able to calculate the value of error in an instrument and measure the accuracy.

3. Be able to find the value of unknown resistance by using bridge circuits.

4. Explain how to measure the power in a three phase circuit.

5. Understand the working of energy meter and calculate the energy consumed

Text Books:

1. ELECTRICAL & ELECTRONICS INSTRUMENTATION – A.K .SAWHANI

Reference Books:

1. ELECTRICAL & ELECTRONICS INSTRUMENTATION – KALSI

Web References:

www.pa.msu.edu
www.tutorvista.com
www.globalspec.com
www.tutorvista.com
www.globalspec.com

E Text Book -

http://www.cl.cam.ac.uk/teaching/1011/SysOnChip/socdam-notes1011.pdf
https://www.doc.ic.ac.uk/~wl/teachlocal/cuscomp/notes/cc11.pdf
https://www.cs.ccu.edu.tw/~chen/arch/SOC-design.pdf

MOOC Course:

https://onlinecourses.nptel.ac.in/noc18_ee33/preview
https://onlinecourses.nptel.ac.in/noc18_ee34/preview

ENVIRONMENTAL STUDIES

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A4MC01	MC	2	0	0	-	30	70	100

OBJECTIVES:

The course should enable the students to:

1. Determine the Natural resources on which the structure of development is raised for sustainability of the society through equitable maintenance of natural resources.
2. Illustrate about biodiversity that raises an appreciation and deeper understanding of species, ecosystems and also the interconnectedness of the living world and thereby avoids the mismanagement, misuse and destruction of biodiversity.
3. Summarize a methodology for identification, assessment and quantification of global environmental issues in order to create awareness about the international conventions for mitigating global environmental problems.
4. Sustainable development that aims to meet raising human needs of the present and future generations through preserving the environment.
5. Outline green environmental issue provides an opportunity to overcome the current global environmental issues by implementing modern techniques like CDM, green building, green computing etc.

UNIT-I ECOSYSTEMS **Classes: 12**

Ecosystems: 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, Bioaccumulation, Bio magnification, ecosystem value, services and carrying capacity.

UNIT-II NATURAL RESOURCES & MINERAL RESOURCES **Classes: 12**

Natural Resources: Classification of Resources: Living and Non-Living resources, water resources: use and over utilization of surface and ground water, floods and droughts, Dams: benefits and problems. Mineral resources: use and exploitation, environmental effects of extracting and using mineral resources, Land resources: Forest resources, Energy resources: growing energy needs, renewable and non renewable energy sources, use of alternate energy source, case studies.

UNIT-III BIODIVERSITY AND BIOTIC RESOURCES **Classes: 15**

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, man-wildlife conflicts; conservation of biodiversity: In-Situ and Exsitu conservation. National Biodiversity act.

UNIT-IV ENVIRONMENTAL POLLUTION AND CONTROL TECHNOLOGIES **Classes: 15**

Environmental Pollution and Control Technologies: Environmental Pollution: Classification of pollution, Air Pollution: Primary and secondary pollutants, Automobile and Industrial pollution, Ambient air quality standards. Water pollution: Sources and types of pollution, drinking water quality standards. Soil Pollution: Sources and types, Impacts of modern agriculture,. Noise Pollution: Sources and Health hazards, standards, Solid waste:

Municipal Solid Waste management, composition and characteristics of e-Waste and its management. Pollution control technologies: Wastewater Treatment methods: Primary, secondary and Tertiary. Overview of air pollution control technologies, Concepts of bioremediation. Global Environmental Problems and Global Efforts: Climate change and impacts on human environment. Ozone depletion and Ozone depleting substances (ODS).. International conventions / Protocols: Earth summit, Kyoto protocol and Montréal Protocol.

UNIT-V ENVIRONMENTAL POLICY, LEGISLATION & EIA Classes: 11

Environmental Policy, Legislation & EIA: Environmental Protection act, Legal aspects Air Act1981, WaterAct, Forest Act, Wild life Act, Municipal solid waste management and handling rules, biomedical waste management and handling rules, hazardous waste management and handling rules. EIA: EIA structure, methods of baseline data acquisition. Overview on Impacts of air, water, biological and Socio-economical aspects. Strategies for risk assessment, Towards Sustainable Future: Concept of Sustainable Development, Population and its explosion, Crazy Consumerism, Environmental Education, Urban Sprawl, Concept of Green Building, Ecological Foot Print, Life Cycle assessment (LCA), Low carbon life style.

Text Books:

1. Textbook of Environmental Studies for Undergraduate Courses by Erach Bharucha for University Grants Commission.
2. Environmental Studies by R. Rajagopalan, Oxford University Press.

Reference Books:

1. Environmental Science: towards a sustainable future by Richard T.Wright. 2008 PHL Learning Private Ltd. New Delhi.
2. Environmental Engineering and science by Gilbert M.Masters and Wendell P. Ela .2008 PHI Learning Pvt. Ltd.
3. Environmental Science by Daniel B. Botkin & Edward A.Keller, Wiley INDIA edition.
4. Environmental Studies by Anubha Kaushik, 4th Edition, New age international publishers. Text book of Environmental Science and Technology - Dr. M. Anji Reddy 2007, BS Publications

Web References:

1. https://www.youtube.com/watch?v=M0mx8S05v60&list=PLBlnK6fEyqRjMH3mWf6kwqiTbT798eAOm
2. https://www.youtube.com/watch?v=CeD2L6KbtVM&list=PL018B3BB2E6FE781D
3. https://www.youtube.com/watch?v=CeD2L6KbtVM&list=PL803563859BF7ED8C

E-Text Books:

http://www.cl.cam.ac.uk/teaching/1011/SysOnChip/socdam-notes1011.pdf
https://www.doc.ic.ac.uk/~wl/teachlocal/cuscomp/notes/cc11.pdf

MOOC Course

https://onlinecourses.nptel.ac.in/noc18_ee33/preview
https://onlinecourses.nptel.ac.in/noc18_ee34/preview

III B.Tech-I SEMESTER

SYLLABUS

POWER ELECTRONICS

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A4EE13	PCC	3	0	0	3	30	70	100

COURSE OVERVIEW:
The application of electronics to energy conversion and control. Topics covered include: modeling, analysis, and control techniques; design of power circuits including inverters, rectifiers, and DC-DC converters; analysis and design of magnetic components and filters; and characteristics of power semiconductor devices. Numerous application examples will be presented such as motion control systems, power supplies, and radio-frequency power amplifiers.

PREREQUISITE(S): Basic knowledge on Electronic Devices, Control systems

COURSE OBJECTIVES:
The course should enable the students to:

I. Integrate the revolutionary development in power transmission, distribution and utilization with the Advent of semiconductor devices.
II. Demonstrate rectifiers, choppers and various schemes of pulse width modulated inverters.
III. Explain AC voltage converters and cyclo-converters.
IV. Outline complete range of power supplies, including switched mode and uninterruptible power supplies.

Course Outcomes:
1. Articulate the basics of power electronic devices

2. Express the design and control of rectifiers, inverters.

3. Design of power electronic converters in power control applications

4. Ability to express characteristics of SCR, BJT, MOSFET and IGBT.

5. Ability to express communication methods.

6. Ability design AC voltage controller and Cyclo Converter.

7. Ability to design Chopper circuits.

SYLLABUS

UNIT – I POWER SEMICONDUCTOR DEVICES AND COMMUTATION CIRCUITS Power semiconductor devices and commutation circuits: Thyristors, principle of operation of silicon controlled rectifiers (SCR), bipolar junction transistor (BJT), power metal oxide semiconductor filed effect transistor (MOSFET), power insulated gate bipolar transistor (IGBT), gate turnoff thyristor (GTO) and characteristics, turn on and turnoff methods, dynamic characteristics of SCR, two transistor analogy, uni-junction transistor firing circuit, series and parallel operation of SCR‟s, design of snubber circuit; Specifications and ratings: Ratings of SCR, BJT and IGBT, line commutation and forced commutation circuits, numerical problems.

UNIT – II SINGLE PHASE AND THREE PHASE CONTROLLED RECTIFIER AC - DC converters: Phase control technique, single phase line commutated converters, midpoint and bridge connections, half controlled converters and semi converters with R, RL and RLE loads, derivation of average load voltage and current, active and reactive power inputs to the converters without and with freewheeling diode, numerical problems; Fully controlled converters: Midpoint and bridge connections with R, RL loads and RLE load, derivation of average load voltage and current, line commutated inverters, active and reactive power inputs to the converters without and with freewheeling diode, derivation of load voltage and current, numerical problems; Three phase converters: Three pulse and six pulse converters, midpoint and bridge connections, average load voltage with R and RL loads, effect of source inductance, operation of single phase and three phase dual converters, numerical problems.

UNIT – III AC VOLTAGE CONTROLLERS AND CYCLOCONVERTERS AC - AC controllers: Introduction, single phase two SCR"s in anti-parallel, with R and RL loads, modes of operation of TRIAC, TRIAC with R and RL loads, derivation of RMS load voltage, current and power factor, wave forms, numerical problems;

Cyclo converters: Principle of operation of single phase midpoint and bridge type cyclo converters with resistive and inductive loads, continuous and discontinuous mode of operation.

UNIT-IV DC-DC CONVERTERS Principle of operation of choppers, time ratio control and current limit control strategies, types of choppers, derivation of load voltage and currents with R, RL and RLE loads, AC chopper, problems; Switched mode regulators: Study of buck, boost and buck - boost regulators, Cuk regulators.

UNIT – V INVERTERS DC - AC converters: Single phase inverter, basic series inverter, parallel inverter, operation and waveforms, voltage source inverter (VSI), three phase inverters 180, 120 degrees conduction modes of operation, voltage control techniques for inverters, pulse width modulation techniques, reduction of harmonics, current source inverter (CSI) with ideal switches, capacitor commutated type CSI, numerical problems.

TEXT BOOKS:

1. M D Singh, K B Kanchandhani, "Power Electronics", Tata Mc Graw Hill Publishing Company, 2nd Edition, 1998.
2. Dr. P S Bimbhra, "Power Electronics", Khanna Publishers, 5th Edition, 2012.
3. Ned Mohan, Tore M Undeland, William P Robbins, "Power Electronics: Converters, Applications, and Design", 3rd Edition, John Wiley and sons, 2002.
4. M H Rashid, "Power Electronics, Circuits, Devices and Applications", Pearson, 3rd Edition, 2001.

REFERENCE BOOKS:

1. Vedam Subramanyam, "Power Electronics", New Age International Limited, 2nd Edition, 2006.
2. P C Sen, "Power Electronics", Tata McGraw-Hill Publishing, 1st Edition, 1987.
3. G K Dubey, S R Doradra, A Joshi, R M K Sinha, "Thyristorised Power Controllers", New Age

International Limited, 2nd Edition, 2008.

4. V R Moorthi, "Power Electronics Devices", Oxford University Press, 4th Edition, 2005.

WEB REFERENCES:

1. https://www.nptel.iitm.ac.in

2. 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

SIGNALS AND SYSTEMS

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A4EC05	PCC	3	0	0	3	30	70	100

OBJECTIVES:

The course should enable the students to:

1. Analyze the different types of signals and systems
2. Represent continuous and discrete systems in time and frequency domain using different transforms
3. Investigate whether the system is stable
4. Sampling and reconstruction of a signal
5. Apply various transforms and its properties to analyze the CT and DT signals and systems
6. Characterize LTI systems in the Time domain and various Transform domains

UNIT-I INTRODUCTION TO SIGNALS AND SYSTEMS Classes: 10

Signals:

Continuous and discrete time signals- representations of continuous, discrete and digital signals- Classifications of Signals based on properties - Energy and power signals, Even and Odd- Periodic and non-periodic-Causal Non causal-Deterministic and non deterministic-Elementary signals-unit step- unit ramp-unit impulse-sinusoidal-signum and sinc signals -Basic operations on signals with examples.

Systems:

Continuous and discrete time Systems - representations of continuous and discrete time systems- Classifications of Systems based on properties - linearity- additivity –homogeneity- shift-invariance- causality- stability- realizability- static and dynamic - Relation between continuous and discrete time systems.

UNIT-II ANALYSIS OF CONTINUOUS TIME SIGNALS Classes: 10

Fourier series analysis- Properties - spectrum of Continuous Time signals- Fourier and Laplace Transforms in CT Signal Analysis – and its Properties-Solve differential equations –system function- impulse response and step response

UNIT-III CONVOLUTION AND CORRELATION Classes: 10

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, Energy density spectrum, Parseval‘s Theorem, Power density spectrum, Relation between Auto Correlation function and Energy/Power spectral density function, Relation between Convolution and Correlation, Detection of periodic signals in the presence of Noise by Correlation, Extraction of signal from noise by filtering.

UNIT-IV SAMPLING AND ANALYSIS OF DISCRETE TIME SIGNALS Classes: 10

Sampling:

Levels of sampling - Sampling Theorem - its implications- sampling and hold circuit operations-Spectra of sampled signals-. Reconstruction of signal- ideal interpolator, zero-order hold, and first-order hold - Aliasing and its effects

DTFT:

Properties of DTFT- IDTFT - Z Transform – Properties of Z Transform -different types of IZT- Z-Transform for discrete time signals and systems- eigen functions- region of convergence and its properties- z-domain analysis- System representation through differential equations and difference equations.

UNIT-V LTI- DT SYSTEMS AND STATE-SPACE ANALYSIS Classes:10

Solving Difference Equations and find – system function- impulse response- step response-poles and zeros-stability-Block diagram representation- Convolution sum- DTFT and Z Transform Analysis of Recursive & Non-Recursive systems

State-space analysis - multi-input and a multi-output representation- The state transition matrix

Text Books:

1. A.V. Oppenheim, A.S. Willsky and I.T. Young, "Signals and Systems", Prentice Hall, 1983.
2. R.F. Ziemer, W.H. Tranter and D.R. Fannin, "Signals and Systems - Continuous and Discrete", 4th edition, Prentice Hall, 1998.

Reference Books:

1. Papoulis, "Circuits and Systems: A Modern Approach", HRW, 1980.
2. B.P. Lathi, "Signal Processing and Linear Systems", Oxford University Press, c1998.
3. Douglas K. Lindner, "Introduction to Signals and Systems", McGraw Hill International Edition: c1999.
4. Simon Haykin, Barry van Veen, "Signals and Systems", John Wiley and Sons (Asia) Private Limited, c1998.
5. Robert A. Gabel, Richard A. Roberts, "Signals and Linear Systems", John Wiley and Sons, 1995.
6. M. J. Roberts, "Signals and Systems - Analysis using Transform methods and MATLAB", TMH, 2003
7. J. Nagrath, S. N. Sharan, R. Ranjan, S. Kumar, "Signals and Systems", TMH New Delhi, 2001.
8. Ashok Ambardar,"Analog and Digital Signal Processing", 2nd Edition, Brooks/ Cole Publishing Company (An international Thomson Publishing Company), 1999.

Web References:

1. https://www.khanacademy.org/science/electrical-engineering/ee-signals/ee-fourier-series/v/ee-fourier-series-intro
2. https://www.khanacademy.org/science/electrical-engineering/ee-signals
3. https://www.edx.org/course/signals-systems-part-2-iitbombayx-ee210-2x-3
4. https://www.edx.org/course/signals-and-systems-part-1-1

E-Text Books:

1. http://www.freebookcentre.net/Mathematics/Fourier-Analysis-Books.html
2. http://www.freebookcentre.net/Mathematics/Differential-Equations-Books_1.html
3. http://www.freebookcentre.net/electronics/communications-systems-books.html

MOOC Course

1. http://nptel.ac.in/courses/117101055/
2. https://ocw.mit.edu/resources/res-6-007-signals-and-systems-spring-2011/lecture-notes/

MICROPROCESSORS AND MICROCONTROLLERS

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A4EC17	PCC	3	0	0	3	30	70	100

COURSE OVERVIEW:

Understand the basic 8, 16 bit microprocessor architecture and its functionalities and programming model of microprocessor. To develop the microprocessor based programs for various applications.To make the interfacing in between microprocessor and various peripherals. To develop DOS/BIOS programs. To develop the micro controller based programs for various applications. To enable the students to understand basic feature of 8051 and AVR controller.

PREREQUISITE(S): Introduction to architecture, operation, and application of Microprocessors.

COURSE OBJECTIVES:

1. To develop an in-depth understanding of the operation of microprocessors
2. To master the assembly language programming using concepts like assembler directives, Procedures, macros, software interrupts etc.
3. To create an exposure to basic peripherals, its programming and interfacing techniques
4. To understand the concept of Interrupts and interfacing details of 8086
5. To impart the basic concepts of serial communication in 8086

COURSE OUTCOMES:

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

1. Understand the internal organization and different modes of operation of popular 8086 microprocessors / 8051 microcontrollers.
2. Understand the importance of addressing modes and the instruction set of the processor / controller which is used for programming the processor and controller. Use design tools for microprocessor system design, test and evaluation.
3. Understand I/O operation with 8086 and software interaction and integration.
4. Understand the memory organization and interrupts of processors/ micro-controllers helps in various system designing aspects.

5. Design and conduct experiments related to microprocessor/microcontroller based system design.

SYLLABUS

Unit-I 8086 architecture: **Classes: 10**

8086 architecture- functional diagram, Register organization, memory segmentation, programming model, Memory addresses, physical memory organization, Signal descriptions of 8086-common function signals, timing diagrams.

UNIT-II Instruction set and assembly language programming of 8086: **Classes: 10**

Instruction formats. Addressing modes, instruction set, assembler directives. Macros, Simple programs involving logical, branch and call instructions. Sorting, evaluating arithmetic expressions, string manipulations.

UNIT-III I/O Interface: **Classes: 10**

8255 PPI, various modes of operation and interfacing to 8086, interfacing of key board, display. Stepper motor interfacing, D/A &A/D converter.

Interfacing With advanced devices: Memory interfacing to 8086, Interrupts of 8086, Vector interrupt table, Interrupt service routine, Serial communication standards, serial data transfer schemes, 8251 USART architecture and Interfacing.

UNIT-IV **Classes: 10**

Introduction to microcontrollers: overview of 8051 microcontroller, Architecture, I/O ports, Memory organization, addressing modes and instruction set of 8051, Simple programs.

UNIT-V **Classes: 10**

8051 Real Time Control: Programming Timer interrupts, programming external hardware interrupts, Programming the serial communication interrupts, Programming 8051 timers and counters.

TEXT BOOKS:

1.D.V.Hall, Microprocessors and Interfacing. TMGH, 2nd edition 2006. 2.Kenneth.J.Ayala.

2.The 8051 microcontroller, 3rd edition, Cengage learning,2010

3.Advanced microprocessors and peripherals-A.K ray and K.M.Bhurchandani, TMH, 2nd edition 2006.

.**REFERENCES:**

1. The 8051 microcontrollers, architecture and programming and applications-K.Uma Rao,

AndhePallavi., Pearson, 2009.

2. Micro computer system 8086/8088 family architecture, programming and design- By Liu and GA

Gibson, PHI, 2nd Ed.,

3. Microcontrollers and application, Ajay.V.Deshmukh,TMGH,2005

4. The 8085 microprocessor: Architecture, programming and interfacing- K.Uday Kumar, B.S.Umashankar, 2008, Pearson

5. Microprocessors and microcontrollers- S.V.Altaf

CONTROL SYSTEMS LAB

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A4EE14	PCC	0	0	3	1.5	30	70	100

COURSE OVERVIEW:

This course focuses on the analysis and design of systems control. This course will introduce time-domain systems dynamic control fundamentals and their designissuesforelectricalengineeringapplications.Emphasiswillbeonlinear timeinvariant,multi-input multioutputcontinuous time systems. Topics include open and closed-loop state-space representations, analytical solutions, computer simulations, stability, controllability, observability, and controller/observer design.

PRE-REQUISITE:

A strong background in linear algebra and differential equations is not required but is highly recommended. The MATLAB/SIMULINK computer software package will be used extensively to assist in the understanding of concepts and fundamentals of system dynamics and control, and also to analyze and design control systems

COURSE OBJECTIVES:

1. Understand mathematical models of electrical and mechanical systems.
2. Analysis of control system stability using digital simulation.
3. Demonstrate the time domain and frequency domain analysis for linear time invariant systems.
4. Apply programmable logic controllers to demonstrate industrial controls in the laboratory

COURSE OUTCOMES:

1. Understand the basic definition of control systems.
2. Explain the concept of Serve mechanism and different translational and rotational motions.
3. Understand the concept of order of a system and finding the response.
4. Able to find the steady state and transient state response of first and second order systems.
5. Explain the concept of relative stability and root locus, Nyquist plots.

LIST OF EXPERIMENTS

Any Eight of the following experiments are to be conducted

1. Time response of Second order system
2. Characteristics of Synchro's
3. Programmable logic controller – Study and verification of truth tables of logic gates, simple Boolean expressions and application of speed control of motor.
4. Effect of feedback on DC servo motor
5. Transfer function of DC motor
6. Effect of P, PD, PI, PID Controller on a second order systems

7. Lag and lead compensation – Magnitude and phase plot
8. Transfer function of DC generator
9. Temperature controller using PID
10. Characteristics of magnetic amplifiers
11. Characteristics of AC servo motor

Any two simulation experiments are to be conducted using software tools

1. Simulation of Op-Amp based Integrator and Differentiator circuits.

2. Linear system analysis (Time domain analysis, Error analysis).

3. Stability analysis (Bode, Root Locus, Nyquist) of Linear Time Invariant system.

4. State space model for classical transfer function– Verification.

POWER ELECTRONICS LAB

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A4EE15	PCC	0	0	2	1	30	70	100

COURSE OVERVIEW:

Understand and learn the characteristics of power electronics devices and control methods of rectifiers and choppers To learn different gating circuits for thyristor turn-on. To learn the operation of ac voltage controllers and inverters. To learn the simulation of power electronics circuits. To understand the concepts of different loads

PREREQUISITE(S): Knowledge on Power Electronics subject

COURSE 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.

COURSE OUTCOMES:

The student will be able to

1. Design a Commutation circuit of a thyristor.

2. Control a supply voltage using converters.

3. Select a suitable power electronic device for different applications.

4. Use PSPICE software for determining the performance of given power electronic converters.

LIST OF EXPERIMENTS

Expt. 1 SCR, MOSFET AND IGBT

Study the characteristics of SCR, MOSFET and IGBT.

Expt. 2 GATE FIRING CIRCUITS

Gate firing circuits of SCR.

Expt. 3 HALF CONTROLLED CONVERTER

Single phase half controlled converter with R and RL loads

Expt. 4 FORCED COMMUTATION CIRCUITS

Forced commutation circuits (Class A, Class B, Class C, Class D and Class E).

Expt. 5 FULLY CONTROLLED BRIDGE CONVERTER

Single phase fully controlled bridge converter with R and RL loads.

Expt. 6 SERIES INVERTER

Single phase series inverter with different loads

Expt. 7 PARALLEL INVERTER

Single phase parallel inverter with different loads.

Expt. 8 VOLTAGE CONTROLLER

Single phase AC voltage controller with R and RL loads

Expt. 9 DUAL CONVERTER

Single phase dual converter with R and RL loads

Expt. 10 CYCLOCONVERTER

Single phase cyclo converters with R and RL loads

In addition to the above ten experiments ,at least any two of the experiments form the following list are required to be conducted

Expt. 11 THREE PHASE CONVERTERS

Three phase half converter with R and RL loads.

Expt. 12 MOSFET BASED CHOPPERS

Operation of step down chopper using MOSFET.

Expt. 13 SIMULATION OF THREE PHASE FULL CONVERTER

Simulation of three phase full converter and PWM inverter with R and RL loads by using MATLAB

Expt. 14 SIMULATION OF BUCK – BOOST CHOPPER

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. Dr. 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

MICROPROCESSORS AND MICROCONTROLLERS LAB

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A4EC19	PCC	0	0	3	1.5	30	70	100

COURSE OVERVIEW:

Familiarize the architecture of 8086 processor, assembling language programming and interfacing with various UNITs. The student can also understand of 8051 Microcontroller concepts, architecture, programming and application of Microcontrollers. Student able to do any type of embedded systems, industrial and real time applications by knowing the concepts of Microprocessor and Microcontrollers.

PREREQUISITE(S): Basic knowledge on programming in 'C', Microprocessors instructions

COURSE OBJECTIVES:

1. Devices and circuits to microprocessors and microcontrollers.

2. Design and develop both the hardware and software for microprocessor /microcontroller based systems.

3.To provide practical introduction to microcontrollers and microprocessors, assembly language programming techniques and interfacing Connect peripheral Interpret specifications for any microprocessor or peripheral chip

COURSE OUTCOMES:

After going through this course the student will be able to

A) Develop the basic skills on hardware and software/programming of microprocessor

B) Enhance assembly language programming skills for simple and complex calculations used in various engineering disciplines

C) Capable to innovative and design intelligent systems, called embedded systems, using microprocessor for special purpose.

D) Involve in verification of functionality, speed and power of microprocessor based system

LIST OF EXPERIMENTS

I. MICROPROCESSOR 8086:

1) Programs involving data Transfer Instruction
   Byte and word transfer in different addressing modes
   Block move Without overlapping
   Block move With overlapping
   Block interchanging

2) Programs involving arithmetic and logical operations like addition and subtraction of multi precision numbers

Addition and Subtraction of Multi precision numbers
Multiplication and division of signed and unsigned Hexadecimal numbers
ASCII adjustment instruction
Code Conversion

Arithmetic program to find square ,cube ,LCM ,GCD and factorial

3) Programs involving bit manipulation instructions like checking

If given data is positive or negative
If given data is odd or even
Logical ones and zeros in a given data
2 out of 5 code Bit wise palindrome

Nibble wise palindrome

4) Programs involving Branch / Loop instructions like :

5) Programs on arrays: addition/subtraction of N nos., finding largest/smallest no., Ascending

/descending order, etc. Near and Far Conditional and Unconditional jumps, Call and Returns

6) Programs on String Manipulations like string transfer, string reversing, searching for a character in a string, palindrome etc

7) Programs involving on Software Interrupts

8) Programs to use DOS interrupt INT 21H Function calls:

Reading a Character from Keyboard, Buffer Keyboard input .Display of characters/String on console

Creation of a new file, read/write from a file,

Read system date, set system date, read system time, set system time

II. INTERFACING WITH 8086:

1) Experiments on interfacing 8086 with the following UNITs through 8255 PPI / 8257 DMA / 8259

PIC
A/D and D/A converters

Matrix keyboard interface

Seven segment display interface

Stepper motor interface

Traffic signals by interfacing traffic controller to 8086

Programming of Microcontroller 8051

2) Execute the Program for Arithmetic and logical instructions
3) Execute the Program to verify timers/counters.
4) Develop and execute the program to interface stepper motor to the8051 Microcontroller.
5) Develop and execute the program to interface LCD to 8051.
6) Develop and execute the program to interface Keyboard to 8051

III YEAR II SEMESTER SYLLABUS

POWER SYSTEMS-II

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A4EE17	PCC	3	0	0	3	30	70	100

Course Objectives:

- To examine the power analysis.
- To understand swing equations `.
- To illustrate the economic aspects of power generation and tariff methods.

PRE-REQUISITE: Power systems -I

Course Outcomes: At the end of this course, students will demonstrate the ability to Use numerical methods to analyse a power system in steady state

- Understand stability constraints in a synchronous grid.
- Understand methods to control the voltage, frequency and power flow.
- Understand the monitoring and control of a power system.
- Understand the basics of power system economics.

SYLLABUS

UNIT -1: Power Flow Analysis : **Classes: 10**

Review of the structure of a Power System and its components. Analysis of Power Flows: Formation of Bus Admittance Matrix. Real and reactive power balance equations at a node. Load and Generator Specifications. Application of numerical methods for solution of nonlinear algebraic equations – Gauss Seidel and Newton-Raphson methods for the solution of the power flow equations. Computational Issues in Large-scale Power Systems.

UNIT-II: Stability Constraints in synchronous grids: **Classes: 10**

Swing Equations of a synchronous machine connected to an infinite bus. Power angle curve. Description of the phenomena of loss of synchronism in a single-machine infinite bus system following a disturbance like a three--phase fault. Analysis using numerical integration of swing equations (using methods like Forward Euler, Runge-Kutta 4th order methods), as well as the Equal Area Criterion. Impact of stability constraints on Power System Operation. Effect of generation rescheduling and series compensation of transmission lines on stability.

UNIT -III: Control of Frequency and Voltage: **Classes: 10**

Turbines and Speed-Governors, Frequency dependence of loads, Droop Control and Power Sharing. Automatic Generation Control. Generation and absorption of reactive power by various components of a Power System. Excitation System Control in synchronous generators, Automatic Voltage Regulators. Shunt Compensators, Static VAR compensators and STATCOMs. Tap Changing Transformers. Power flow control using embedded dc links, phase shifters

UNIT-IV: Monitoring and Control Overview of Energy Control Centre Functions: **Classes: 10**

SCADA systems. Phasor Measurement Units and Wide-Area Measurement Systems. State-estimation. System Security Assessment. Normal, Alert, Emergency, Extremis states of a Power System. Contingency Analysis. Preventive Control and Emergency Control.

UNIT –V Power System Economics and Management : **Classes: 10**

Basic Pricing Principles: Generator Cost Curves, Utility Functions, Power Exchanges, Spot Pricing. Electricity Market Models (Vertically Integrated, Purchasing Agency, Whole-sale competition, Retail Competition), Demand Side-management, Transmission and Distributions charges, Ancillary Services. Regulatory framework. AICTE

Text/References:

1. J. Grainger and W. D. Stevenson, "Power System Analysis", McGraw Hill Education, 1994.

2. O. I. Elgerd, "Electric Energy Systems Theory", McGraw Hill Education, 1995.

3. A. R. Bergen and V. Vittal, "Power System Analysis", Pearson Education Inc., 1999.

4. D. P. Kothari and I. J. Nagrath, "Modern Power System Analysis", McGraw Hill Education, 2003.

5. B. M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G. Strbac, "Electric Power Systems", Wiley, 2012.

ELECTRICAL DRIVES AND CONTROL

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A4EE18	PCC	3	0	0	3	30	70	100

COURSE OVERVIEW:

Characteristics, fabrication, and application of power semiconductor devices, which may include p-i-n and Schottky diodes, insulated gate bipolar transistors, field effect transistors, and thyristors. Effect of semiconductor material, device structure, and current injection levels on device performance. Device drive requirements and power circuit interaction. Implementation of power devices using wide band gap semiconductors such as silicon carbide and gallium nitride

PRE-REQUISITIES:

Knowledge of semiconductor materials, gained from the graduate course on semiconductor material and to identify the properties needed for use in high electric fields and high currents and to understand why certain materials are used when fabricating power semiconductor devices

COURSE OBJECTIVES:

To understand and analyze various powers Semi Conductor drives methods.

COURSE OUTCOMES:
After going through this course the student will be able to

To understand and analyze various powers Semi Conductor drives methods.

SYLLABUS

UNIT – I CONTROL OF DC MOTORS BY PHASE CONTROLLED CONVERTERS: Classes: 10

Introduction to Thyristor controlled Drives, Single Phase semi and Fully controlled converters connected to D.C separately excited and D.C series motors, continuous current operation, output voltage and current waveforms. Speed and Torque expressions, Speed – Torque Characteristics. Three phase semi and fully controlled converters connected to D.C separately excited and D.C series motors, output voltage and current waveforms. Speed and Torque expressions, Speed–Torque characteristics.

UNIT – II FOUR QUADRANT OPERATION OF DC DRIVES: Classes: 10

Introduction to Four quadrant operation – Motoring operations, Electric Braking – Plugging, Dynamic and Regenerative Braking operations. Four quadrant operation of D.C motors by dual converters – Closed loop operation of DC motor (Block Diagram Only)

CONTROL OF DC MOTORS BY CHOPPERS: Classes: 10

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 D.C Motors, Closed Loop operation (Block Diagram Only)

UNIT – III CONTROL OF INDUCTION MOTOR OF STATOR SIDE: **Classes: 10**

Variable voltage characteristics, Control of Induction Motor by Ac Voltage Controllers, Waveforms, speed torque characteristics.

STATOR FREQUENCY CONTROL:

Variable frequency characteristics, Variable frequency control of induction motor by Voltage source and current source inverter and cyclo converters. PWM control, Comparison of VSI and CSI operations, Speed torque characteristics, numerical problems on induction motor drives, closed loop operation of induction motor drives (Block Diagram Only).

UNIT – IV CONTROL OF INDUCTION MOTOR OF ROTOR SIDE: **Classes: 10**

Static rotor resistance control, Slip power recovery, Static Scherbius drive, Static Kramer Drive, their performance and speed torque characteristics, advantages applications.

UNIT – V CONTROL OF SYNCHRONOUS MOTORS: **Classes: 10**

Separate control & self control of synchronous motors. Operation of self controlled synchronous motors by VSI and CSI cyclo converters. Load commutated CSI fed Synchronous Motor, Operation, Waveforms, speed torque characteristics, Applications, Advantages. Closed Loop control operation of synchronous motor drives (Block Diagram Only), variable frequency control, Cycloconverter, PWM, VFI, CSI

TEXT BOOKS:

1. G. K. Dubey (2002), Fundamentals of Electric Drives, 2nd edition, Narosa Publications, New Delhi.

2. M. H. Rashid (2003), Power Electronic Circuits, Devices and applications, 3rd edition, Prentice Hall of India, New Delhi, India.

REFERENCE BOOKS:

1. M. D. Singh, K. B. Khanchandani (2008), Power Electronics, 2nd Edition, Tata McGraw Hill Publications, New Delhi.

2. Vedam Subramanyam (2008), Thyristor Control of Electric drives, 1st Edition, Tata McGraw Hill Publications, New Delhi, India.

3. S. K. Pillai (2007), A First course on Electrical Drives, 2nd Edition, New Age International (P) Ltd.,NewDelhi

POWER QUALITY

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A4EE19	PCC	3	0	0	3	30	70	100

COURSE OVER VIEW: 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 CBEMA curve, PSCAD AND EMTP – International standards – IEEE and IEC standards

PRE-REQUISITIES: POWER SYSTEMS- LOAD FLOW ANALYSIS

COURSE OBJECTIVE: To understand and analyze various powers disturbances .

COURSE OUTCOMES: At the end of this course, students will

- Understand the basic concepts of power quality.
- Understand the working principles of devices to improve power quality.

SYLLABUS

UNIT-I INRODUCTION TO POWER QUALITY : **Classes: 10**

Terms and definitions :overloading –under voltage –over voltage .concept of transients –short duration variations such as interruption –long duration variations such as sustained interruption .sags and swells –voltage sag –voltage swell –voltage imbalance –voltage fluctuations –power frequency variations. International standards of power quality .computer business equipment manufacturers associations (CBEMA) Curve

UNIT-II VOLTAGE SAGS & INTERRUPTIONS: **Classes: 10**

Sources of sags and interruptions –estimating voltage sag performance .Thevinin's equivalent source –analysis and calculation of various faulted condition. Voltage sags due to induction motor starting. Estimation of the sag severity –mitigation of voltage due to sags , active series compensators .static transfer switches and fast transfer switches .

UNIT-III OVER VOLTAGES: **Classes: 10**

Sources of over voltages –capacitors switching –lightning –Ferro resonance .mitigation of voltage swells – surge arresters –low pass filters –power conditioners. Lightning protection –shielding –line arresters –protection of transformers and cables .An introduction to computer analysis tools for transients, PSCAD and EMTP.

UNIT –IV HARMONIS: **Classes: 10**

Harmonic sources from commercial and industrial loads, locating harmonic sources. Power system response characteristics –Harmonics Vs transients. Effect of harmonics –harmonic distortion- voltage and current distortion –harmonic indices –inter harmonics – resonance .harmonics distortion

evaluation –devices for controlling harmonic distortion –passive and active filters .IEEE and IEC standards.

UNIT –V POWER QUALITY MONITORING : **Classes: 10**

Monitoring considerations – monitoring and diagnostics techniques for various power quality problems –modelling of power quality (harmonic and voltage sag) problems by mathematical simulation tools –power line disturbance analyzer –quality measurement equipment –harmonic/ spectrum analyzer –flicker meters –disturbance analyzer .applications of expert systems for power quality monitoring

TEXT BOOKS:

- Roger. C. Dugan, Mark. F. McGranagham, Surya Santoso, H.Wayne Beaty, 'Electrical Power Systems Quality' McGraw Hill,2003.(For Chapters1,2,3, 4 and 5).
- Eswald.F.Fudis and M.A.S.Masoum, "Power Quality in Power System and Electrical Machines," Elseviar Academic Press, 2013.
- J. Arrillaga, N.R. Watson, S. Chen, 'Power System Quality Assessment', Wiley, 2011.

REFERENCES:

- G.T. Heydt, 'Electric Power Quality', 2nd Edition. (West Lafayette, IN, Stars in a Circle Publications, 1994). (For Chapter 1, 2, 3 and 5)
- M.H.J Bollen, 'Understanding Power Quality Problems: Voltage Sags and Interruptions', (New York: IEEE Press, 1999). (For Chapters 1, 2, 3 and 5)
- G.J.Wakileh, "Power Systems Harmonics – Fundamentals, Analysis and Filter Design," Springer 2007.
- E.Aeha and M.Madrigal, "Power System Harmonics, Computer Modelling and Analysis, " Wiley India, 2012.
- R.S.Vedam, M.S.Sarma, "Power Quality – VAR Compensation in Power Systems," CRC Press 2013.
- C. Sankaran, 'Power Quality', CRC press, Taylor & Francis group, 2002.

POWER SYSTEM LAB

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A4EE20	PCC	0	0	3	1.5	30	70	100

COURSE OVERVIEW:

1. Expose students to automated measurements of 3-phase power.
2. Learn use of open-circuit and short-circuit tests to determine transformer Characteristics
3. Determine synchronous machine characteristics, and synchronization of machine to the power line voltage and frequency.
4. Learn to design solutions for power system problems.

PREREQUISITE(S):

Basic measurement techniques, theory of transformers and synchronous machines, AC circuits analysis and basics of 3-phase power and per unit analysis.

COURSE OBJECTIVES:

The course should enable the students to:

I. Simulate transmission lines using PSCAD to analyze faults in transmission lines

II. Demonstrate load flow studies using methods.

III. Analyze transient state stability in power systems.

COURSE OUTCOMES:

Upon successful completion of this course, students will have a better understanding of the merits and demerits of critical analytical solution methods which are the basis for valid techniques in solving power system problems

LIST OF EXPERIMENTS

Expt. 1 MODELING OF SURGE ARRESTERS

Switching over voltages and modeling of surge arresters using PSCAD

Expt. 2 MODELING OF HVDC TRANSMISSION LINE

Obtaining parameters of a HVDC transmission line and modeling it in PSCAD

Expt. 3 REACTIVE POWER AND POWER FACTOR CORRECTION

Familiarization with PSCAD and Understanding of Reactive Power and Power Factor Correction in AC Circuits

Expt. 4 TRANSIENT STABILITY

Study of transient stability in a typical power system

Expt. 5 FAULT ANALYSIS

Symmetrical fault analysis of a simple ac system using PSCAD

Expt. 6 TWO AREA POWER SYSTEM

Two Area Power System – Initializing the simulation to a specific load flow.

Expt. 7 MODELING OF TWO-AREA POWER SYSTEM

Two-area system model for a transient study

Expt. 8 TRANSIENT RECOVERY VOLTAGE

Transient Recovery Voltage under fault and normal switching conditions and use of multiple run

Expt. 9 FAST FRONT STUDIES-LIGHTNING STRIKE

Study the over voltages at transformer terminals during lightning stroke.

Expt. 10 SINGLE MACHINE INFINITE BUS

Simulate one machine infinite bus to measure active and reactive powers at steady state

Expt. 11 LOAD FLOW

Initializing the machine to a load flow

Expt. 12 SIMULATIONS OF FAULTS

Analyze symmetrical faults

Expt. 13 LOAD FREQUENCY CONTROL

Determination dynamic response of the given two - area load frequency control problem

Expt. 14 FAULT ANLAYSIS

Analysis of unsymmetrical faults using PSCAD

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

WEB REFERENCES:

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

Course Home Page:

SOFTWARE& HARDWARE: Power System Computer Aided Designing (PSCAD)& 36 COMPUTERS

ADVANCED ENGLISH COMMUNICATION SKILLS LAB

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A4HS07	HSMC	-	-	3	1.5	30	70	100

The introduction of the Advanced Communication Skills Lab is considered essential at3rdyear level. At this stage, the students need to prepare themselves for their careers which may require them to listen to, read, speak and write in English both for their professional and interpersonal communication in the globalised context. The proposed course should be a laboratory course to enable students to use 'good' English and perform the following:

1. Gathering ideas and information to organize ideas relevantly and coherently.
2. Engaging in debates.
3. Participating in group discussions.
4. Facing interviews.
5. Writing project / research reports/technical reports.
6. Making oral presentations.
7. Writing formal letters.
8. Transferring information from non-verbal to verbal texts and vice-versa.
9. Taking part in social and professional communication.

COURSE OBJECTIVES:

The course should enable the students to:

1. Improve thestudents'fluencyinEnglish,throughawell-developedvocabularyandenablethemto listentoEnglishspokenatnormalconversationalspeedbyeducatedEnglish speakers and respond appropriately in different socio-cultural and professional contexts.
2. Further ,they would be required to communicate their ideas relevantly and coherently in writing.
3. To prepare all the students for their placements.

COURSE OUTCOMES:

Upon successful completion of the course, the student is able to

1. Improve thestudents'fluencyinEnglish, throughawell-developedvocabularyandenablethemto listentoEnglishspokenatnormalconversationalspeedbyeducatedEnglish speakers and respond appropriately in different socio-cultural and professional contexts.
2. Further, they would be required to communicate their ideas relevantly and coherently in writing.
3. To prepare all the students for their placements.

SYLLABUS The following course content to conduct the activities are prescribed for the Advanced Communication Skills (ACS) Lab:

1. Listening for writing short answers, identifying topic, context, function, etc.

2. Activities on Fundamentals of Inter-personal Communication and Building Vocabulary-Starting a conversation-responding appropriately and relevantly- using the right body language- Role Play indifferent situations & Discourse

Skills-using visuals-Synonyms and antonyms, word roots, one-word substitutes, prefixes and suffixes, study of word origin, business vocabulary, analogy, idioms and phrases, collocations & usage of vocabulary.

3. Activities on Reading Comprehension-General Vs Local comprehension, reading for facts, guessing meanings from context, scanning, skimming ,inferring meaning, critical reading &effective googling, understanding sentence structure/ error identification.

4. Functional/Communicative Task e.g. giving instructions, explaining a development, asking for comments, requesting information, agreeing to requests Correspondence: e.g. explaining, apologizing, reassuring, and complaining. Report: describing, summarizing. Proposal: describing summarizing, recommending, persuading. Activities on Writing Skills – Structure and presentation of different types of writing- letter writing/Resumewriting/e-correspondence/Technicalreportwriting/Portfoliowriting- planning for writing-improving one's writing.

5. Format and Focus on Conversation between the interlocutor and each candidate-Giving personal information. Talking about present circumstances, past experiences and future plans, expressing opinions, speculating etc.-A _mini presentation' by each candidate on a business theme- Organizing a larger unit of discourse-Giving information and expressing and justifying opinions-Two-way conversation between candidates followed by further prompting from the interlocutor -Expressing and justifying opinions, speculating, comparing and contrasting agreeing and disagreeing etc.

6. Activities on Presentation Skills - Oral presentations (individual and group) through JAM sessions/seminars/PPTs and written presentations through posters/projects/reports/e-mails/assignments etc.

7. Activitie son Group Discussion and Interview Skills - Dynamics of group discussion, intervention,summarizing,modulationofvoice,bodylanguage,relevance,fluencyand organization of ideas and rubrics for evaluation- Concept and process, pre-interview planning, opening strategies,answeringstrategies,interviewthroughtele-conference&video-conference and Mock Interviews.

Minimum Requirement: The Advanced Communication Skills (ACS) Laboratory shall have the following infra-structural facilities to accommodateatleast35 students in the lab:

- Spacious room with appropriate acoustics.
- Round Tables with movable chairs
- Audio-visual aids
- LCD Projector
- Public Address system
- P- IVProcessor,HardDisk-80 GB, RAM-512 MBMinimum,Speed-2.8 GHZ
- T.V, a digital stereo &Camcorder
- Headphones of High quality

Suggested Software: The software consisting of the prescribed topics elaborated above should be procured and used.

- Oxford Advanced Learner's Compass, 3rd Edition
- DELTA's key to the Next Generation TOEFL Test: Advanced Skill Practice.
- Lingua TOEFL CBT Insider, by Dreamtech
- TOEFL &GRE (KAPLAN, AARCO & BARRONS, USA, Cracking GRE by CLIFFS)
- The following software from 'train2success.com'~ Preparing for being Interviewed ~ Positive

Thinking ~ Interviewing Skills ~ Telephone Skills ~ Time Management

Books Recommended:

1. TechnicalCommunicationbyMeenakshiRaman&SangeetaSharma,OxfordUniversity Press2009.
2. AdvancedCommunicationSkillsLaboratoryManualbySudhaRani,D,Pearson Education2011.
3. Technical Communication by PaulV.Anderson.2007.CengageLearningpvt.Ltd.NewDelhi.

ELECTRIC DRIVES LAB

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A4EE25	PCC	0	0	3	1.5	30	70	100

COURSE OVERVIEW:
This course deals with control of single phase and three phase motors using electronic devices.

PRE-REQUISITIES:

Knowledge of semiconductor materials, gained from the graduate course on semiconductor material and to identify the properties needed for use in high electric fields and high currents and to understand why certain materials are used when fabricating power semiconductor devices

COURSE OBJECTIVES:

The main objective of this course is to know the students about the speed control of DC motors using Thyristors.

COURSE OUTCOMES:

The course should enable the students to:

1. To understand about Cycloconverters and its uses.

2. To apply thyristors for Different speed control methods of DC motors.

3. To design Choppers and converters.

SYLLABUS

LIST OF EXPERIMENTS

1. Speed Control of DC Motor using single phase Half Converter.

2. Speed Control of DC Motor using single phase Full Converter.

3. Speed Control of DC Motor using Three phase Half Controlled Bridge Converter

4. Speed Control of DC Motor using Chopper.

5. Study of SCR to drive small load.

6. Speed Control of single phase AC Motor using SCR.

7. Single phase cycloconverter fed AC Motor.

8. Three phase AC Induction Motor drive with VVVF control.

In addition to the above eight experiments , at least any two of the experiments from the following list are required to be conducted

9. Speed Measurement and closed loop control using PMDC Motor.

10. Thyristorised drive for PMDC motor with speed measurement and closed loop control.

11. Study of series inverter for light load

12. Speed control of PMDC motor using MOSFET based Buck Boost Converter

IV YEAR I SEMESTER
SYLLABUS

POWER SYSTEM OPERATION AND CONTROL

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A4EE22	PCC	3	0	0	3	30	70	100

COURSE OVERVIEW:

1. Expose students to automated measurements of 3-phase power.
2. Learn use of open-circuit and short-circuit tests to determine transformer Characteristics
3. Determine synchronous machine characteristics, and synchronization of machine to the power line voltage and frequency.
4. Learn to design solutions for power system problems.

PREREQUISITE(S):

POWER DISTRIBTIONS AND TRANSMISSION SYSTEMS.

COURSE OBJECTIVES:

The course should enable the students to:

- To have an overview of power system operation and control.
- To model power-frequency dynamics and to design power-frequency controller
- To model reactive power-voltage interaction and the control actions to be implemented for maintaining the voltage profile against varying system load.
- To study the economic operation of power system.
- To teach about SCADA and its application for real time operation and control of power system

COURSE OUTCOMES:

Ability to understand and analyze power system operation, stability, control and protection

SYLLABUS

UNIT- I INTRODUCTION : **Classes: 10**

An overview of power system operation and control - system load variation - load characteristics - load curves and load-duration curve - load factor - diversity factor - Importance of load forecasting and quadratic and exponential curve fitting techniques of forecasting – plant level and system level controls .

UNIT- II REAL POWER - FREQUENCY CONTROL: **Classes: 10**

Basics of speed governing mechanism and modeling - speed-load characteristics – load sharing between two synchronous machines in parallel - control area concept - LFC control of a single-area system - static and dynamic analysis of uncontrolled and controlled cases - two-area system – modeling - static analysis of uncontrolled case - tie line with frequency bias control - state variable model - integration of economic dispatch control with LFC.

UNIT III REACTIVE POWER–VOLTAGE CONTROL : **Classes: 10**

Generation and absorption of reactive power - basics of reactive power control - excitation systems – modeling - static and dynamic analysis - stability compensation - methods of voltage control: tapchanging transformer, SVC (TCR + TSC) and STATCOM – secondary voltage control.

UNIT- IV UNIT COMMITMENT AND ECONOMIC DISPATCH : **Classes: 10**

Formulation of economic dispatch problem – I/O cost characterization – incremental cost curve - coordination equations without and with loss (No derivation of loss coefficients) - solution by direct method and λ-iteration method - statement of unit commitment problem – priority-list method - forward dynamic programming.

UNIT V COMPUTER CONTROL OF POWER SYSTEMS : **Classes: 10**

Need for computer control of power systems - concept of energy control centre - functions - system monitoring - data acquisition and control - system hardware configuration – SCADA and EMS functions - network topology - state estimation – WLSE - Contingency Analysis - state transition diagram showing various state transitions and control strategies.

TEXT BOOKS:

1. Olle.I.Elgerd, 'Electric Energy Systems theory - An introduction', Tata McGraw Hill Education Pvt. Ltd., New Delhi, 34th reprint, 2010.

2. Allen. J. Wood and Bruce F. Wollenberg, 'Power Generation, Operation and Control', John Wiley & Sons, Inc., 2003.

3. Abhijit Chakrabarti, Sunita Halder, 'Power System Analysis Operation and Control', PHI learning Pvt. Ltd., New Delhi, Third Edition, 2010. www.rejinpaul.com 71

REFERENCES:

1. Nagrath I.J. and Kothari D.P., 'Modern Power System Analysis', Tata McGraw-Hill, Fourth Edition, 2011.

2. Kundur P., 'Power System Stability and Control, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 10th reprint, 2010.

3. Hadi Saadat, 'Power System Analysis', Tata McGraw Hill Education Pvt. Ltd., New Delhi, 21st reprint, 2010.

4. N.V.Ramana, "Power System Operation and Control," Pearson, 2011. 5. C.A.Gross, "Power System Analysis," Wiley India, 2011.

SWITCH GEAR AND PROTECTION

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A4EE23	PCC	3	0	0	3	30	70	100

PREREQUISITE(S):

POWER SYSTEMS

COURSE OBJECTIVES:

The course should enable the students to:

- To educate the causes of abnormal operating conditions (faults, lightning and switching surges) of the apparatus and system.
- To introduce the characteristics and functions of relays and protection schemes.
- To impart knowledge on apparatus protection
- To introduce static and numerical relays
- To impart knowledge on functioning of circuit breakers

COURSE OUTCOMES

Ability to understand and analyze power system operation, stability, control and protection.

SYLLABUS

UNIT I PROTECTION SCHEMES: **Classes: 10** \

Principles and need for protective schemes – nature and causes of faults – types of faults – fault current calculation using symmetrical components – Methods of Neutral grounding – Zones of protection and essential qualities of protection – Protection schemes

UNIT II ELECTROMAGNETIC RELAYS: **Classes: 10**

Operating principles of relays - the Universal relay – Torque equation – R-X diagram – Electromagnetic Relays – Overcurrent, Directional, Distance, Differential, Negative sequence and Under frequency relays.

UNIT III APPARATUS PROTECTION: **Classes: 10**

Current transformers and Potential transformers and their applications in protection schemes - Protection of transformer, generator, motor, busbars and transmission line.

UNIT IV STATIC RELAYS AND NUMERICAL PROTECTION: **Classes: 10**

Static relays – Phase, Amplitude Comparators – Synthesis of various relays using Static comparators – Block diagram of Numerical relays – Overcurrent protection, transformer differential protection, distant protection of transmission lines.

UNIT V CIRCUIT BREAKERS: **Classes: 10**

Physics of arcing phenomenon and arc interruption - DC and AC circuit breaking – re-striking voltage and recovery voltage - rate of rise of recovery voltage - resistance switching - current chopping - interruption of capacitive current - Types of circuit breakers – air blast, air break, oil, SF6 and vacuum circuit breakers – comparison of different circuit breakers – Rating and selection of Circuit breakers.

TEXT BOOKS:

1. Sunil S.Rao, 'Switchgear and Protection', Khanna Publishers, New Delhi, 2008.

2. B.Rabindranath and N.Chander, 'Power System Protection and Switchgear', New Age International (P) Ltd., First Edition 2011.

3. M.L.Soni, P.V.Gupta, U.S.Bhatnagar, A.Chakrabarti, 'A Text Book on Power System Engineering', Dhanpat Rai & Co.,1998.

REFERENCES:

1. Badri Ram ,B.H. Vishwakarma, 'Power System Protection and Switchgear', New Age International Pvt Ltd Publishers, Second Edition 2011.

2. Y.G.Paithankar and S.R.Bhide, 'Fundamentals of power system protection', Second Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2010.

3. C.L.Wadhwa, 'Electrical Power Systems', 6th Edition, New Age International (P) Ltd., 2010

4. Ravindra P.Singh, ' Switchgear and Power System Protection', PHI Learning Private Ltd., New Delhi, 2009.

5. Bhavesh Bhalja, R.P. Maheshwari, Nilesh G. Chotani,'Protection and Switchgear' Oxford University Press, 2011.

ELECTRICAL AND ELECTRONICS DESIGN LAB

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A4EE24	PCC	0	0	3	1.5	25	75	100

Course Objectives:

- To enhance practical knowledge related to different subjects
- To develop hardware skills such as soldering, winding etc.
- To develop debugging skills.
- To increase ability for analysis and testing of circuits.
- To give an exposure to market survey for available components
- To develop an ability for proper documentation of experimentation.
- To enhance employability of a student.
- To prepare students for working on different hardware projects.

Course Outcomes:

After completion of course, student will be able to

- Get practical knowledge related to electrical
- Fabricate basic electrical circuit elements/networks
- Trouble shoot the electrical circuits
- Design filter circuit for application
- Get hardware skills such as soldering, winding etc.
- Get debugging skills.

LIST OF EXPERIMENTS

Group A:

1. Design and fabrication of reactor/ electromagnet for different inductance values.
2. Design and fabrication of single phase Induction/three phase motor stator.
3. Start delta starter wiring for automatic and manual operation.
4. Wiring of distribution box with MCB, ELCB, RCCB and MCCB.
5. Wiring of 40 W tube, T-5, LED, Metal Halide lamps and available latest luminaries.
6. Assembly of various types of contactors with wiring.
7. Assembly of DOL and 3 point starter with NVC connections and overload operation.

Group B:

This group consists of electronic circuits which must be assembled and tested on general purpose PCB or bread boards.

1.Design and development of 5 V regulated power supply.

2.Design and development of precision rectifier.

3.Design and development of first order/ second order low pass/high pass filters with an application.
4.Microcontroller Interface circuit for temperature/level/speed/current/voltage measurement.
5.Peak detector using op-amplifiers.
6.Zero crossing detector using op-amplifiers.
7.PCB design and layout.

POWER SYSTEM COMPUTER AIDED DESIGN LAB

IV B.Tech -I Semester **L T P C**

Course Code: A4EE65 **- 1 3 2**

COURSE OVERVIEW:

1. Expose students to automated measurements of 3-phase power.
2. Learn use of open-circuit and short-circuit tests to determine transformer Characteristics
3. Determine synchronous machine characteristics, and synchronization of machine to the power line voltage and frequency.
4. Learn to design solutions for power system problems.

PREREQUISITE(S):

Basic measurement techniques, theory of transformers and synchronous machines, AC circuits analysis and basics of 3-phase power and per unit analysis.

COURSE OBJECTIVES:

The course should enable the students to:

I. Simulate transmission lines using PSCAD to analyze faults in transmission lines

II. Demonstrate load flow studies using methods.

III. Analyze transient state stability in power systems.

COURSE OUTCOMES:

Upon successful completion of this course, students will have a better understanding of the merits and demerits of critical analytical solution methods which are the basis for valid techniques in solving power system problems

LIST OF EXPERIMENTS

Expt. 1 MODELING OF SURGE ARRESTERS

Switching over voltages and modeling of surge arresters using PSCAD

Expt. 2 MODELING OF HVDC TRANSMISSION LINE

Obtaining parameters of a HVDC transmission line and modeling it in PSCAD

Expt. 3 REACTIVE POWER AND POWER FACTOR CORRECTION

Familiarization with PSCAD and Understanding of Reactive Power and Power Factor Correction in AC Circuits

Expt. 4 TRANSIENT STABILITY

Study of transient stability in a typical power system

Expt. 5 FAULT ANALYSIS

Symmetrical fault analysis of a simple ac system using PSCAD

Expt. 6 TWO AREA POWER SYSTEM

Two Area Power System – Initializing the simulation to a specific load flow.

Expt. 7 MODELING OF TWO-AREA POWER SYSTEM

Two-area system model for a transient study

Expt. 8 TRANSIENT RECOVERY VOLTAGE

Transient Recovery Voltage under fault and normal switching conditions and use of multiple run

Expt. 9 FAST FRONT STUDIES-LIGHTNING STRIKE

Study the over voltages at transformer terminals during lightning stroke.

Expt. 10 SINGLE MACHINE INFINITE BUS

Simulate one machine infinite bus to measure active and reactive powers at steady state

Expt. 11 LOAD FLOW

Initializing the machine to a load flow

Expt. 12 SIMULATIONS OF FAULTS

Analyze symmetrical faults

Expt. 13 LOAD FREQUENCY CONTROL

Determination dynamic response of the given two - area load frequency control problem

Expt. 14 FAULT ANLAYSIS

Analysis of unsymmetrical faults using PSCAD

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

WEB REFERENCES:

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

Course Home Page:

SOFTWARE: Power System Computer Aided Designing (PSCAD)

HARDWARE: 36 No. of Desktop Computers

PROJECT PHASE -1

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A4EE26	PWC	0	0	8	4	100	0	100

COURSE OVERVIEW:

A series of exercises and experiments covering bottom-up structural design and top-down behavioral design using Verilog and System Verilog (IEEE Std. 1800) for circuit description and design verification. Lab exercises emphasize use of professional compilation and simulation tools for design validation.

PREREQUISITE(S) :

Students need a thorough understanding of Boolean algebra, combinational and sequential digital circuits and number systems (binary, hexadecimal).

COURSE OBJECTIVE: The main objective of this course is to train the students to meet the industrial needs.

COURSE OUTCOMES:

After completing this course the students should be able to:

1. The ability to code and simulate any digital function in Verilog HDL.
2. Know the difference between synthesizable and non-synthesizable code.
3. Understand library modeling, behavioral code and the differences between then.
4. Understand the differences between simulator algorithms.
5. Learn good coding techniques per current industrial practices.
6. Understand logic verification using Verilog simulation.

Relationship to Student Outcomes:

This supports the achievement of the following student outcomes:

1. An ability to apply knowledge of mathematics, science, and engineering to the analysis of electrical and computer engineering problems.
2. An ability to design and conduct scientific and engineering experiments, as well as to analyze and interpret data.
3. An ability to design systems which include hardware and/or software components within realistic constraints such as cost, manufacturability, safety and environmental concerns.
4. An ability to identify, formulate, and solve electrical and computer engineering problems.
5. An ability to communicate effectively through written reports and oral presentations
6. An ability to use modern engineering techniques for analysis and design.
7. An ability to analyze and design complex devices and/or systems containing hardware and/or software components.

WIND AND SOLAR ENERGY SYSTEMS
(PROFESSIONAL ELECTIVE- I)

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A4EE28	PEC	3	0	0	3	30	70	100

COURSE OVERVIEW:

To understand the concept of state variable and stability analysis.

PREREQUISITE(S): Basics on control systems, Laplace transform and other transformation

COURSE OBJECTIVES:

I. Apply phase plane analysis to linear and non linear control systems.

II. Analyze the stability of the systems using different techniques.

III. Illustrate the design of optimal controller.

IV. Demonstrate state variable analysis, non-linear systems and optimal control.

COURSE OUTCOMES:

After going through this course the student will be able to

At the end of this course, students will demonstrate the ability to
 Understand the energy scenario and the consequent growth of the power generation from renewable en sources
. Understand the basic physics of wind and solar power generation.
 Understand the power electronic interfaces for wind and solar generation.
 Understand the issues related to the grid-integration of solar and wind energy systems

SYLLABUS

UNIT-1: Physics of Wind Power **Classes: 10**

History of wind power, Indian and Global statistics, Wind physics, Betz limit, Tip speed ratio, stall and pitch control, Wind speed statistics-probability distributions, Wind speed and power-cumulative distribution functions.

UNIT- 2: Wind generator topologies: **Classes: 10**

Review of modern wind turbine technologies,Fixed and Variable speed wind turbines, Induction Generators, Doubly-Fed Induction Generators and their characteristics, PermanentMagnet Synchronous Generators, Power electronics converters. Generator-Converter configurations, Converter Control.

UNIT-3: The Solar Resource: **Classes: 10**

Introduction, solar radiation spectra, solar geometry, Earth Sun angles,observer Sun angles, solar day length, Estimation of solar energy availability.

UNIT-4: Solar photovoltaic: **Classes: 10**

Technologies-Amorphous, mono crystalline , polycrystalline; V-I characteristics of a PV cell, PV module, array, Power Electronic Converters for Solar Systems, Maximum Power Point Tracking (MPPT) algorithms. Converter Control.

UNIT- 5: Network Integration Issues: **Classes: 10**

Overview of grid code technical requirements. Fault ride-through for wind farms - real and reactive power regulation, voltage and frequency operating limits, solar PV and wind farm behaviour during grid disturbances. Power quality issues. Power system interconnection experiences in the world. Hybrid and isolated operations of solar PV and wind systems.

Solar thermal power generation: Technologies, Parabolic trough, central receivers, parabolic dish, Fresnel, solar pond, elementary analysis.

Text / References:

1. T. Ackermann, "Wind Power in Power Systems", John Wiley and Sons Ltd., 2005.
2. G. M. Masters, "Renewable and Efficient Electric Power Systems", John Wiley and Sons, 2004.
3. S. P. Sukhatme, "Solar Energy: Principles of Thermal Collection and Storage", McGraw Hill, 1984.
4. H. Siegfried and R. Waddington, "Grid integration of wind energy conversion systems" John Wiley and Sons Ltd., 2006.
5. G. N. Tiwari and M. K. Ghosal, "Renewable Energy Applications", Narosa Publications, 2004.
6. J. A. Duffie and W. A. Beckman, "Solar Engineering of Thermal Processes", John Wiley & Sons, 1991.

LINE COMMUTATED AND ACTIVE RECTIFIERS
PROFFESSIONAL ELECTIVE -I

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A4EE29	PEC	3	0	0	3	30	70	100

COURSE OBJECTIVES:

*****To provide the electrical circuit concepts behind the different working modes of power converters so as to enable deep understanding of their operation

*****To equip with required skills to derive the criteria for the design of power converters starting from basic fundamentals.

*****Analyze the operation of rectifier circuit with L and LC filter

COURSE OUT COMES : At the end of this course, students will demonstrate the ability to

* Analyse controlled rectifier circuits.

*Understand the operation of line-commutated rectifiers – 6 pulse and multi-pulse configurations.

* Understand the operation of PWM rectifiers – operation in rectification and regeneration modes and lagging, leading and unity power factor mode.

SYLLABUS

UNIT-I: Diode rectifiers with passive filtering : **Classes: 10**

Half-wave diode rectifier with RL and RC loads; 1-phase full-wave diode rectifier with L, C and LC filter; 3-phase diode rectifier with L, C and LC filter; continuous and discontinuous conduction, input current waveshape, effect of source inductance; commutation overlap.

UNIT-2: Thyristor rectifiers with passive filtering : **Classes: 10**

Half-wave thyristor rectifier with RL and RC loads; 1-phase thyristor rectifier with L and LC filter; 3-phase thyristor rectifier with L and LC filter; continuous and discontinuous conduction, input current waveshape.

UNIT-3: Multi-Pulse converter : **Classes: 10**

Review of transformer phase shifting, generation of 6-phase ac voltage from 3-phase ac, 6pulse converter and 12-pulse converters with inductive loads, steady state analysis, commutation overlap, notches during commutation.

UNIT-4: Single-phase ac-dc single-switch boost converter : **Classes: 7**

Review of dc-dc boost converter, power circuit of single-switch ac-dc converter, steady state analysis, unity power factor operation, closed-loop control structure.

UNIT 5: Ac-dc bidirectional boost converter : **Classes: 13**

Review of 1-phase inverter and 3-phase inverter, power circuits of 1-phase and 3-phase ac-dc boost converter, steady state analysis, operation at leading, lagging and unity power factors. Rectification and regenerating modes. Phasor diagrams, closed-loop control structure.

Isolated single-phase ac-dc flyback converter: Dc-dc flyback converter, output voltage as a function of duty ratio and transformer turns ratio. Power circuit of ac-dc flyback converter, steady state analysis, unity power factor operation, closed loop control structure.

Text / References:

1. G. De, "Principles of Thyristorised Converters", Oxford & IBH Publishing Co, 1988.
2. J.G. Kassakian, M. F. Schlecht and G. C. Verghese, "Principles of Power Electronics", AddisonWesley, 1991. 3. L. Umanand, "Power Electronics: Essentials and Applications", Wiley India, 2009.
4. N. Mohan and T. M. Undeland, "Power Electronics: Converters, Applications and Design", John Wiley & Sons, 2007.
5. R. W. Erickson and D. Maksimovic, "Fundamentals of Power Electronics", Springer Science & Business Media, 2001.

POWER SYSTEM DYNAMICS AND CONTROL
PROFFESSIONAL ELECTIVE -I

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A4EE30	PEC	3	0	0	3	30	70	100

COURSE OBJECTIVES:

- To remember the dynamic characteristics of power system equipment
- To recognize dynamic performance of power systems
- To illustrate the system stability and controls.

COURSE OUTCOMES : At the end of this course, students will demonstrate the ability to

- Understand the problem of power system stability and its impact on the system.
- Analyse linear dynamical systems and use of numerical integration methods.
- Model different power system components for the study of stability.
- Understand the methods to improve stability.

SYLLABUS

UNIT-1: Introduction to Power System Operations : **Classes: 10**

Introduction to power system stability. Power System Operations and Control. Stability problems in Power System. Impact on Power System Operations and control.

UNIT-2 : Analysis of Linear Dynamical System and Numerical Methods: **Classes: 09**

Analysis of dynamical System, Concept of Equilibrium, Small and Large Disturbance Stability. Modal Analysis of Linear System. Analysisusing Numerical Integration Techniques. Issues in Modeling: Slow and Fast Transients, Stiff System.

UNIT-3 : Modeling of Synchronous Machines and Associated Controllers : **Classes: 11**

Modeling of synchronous machine: Physical Characteristics. Rotor position dependent model. D-Q Transformation. Model with Standard Parameters. Steady State Analysis of Synchronous Machine. Short Circuit Transient Analysis of a Synchronous Machine. Synchronization of Synchronous Machine to an Infinite Bus. Modeling of Excitation and Prime Mover Systems. Physical Characteristics and Models. Excitation System Control. Automatic Voltage Regulator. Prime Mover Control Systems. Speed Governors.

UNIT-4 : Modeling of other Power System Components : **Classes: 10**

Modeling of Transmission Lines and Loads. Transmission Line Physical Characteristics. Transmission Line Modeling. Load Models - induction machine model. Frequency and Voltage Dependence of Loads. Other Subsystems – HVDC and FACTS controllers, Wind Energy Systems.

UNIT- 5 : Stability Analysis **Classes: 10**

Angular stability analysis in Single Machine Infinite Bus System. Angular Stability in multimachine systems – Intra-plant, Local and Inter-area modes. Frequency Stability: Centre of Inertia Motion. Load Sharing:

Governordroop. Single Machine Load Bus System: Voltage Stability. Introduction to Torsional Oscillations and the SSR phenomenon. Stability Analysis Tools:Transient Stability Programs, Small Signal Analysis Programs.

Enhancing System Stability Planning Measures. Stabilizing Controllers (Power System Stabilizers).Operational Measures-Preventive Control. Emergency Control.

Text/Reference Books

1. K.R. Padiyar, "Power System Dynamics, Stability and Control", B. S. Publications, 2002.
2. P. Kundur, "Power System Stability and Control", McGraw Hill, 1995.
3. P. Sauer and M. A. Pai, "Power System Dynamics and Stability", Prentice Hall, 1997

ELECTRICAL AND HYBRID VEHICLES
PROFFESSIONAL ELECTIVE –I

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A4EE31	PEC	3	0	0	3	30	70	100

COURSE OBJECTIVES:

- Explain the basics of electric and hybrid electric vehicles, their architecture, technologies and fundamentals.
- Analyze various electric drives suitable for hybrid electric vehicles
- Discuss different energy storage technologies used for hybrid electric vehicles and their control.
- Demonstrate different configurations of electric vehicles and its components, hybrid vehicle configuration by different techniques, sizing of components and design optimization and energy management.

COURSE OUTCOMES : At the end of this course, students will demonstrate the ability to

- Understand the models to describe hybrid vehicles and their performance.
- Understand the different possible ways of energy storage.
- Understand the different strategies related to energy storage systems.

.

SYLLABUS

UNIT-1: Introduction Conventional **Vehicles:** **Classes: 10**

Basics of vehicle performance, vehicle power source characterization, transmission characteristics, mathematical models to describe vehicle performance.

UNIT-2 Introduction to Hybrid Electric Vehicles: **Classes: 10**

History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies. 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.

UNIT-3: **Electric Drive-trains:** **Classes: 10**

Basic concept of electric traction, introduction to various electric drivetrain topologies, power flow control in electric drive-train topologies, fuel efficiency analysis. 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.

UNIT-4 Energy Storage: **Classes: 10**

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

UNIT-5: **Energy Management Strategies:** **Classes: 10**

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 / References:

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

ELECTRICAL MACHINE DESIGN
(Professional elective –II)

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A4EE32	PEC	3	0	0	3	30	70	100

COURSE OVER VIEW: 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 CBEMA curve, PSCAD AND EMTP – International standards – IEEE and IEC standards

PRE-REQUISITIES: POWER SYSTEMS- LOAD FLOW ANALYSIS

COURSE OBJECTIVE:

- To study mmf calculation and thermal rating of various types of electrical machines.
- To design armature and field systems for D.C. machines
- To design core, yoke, windings and cooling systems of transformers.
- To design stator and rotor of induction machines.
- To design stator and rotor of synchronous machines and study their thermal behaviour

•COURSE OUTCOMES: At the end of this course, students will

Ability to model and analyze electrical equipments and their application to power system.

SYLLABUS

UNIT-I INTRODUCTION: **Classes: 10**

Major considerations in Electrical Machine Design - Electrical Engineering Materials – Space factor – Choice of Specific Electrical and Magnetic loadings - Thermal considerations - Heat flow – Temperature rise and Insulating Materials - Rating of machines – Standard specifications.

UNIT-II DC MACHINES : **Classes: 10**

Output Equations – Main Dimensions – Choice of Specific Electric and Magnetic Loading - Maganetic Circuits Calculations - Carter's Coefficient - Net length of Iron –Real & Apparent flux densities – Selection of number of poles – Design of Armature – Design of commutator and brushes – performance prediction using design values.

UNIT-III TRANSFORMERS : **Classes: 10**

Output Equations – Main Dimensions - kVA output for single and three phase transformers – Window space factor – Design of core and winding – Overall dimensions – Operating characteristics – No load current – Temperature rise in Transformers – Design of Tank - Methods of cooling of Transformers.

UNIT-IV INDUCTION MOTORS : **Classes: 10**

Output equation of Induction motor – Main dimensions – Choice of Average flux density – Length of air gap- Rules for selecting rotor slots of squirrel cage machines – Design of rotor bars & slots – Design of end rings – Design of wound rotor – Magnetic leakage calculations – Leakage reactance of polyphase machines- Magnetizing current - Short circuit current – Operating characteristics- Losses and Efficiency.

UNIT-V SYNCHRONOUS MACHINES **Classes: 10**

Output equations – choice of Electrical and Magnetic Loading – Design o 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.

TEXT BOOKS:

1. Sawhney, A.K., 'A Course in Electrical Machine Design', Dhanpat Rai & Sons, New Delhi, 1984.

2. M.V.Deshpande “Design and Testing of Electrical Machine Design” Wheeler Publications, 2010.

REFERENCES:

1. A.Shanmuga Sundaram, G.Gangadharan, R.Palani 'Electrical Machine Design Data Book', New Age International Pvt. Ltd., Reprint, 2007.

2. R.K.Agarwal “ Principles of Electrical Machine Design” Esskay Publications, Delhi, 2002.

3. Sen, S.K., 'Principles of Electrical Machine Designs with Computer Programmes', Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 1987.

CONTROL SYSTEM DESIGN
Professional Elective II

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A4EE33	PEC	3	0	0	3	30	70	100

Course Objectives:

- To Study the effect of addition of pole and zero on the system response
- Design of compensators in time and frequency domain
- Design of observers
- To study the effect of various non-linearities on system performance

Course Outcomes: At the end of this course, students will demonstrate the ability to Use numerical methods to analyse a power system in steady state

- Understand various design specifications
- Design controllers to satisfy the desired design specifications using simple controller structures (P, PI, PID, compensators).
- Design controllers using the state-space approach.

SYLLABUS

UNIT-1 Design Specifications: **Classes: 10**

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.

UNIT 2 Design of Classical Control System in the time domain : **Classes: 10**

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

UNIT 3 Design of Classical Control System in frequency domain: **Classes: 12**

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.

UNIT 4 Control System Design in state space : **Classes: 10**

Review of state space representation. Concept of controllability & observability, effect of pole zero cancellation on the controllability & observability of the system, pole placement design through state feedback. Ackerman's Formula for feedback gain design. Design of Observer. Reduced order observer. Separation Principle.

UNIT 5 Nonlinearities and its effect on system performance : **Classes: 8**

Various types of non-linearities. Effect of various non-linearities on system performance. Singular points. Phase plot analysis.

Text and Reference Books :

1. N. Nise, “Control system Engineering”, John Wiley, 2000.
2. I. J. Nagrath and M. Gopal, “Control system engineering”, Wiley, 2000.
3. M. Gopal, “Digital Control Engineering”, Wiley Eastern, 1988.
4. K. Ogata, “Modern Control Engineering”, Prentice Hall, 2010.
5. B. C. Kuo, “Automatic Control system”, Prentice Hall, 1995.
6. J. J. D’Azzo and C. H. Houpis, “Linear control system analysis and design (conventional and modern)”, McGraw Hill, 1995.
7. R. T. Stefani and G. H. Hostetter, “Design of feedback Control Systems”, Saunders College Pub, 1994.

HVDC TRANSMISSION SYSTEMS
PROFESSIONAL ELECTIVE-II

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A4EE34	PEC	3	0	0	3	30	70	100

COURSE OBJECTIVES: To understand the High voltage direct current transmission system

• To understand the concept, planning of DC power transmission and comparison with AC Power transmission.
• To analyze HVDC converters & harmonics and design of filters
• To study about the HVDC system control
. • To model and analysis the DC system under study state

PRE-REQUISITIES: Power systems- power transmission and distribution

COURSE OUTCOMES: Ability to understand and analyze power system operation, stability, control and protection.

SYLLABUS

UNIT I INTRODUCTION: **Classes: 10**

DC Power transmission technology – Comparison of AC and DC transmission – Application of DC transmission – Description of DC transmission system – Planning for HVDC transmission – Modern trends in HVDC technology – DC breakers – Operating problems – HVDC transmission based on VSC – Types and applications of MTDC systems.

UNIT II ANALYSIS OF HVDC CONVERTERS : **Classes: 10**

Line commutated converter - Analysis of Graetz circuit with and without overlap - Pulse number – Choice of converter configuration – Converter bridge characteristics – Analysis of a 12 pulse converters – Analysis of VSC topologies and firing schemes.

UNIT III CONVERTER AND HVDC SYSTEM CONTROL: **Classes: 10**

Principles of DC link control – Converter control characteristics – System control hierarchy – Firing angle control – Current and extinction angle control – Starting and stopping of DC link – Power control – Higher level controllers – Control of VSC based HVDC link.

UNIT IV REACTIVE POWER AND HARMONICS CONTROL: **Classes: 10**

Reactive power requirements in steady state – Sources of reactive power – SVC and STATCOM – Generation of harmonics – Design of AC and DC filters – Active filters**.**

UNIT V POWER FLOW ANALYSIS IN AC/DC SYSTEMS **Classes: 10**

Per unit system for DC quantities – DC system model – Inclusion of constraints – Power flow analysis – case study.

TEXT BOOKS:

1. Padiyar, K. R., "HVDC power transmission system", New Age International (P) Ltd., New Delhi, Second Edition, 2010.

2. Edward Wilson Kimbark , "Direct Current Transmission", Vol. I, Wiley inter science, New York, London, Sydney, 1971.

3. Rakosh Das Begamudre, "Extra High Voltage AC Transmission Engineering", New Age International (P) Ltd., New Delhi, 1990.

REFERENCES:

1. Kundur P., "Power System Stability and Control", McGraw-Hill, 1993.

2. Colin Adamson and Hingorani N G, "High Voltage Direct Current Power Transmission", Garraway Limited, London, 1960.

3. Arrillaga, J., "High Voltage Direct Current Transmission", Peter Pregrinus, London, 1983

INDUSTRIAL AUTOMATION

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A4EE35	PEC	3	0	0	3	30	70	100

SYLLABUS

Unit I :Introduction: Automation overview, Requirement of automation systems, Architecture of Industrial Automation system, Introduction of PLC and supervisory control and data acquisition (SCADA). Industrial bus systems: modbus & profibus

Unit II :Automation components: Sensors for temperature, pressure, force, displacement, speed, flow, level, humidity and pH measurement. Actuators, process control valves, power electronics devices DIAC, TRIAC, power MOSFET and IGBT. Introduction of DC and AC servo drives for motion control.

Unit III :Computer aided measurement and control systems: Role of computers in measurement and control, Elements of computer aided measurement and control, man-machine interface, computer aided process control hardware, process related interfaces, Communication and networking, Industrial communication systems, Data transfer techniques, Computer aided process control software, Computer based data acquisition system, Internet of things (IoT) for plant automation

Unit IV : Programmable logic controllers: Programmable controllers, Programmable logic controllers, Analog digital input and output modules, PLC programming, Ladder diagram, Sequential flow chart, PLC Communication and networking, PLC selection, PLC Installation, Advantage of using PLC for Industrial automation, Application of PLC to process control industries.

Unit V : Distributed Control System: Overview of DCS, DCS software configuration, DCS communication, DCS Supervisory Computer Tasks, DCS integration with PLC and Computers, Features of DCS, Advantages of DCS.

Reference Books:

[1] Industrial Instrumentation and Control By. S.K. Singh The McGraw Hill Companies

[2] Process Control Instrumentation Technology By. C.D. Johnson,

PHI [3] Industrial control handbook, Parr, Newnem

[4] Programmable logic controller, Dunning, Delmar

Course Outcome:

After learning the course the students should be able to:

1. Understand various automation components and systems
2. Draw block diagram of industrial automation and control system
3. Explain architecture of industrial automation system
4. Measure industrial parameters like temperature, pressure, force, displacement, speed, flow, level, humidity and pH.
5. Explain fundamentals of process control
6. List basic devices used in automated systems
7. Use programmable logic controllers for industrial automation
8. Draw block diagram of supervisory control and data acquisition (SCADA).
9. Integrate SCADA with PLC systems
10. Use Internet of Things for industrial automation
11. Know use of robot for industrial applications

HIGH VOLTAGE ENGINEERING

(PROFESSIONAL ELECTIVE –III)

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A4EE36	PEC	3	0	0	3	30	70	100

COURSE OBJECTIVES: To understand the various types of over voltages in power system and protection methods.

- Generation of over voltages in laboratories
- Measurement of over voltages
- Nature of Breakdown mechanism in solid, liquid and gaseous dielectrics.
- Testing of power apparatus and insulation coordination

PRE-REQUISITIES: Power systems- power transmission and distribution

COURSE OUTCOMES: Ability to understand and analyze power system operation, stability, control and protection.

SYLLABUS

UNIT-I OVER VOLTAGES IN ELECTRICAL POWER SYSTEMS: **Classes: 10**

Causes of over voltages and its 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.

UNIT II DIELECTRIC BREAKDOWN: **Classes: 10**

Gaseous breakdown in uniform and non-uniform fields – Corona discharges – Vacuum breakdown – Conduction and breakdown in pure and commercial liquids, Maintenance of oil Quality – Breakdown mechanisms in solid and composite dielectrics.

UNIT III GENERATION OF HIGH VOLTAGES AND HIGH CURRENTS : **Classes: 10**

Generation of High DC, AC, impulse voltages and currents - Triggering and control of impulse generators.

UNIT IV MEASUREMENT OF HIGH VOLTAGES AND HIGH CURRENTS: **Classes: 10**

High Resistance with series ammeter – Dividers, Resistance, Capacitance and Mixed dividers - Peak Voltmeter, Generating Voltmeters - Capacitance Voltage Transformers, Electrostatic Voltmeters – Sphere Gaps - High current shunts- Digital techniques in high voltage measurement.

UNIT V HIGH VOLTAGE TESTING & INSULATION COORDINATION: **Classes: 10**

High voltage testing of electrical power apparatus as per International and Indian standards – Power frequency, impulse voltage and DC testing of Insulators, circuit breakers, bushing, isolators and transformers- Insulation Coordination.

- **TEXT BOOKS:**

1. S.Naidu and V. Kamaraju, 'High Voltage Engineering', Tata McGraw Hill, Fifth Edition, 2013.
2. E. Kuffel and W.S. Zaengl, J.Kuffel, 'High voltage Engineering fundamentals', Newnes Second Edition Elsevier , New Delhi, 2005.
3. Subir Ray,' An Introduction to High Voltage Engineering' PHI Learning Private Limited, New

REFERENCES:

1. L.L. Alston, 'High Voltage Technology', Oxford University Press, First Indian Edition, 2011.

2. C.L. Wadhwa, 'High voltage Engineering', New Age International Publishers, Third Edition, 2010.

ELECTRICAL ENERGY CONSERVATION AND AUDITING
(PROFESSIONAL ELECTIVE –III)

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A4EE37	PEC	3	0	0	3	30	70	100

COURSE OBJECTIVES:

- Identify the demand supply gap of energy in Indian scenario
- Carry out energy audit of an industry/Organization
- Draw the energy flow diagram of an industry and identify the energy wasted or a waste stream.
- Select appropriate energy conservation method to reduce the wastage of energy
- Evaluate the techno economic feasibility of the energy conservation technique adopted.

PRE-REQUISITIES: Power systems- power transmission and distribution

COURSE OUTCOMES: At the end of this course, students will demonstrate the ability to

- Understand the electrical wiring systems for residential, commercial and industrial consumers, representing the systems with standard symbols and drawings, SLD
- Understand various components of industrial electrical systems.
- Analyze and selectthe proper size of various electrical system components

SYLLABUS

UNIT-1 Energy Scenario : **Classes: 10**

Commercial and Non-commercial energy, primary energy resources, commercial energy production, final energy consumption, energy needs of growing economy, long term energy scenario, energy pricing, energy sector reforms, energy and environment, energy security, energy 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.

UNIT-2: Basics of Energy and its various forms : **Classes: 8**

Electricity tariff, load management and maximum demand control, power factor improvement, selection & location of capacitors, Thermal Basics-fuels, thermal energy contents of fuel, temperature & pressure, heat capacity, sensible and latent heat, evaporation, condensation, steam, moist air and humidity & heat transfer, units and conversion.

UNIT-3: Energy Management & Audit : **Classes: 10**

Definition, energy audit, need, types of energy audit. Energy management (audit) 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.

UNIT- 4: Energy Efficiency in Electrical Systems: **Classes: 10**

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, losses in induction motors, motor efficiency, factors affecting motor performance, rewinding and motor replacement issues, energy saving opportunities with energy efficient motors.

UNIT- 5: Energy Efficiency in Industrial Systems: **Classes: 12**

Compressed Air System: Types of air compressors, compressor efficiency, efficient compressor operation, Compressed air system components, capacity assessment, leakage test, factors affecting the 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.

Energy Efficient Technologies in Electrical Systems 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/Reference Books

1. Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-1, General Aspects (available online)
2. Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-3, Electrical Utilities (available online)
3. S. C. Tripathy, “Utilization of Electrical Energy and Conservation”, McGraw Hill, 1991.
4. Success stories of Energy Conservation by BEE, New Delhi (www.bee-india.org)

INDUSTRIAL ELECTRICAL SYSTEMS

(PROFESSIONAL ELECTIVE –III)

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A4EE38	PEC	3	0	0	3	30	70	100

COURSE OBJECTIVES:

- To discuss about electrical industrial circuit breakers.
- To demonstrate the usage of electrical protection devices to residential applications
- To analyze and discuss the different industrial electrical machines.

PRE-REQUISITIES: Power systems- power transmission and distribution

COURSE OUTCOMES: At the end of this course, students will demonstrate the ability to

- Understand the electrical wiring systems for residential, commercial and industrial consumers, representing the systems with standard symbols and drawings, SLD
- Understand various components of industrial electrical systems.
- Analyze and select the proper size of various electrical system components

SYLLABUS

UNIT 1: Electrical System Components: **Classes: 10**

LT system wiring components, selection of cables, wires, switches, distribution box, metering system, Tariff structure, protection components- Fuse, MCB, MCCB, ELCB, inverse current characteristics, symbols, single line diagram (SLD) of a wiring system, Contactor, Isolator, Relays, MPCB, Electric shock and Electrical safety practices

UNIT 2: Residential and Commercial Electrical Systems : **Classes: 10**

Types of residential and commercial wiring systems, general rules and guidelines for installation, load calculation and sizing of wire, rating of main switch, distribution board and protection devices, earthing system calculations, requirements of commercial installation, deciding lighting scheme and number of lamps, earthing of commercial installation, selection and sizing of components.

UNIT 3: Illumination Systems: **Classes: 10**

Understanding various terms regarding light, lumen, intensity, candle power, lamp efficiency, specific consumption, glare, space to height ratio, waste light factor, depreciation factor, various illumination schemes, Incandescent lamps and modern luminaries like CFL, LED and their operation, energy saving in illumination systems, design of a lighting scheme for a residential and commercial premises, flood lighting.

UNIT 4: Industrial Electrical Systems I: **Classes: 10**

HT connection, industrial substation, Transformer selection, Industrial loads, motors, starting of motors, SLD, Cable and Switchgear selection, Lightning Protection, Earthing design, Power factor correction – kVAR calculations, type of compensation, Introduction to PCC, MCC panels. Specifications of LT Breakers, MCB and other LT panel components.

UNIT V Industrial Electrical Systems II: **Classes: 10**

DG Systems, UPS System, Electrical Systems for the elevators, Battery banks, Sizing the DG, UPS and Battery Banks, Selection of UPS and Battery Banks.

Industrial Electrical System Automation Study of 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/Reference Books

1. S. L. Uppal and G. C. Garg, "Electrical Wiring, Estimating & Costing", Khanna publishers, 2008.
2. K. B. Raina, "Electrical Design, Estimating & Costing", New age International, 2007.
3. S. Singh and R. D. Singh, "Electrical estimating and costing", Dhanpat Rai and Co., 1997.
4. Web site for IS Standards. 6. H. Joshi, "Residential Commercial and Industrial Systems", McGraw Hill Education, 2008.

ELECTRICAL DISTRIBUTION SYSTEMS

(PROFESSIONAL ELECTIVE –III)

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A4EE39	PEC	3	0	0	3	30	70	100

COURSE OBJECTIVES: To understand the various types of over voltages in power system and protection methods.

- Generation of over voltages in laboratories
- Measurement of over voltages
- Nature of Breakdown mechanism in solid, liquid and gaseous dielectrics.
- Testing of power apparatus and insulation coordination

PRE-REQUISITIES: Power systems- power transmission and distribution

COURSE OUTCOMES: Ability to understand and analyze power system operation, stability, control and protection.

SYLLABUS

UNIT1: GENERAL CONCEPTS: **Classes: 10**

Introduction to distribution systems, Load modelling and characteristics. Coincidence factor, contribution factor loss factor – Relationship between the load factor and loss factor. Classification of loads (Residential, commercial, Agricultural and Industrial) and their characteristics.

UNIT – II: DISTRIBUTION FEEDERS & SUBSTATIONS: **Classes: 10**

Design Considerations of Distribution Feeders: Radial and loop types of primary feeders, voltage levels, feeder loading; basic design practice of the secondary distribution system.

Location of Substations: Rating of distribution substation, service area within primary feeders. Benefits derived through optimal location of substations.

UNIT – III :SYSTEM ANALYSIS& COORDINATION: **Classes: 10**

Voltage drop and power-loss calculations: Derivation for voltage drop and power loss in lines, manual methods of solution for radial networks, three phase balanced primary lines.

Coordination of Protective Devices: General coordination procedure

UNIT –IV: PROTECTION : **Classes: 10**

Objectives of distribution system protection, types of common faults and procedure for fault calculations. Protective Devices: Principle of operation of Fuses, Circuit Re-closers, line sectionalizers, and circuit breakers.

UNIT – V: COMPENSATION FOR POWER FACTOR IMPROVEMENT& VOLTAGE CONTROL

Classes: 10

Capacitive compensation for power-factor control. Different types of power capacitors, shunt and series capacitors, effect of shunt capacitors (Fixed and switched), Power factor correction, capacitor allocation – Economic justification – Procedure to determine the best capacitor location Voltage Control: Equipment for voltage control, effect of series capacitors, effect of AVB/AVR, line drop compensation.

TEXT BOOK:

1. "Electric Power Distribution system, Engineering" – by Turan Gonen, Mc Graw-hill Book Company.

2. Electric Power Distribution – by A.S. Pabla, Tata Mc Graw-hill Publishing company, 4th edition, 1997.

REFERENCE BOOK:

1. Electrical Power Distribution and Automation by S.Sivanagaraju, V.Sankar, Dhanpat Rai & Co, 2006

2. Electrical Power Distribution Systems by V.Kamaraju , Right Publishers.

DIGITAL CONTROL SYSTEMS

(PROFFESSIONAL ELECTIVE-IV)

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A4EE40	PEC	3	0	0	3	30	70	100

COURSE OBJECTIVES: To understand the various types of over voltages in power system and protection methods.

- Generation of over voltages in laboratories
- Measurement of over voltages
- Nature of Breakdown mechanism in solid, liquid and gaseous dielectrics.
- Testing of power apparatus and insulation coordination

PRE-REQUISITIES: Power systems- power transmission and distribution

COURSE OUTCOMES: Ability to understand and analyze power system operation, stability, control and protection.

UNIT 1: Discrete Representation of Continuous Systems: **Classes: 10**

Basics of Digital Control Systems. Discrete representation of continuous systems. Sample and hold circuit. Mathematical Modelling of sample and hold circuit. Effects of Sampling and Quantization. Choice of sampling frequency. ZOH equivalent.

UNIT-II Discrete System Analysis : **Classes: 10**

Z-Transform and Inverse Z Transform for analyzing discrete time systems. Pulse Transfer function. Pulse transfer function of closed loop systems. Mapping from s-plane to z plane. Solution of Discrete time systems . Time response of discrete time system.

UNIT-III: Stability of Discrete Time System: **Classes: 10**

Stability analysis by Jury test. Stability analysis using bilinear transformation. Design of digital control system with dead beat response. Practical issues with dead beat response design.

UNIT-IV: State Space Approach for discrete time systems : **Classes: 10**

State space models of discrete systems, State space analysis. Lyapunov Stability. Controllability, reach-ability, Reconstructibility and observability analysis. Effect of pole zero cancellation on the controllability & observability.

UNIT-V : Design of Digital Control System & Discrete output feedback control : **Classes: 10**

Design of Discrete PID Controller, Design of discrete state feedback controller. Design of set point tracker. Design of Discrete Observer for LTI System. Design of Discrete compensator.

Design of discrete output feedback control. Fast output sampling (FOS) and periodic output feedback controller design for discrete time systems

Text Books :

1. K. Ogata, "Digital Control Engineering", Prentice Hall, Englewood Cliffs, 1995.

2. M. Gopal, "Digital Control Engineering", Wiley Eastern, 1988.

3. G. F. Franklin, J. D. Powell and M. L. Workman, "Digital Control of Dynamic Systems", Addison-Wesley, 1998.

4. B.C. Kuo, "Digital Control System", Holt, Rinehart and Winston, 1980.

DIGITAL SIGNAL PROCESSING

L T P C

Course Code: A4EE41 **3 1 - 3**

COURSE OVERVIEW:

This course provides an introduction to digital signal processing for both undergraduate and for graduate students. In this course, a detailed examination of basic digital signal processing operations including sampling/reconstruction of continuous time signals, Fourier and Z-transforms will be given. The Fourier and Z-transforms will be used to analyze the stability of systems, and to find the system transfer function. The discrete Fourier transform (DFT) and fast Fourier transform (FFT) will be studied. Finally, we will examine time and frequency domain techniques for designing and applying infinite impulse response (IIR) and finite impulse response (FIR) digital filters. Two-dimensional signals and introductory image processing operations will also be discussed.

PREREQUISITE(S): Basic knowledge on Engineering Mathematics

COURSE OBJECTIVES:

1. To provide background and fundamental material for the analysis and processing of digital signals.
2. To familiarize the relationships between continuous-time and discrete-time signals and systems.
3. To study fundamentals of time, frequency and z-plane analysis and to discuss the inter-relationships of these Analytic method
4. To study the designs and structures of digital (IIR and FIR) filters from analysis to synthesis for a given Specifications
5. To introduce a few real-world signal processing applications.

COURSE OUTCOMES:

1. Understand how digital to analog (D/A) and analog to digital (A/D) converters operate on a signal and be able to model these operations mathematically.
2. Perform time, frequency and Z-transform analysis on signals and LTI systems and study the properties like stability, causality, time-invariance and etc.
3. Understand the inter-relationship between DFT and various transforms.
4. Understand the significance of various filter structures and effects of round-off errors.
5. Design of infinite impulse response filters for a given specification.
6. Study the architecture of DSP's and applications

SYLLABUS

UNIT–I

INTRODUCTION TO DIGITAL SIGNAL PROCESSING: Discrete time signals & systems, linear shift invariant systems, stability and causality, discrete time systems described by difference equations, Frequency domain representation of discrete time signals and systems.

UNIT–II

FOURIER SERIES AND FOURIER TRANSFORMS: Discrete Fourier series representation of periodic sequences, Properties of discrete Fourier series, Discrete Fourier transforms: frequency domain sampling, , linear convolution of sequences using DFT, Computation of DFT, Relationship of DFT to other transforms, Properties of DFT, Fast Fourier transforms (FFT) - Radix-2 FFT algorithm, Radix-4 FFT algorithms, Inverse FFT.

UNIT–III

Z-TRANSFORMS: Review of Z-transforms, Properties of Z-transform, Rational Z-transforms, and Inversion of Z- transforms, stability and causality.

REALIZATION OF DIGITAL FILTERS: Structures for FIR systems: Direct form structure, Cascade form structures, Structures for IIR systems: Direct form structures, Signal flow graphs and transposed structures, cascade form structures, Parallel form structures.

UNIT–IV

DESIGN OF FIR DIGITAL FILTERS: Symmetric and antisymmeric FIR filters, Design of linear phase FIR Digital Filters using Windows, Design of linear phase FIR Digital Filters by Frequency Sampling method.

DESIGN OF IIR DIGITAL FILTERS: IIR filter design by Approximation of Derivatives, IIR filter design by impulse invariance, IIR filter design by bilinear transformation, Characteristics of commonly used analog filters (Butter worth and Chebyshev), Frequency transformations, comparison of IIR & FIR filters.

UNIT– V

MULTIRATE DIGITAL SIGNAL PROCESSING: Decimation by a factor D, interpolation by a factor I, sampling rate conversion by a rational factor I/D, Filter Design & Implementation for sampling rate conversion, Multi stage Implementation of sampling rate conversion.

TEXT BOOKS:

1. John G. Proakis, Dimitris G. Manolakis (2007), Digital Signal Processing, Principles, Algorithms, and Applications,Pearson Education / PHI, India.

2. A.V. Oppenheim, R. W. Schaffer (2009), Discrete Time Signal Processing, Prentice Hall of India, New Delhi.

REFERENCE BOOKS:

1. Andreas Antoniou (2006), Digital Signal Processing, Tata McGraw Hill, NewDelhi.

2. M. H. Hayes (2007), Schaums Outlines of Digital Signal Processing, Tata McGraw Hill, India.

COMPUTER ARCHITECTURE

(PROFESSIONAL ELECTIVE – IV)

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A4EE42	PEC	3	0	0	3	30	70	100

COURSE OBJECTIVES:

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

- Understand the concepts of microprocessors, their principles and practices.
- Write efficient programs in assembly language of the 8086 family of microprocessors.
- Organize a modern computer system and be able to relate it to real examples.
- Develop the programs in assembly language for 80286, 80386 and MIPS processors in real and protected modes. Implement embedded applications using ATOM processor

COURSE OUTCOMES:

1. Analyze the various engineering materials.
2. Application of various engineering materials.

SYLLABUS

UNIT 1: Introduction to computer organization: **Classes: 10**

Architecture and function of general computer system, CISC Vs RISC, Data types, Integer Arithmetic - Multiplication, Division, Fixed and Floating point representation and arithmetic, Control unit operation, Hardware implementation of CPU with Micro instruction, microprogramming, System buses, Multi-bus organization.

UNIT 2: Memory organization : **Classes: 10**

System memory, Cache memory - types and organization, Virtual memory and its implementation, Memory management unit, Magnetic Hard disks, Optical Disks.

UNIT 3:Input – output Organization : **Classes: 10**

Accessing I/O devices, Direct Memory Access and DMA controller, Interrupts and Interrupt Controllers, Arbitration, Multilevel Bus Architecture, Interface circuits - Parallel and serial port. Features of PCI and PCI Express bus.

UNIT 4: 16 and 32 microprocessors: **Classes: 10**

80x86 Architecture, IA – 32 and IA – 64, Programming model, Concurrent operation of EU and BIU, Real mode addressing, Segmentation, Addressing modes of 80x86, Instruction set of 80x86, I/O addressing in 80x86

UNIT 5: Pipelining: **Classes: 10**

Introduction to pipelining, Instruction level pipelining (ILP), compiler techniques for ILP, Data hazards, Dynamic scheduling, Dependability, Branch cost, Branch Prediction, Influence on instruction set.

Different Architectures : VLIW Architecture, DSP Architecture, SoC architecture, MIPS Processor and programming

Text/Refence Books

1. V. Carl, G. Zvonko and S. G. Zaky, "Computer organization", McGraw Hill, 1978.

2. B. Brey and C. R. Sarma, "The Intel microprocessors", Pearson Education, 2000.

3. J. L. Hennessy and D. A. Patterson, "Computer Architecture A Quantitative Approach", Morgan Kauffman, 2011.

4. W. Stallings, "Computer organization", PHI, 1987.

5. P. Barry and P. Crowley, "Modern Embedded Computing", Morgan Kaufmann, 2012.

6. N. Mathivanan, "Microprocessors, PC Hardware and Interfacing", Prentice Hall, 2004.

RENEWABLE ENERGY SOURCES

(PROFESSIONAL ELECTIVE -IV)

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A4EE43	PEC	3	0	0	3	30	70	100

COURSE OVERVIEW:

Non-Conventional Power Generation deals with knowledge on solar power generation and implementation.

It deals with solar energy collection, storage and application.

PREREQUISITE(S): Basic knowledge on photo voltaic cells

COURSE OBJECTIVES:

The course should enable the students to:

I. Demonstrate power generation systems including major subsystems.
II. Understand basic working principles of nuclear power generation systems.
III. Apply knowledge of solar power generation systems in design and implementation to obtain clean energy.

COURSE OUTCOMES:

I. Understand basic working principles of nuclear power generation systems.

II. Apply knowledge of solar power generation systems in design and implementation to obtain clean energy.

SYLLABUS

UNIT – I PRINCIPLES OF SOLAR RADIATION: **Classes: 10**

Role and potential of new and renewable source, the solar energy option, Environmental impact of solar power, physics of the sun, the solar constant, extraterrestrial and terrestrial solar radiation, solar radiation on titled surface, instruments for measuring solar radiation and Sun shine, solar radiation data.

UNIT – II SOLAR ENERGY COLLECTORS: **Classes: 10**

Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors.

STORAGE AND APPLICATIONS: **Classes: 10**

Different methods of solar energy storage, Sensible, latent heat and stratified storage, solar ponds. Solar Applications- solar heating /cooling technique, solar distillation and drying.

UNIT – III PHOTO VOLTAICS (PV): **Classes: 10**

Fundamentals of solar cells, types of solar cells, semiconducting materials, band gap theory, absorption of photons, excitations and photo emission of electrons, band engineering.

PV CELL PROPERTIES:

Solar cell properties and design, p-n junction photodiodes, depletion region, electrostatic field across the depletion layer, electron and holes transports, device physics, charge carrier generation, recombination and other losses, I-V characteristics, output power. \

UNIT – IV SOLAR CELL APPLICATIONS: **Classes: 10**

PV cell interconnection, module structure and module fabrication, Equivalent circuits, load matching, efficiency, fill factor and optimization for maximum power, Design of stand-alone PV systems, system sizing, device structures, device construction, DC to AC conversion, inverters, on-site storage and grid connections.

UNIT – V COST ANALYSIS AND ENVIRONMENTAL ISSUES: **Classes: 10**

Cost analysis and pay back calculations for different types of solar panels and collectors, installation and operating costs, Environmental and safety issues, protection systems, performance monitoring.

ALTERNATIVE ENERGY SOURCES:

Solar Energy: Types of devices for Solar Energy Collection, Thermal Storage System. Control Systems, Wind Energy, Availability, Wind Devices, Wind Characteristics, Performance of Turbines and systems.

TEXT BOOKS:

1. G. D. Rai (2009), *Non-Conventional Energy Sources*, 4th edition, Khanna Publishers, New Delhi.

2. Martin A. Green (2008), *Solar Cells: Operating Principles, Technology and system Applications*, 1st edition, Prentice Hall, New Delhi.

REFERENCES BOOKS:

1. Sukatme (2008), Solar Energy, 3rd Edition, McGraw Hill Companies, New Delhi.

2. D. Yogi gosuami, Frank Kreith, Jan F. Kreider (2000), Principles of Solar Engineering, 2nd edition, Taylor & Francis, USA.

COMPUTATIONAL ELECTROMAGNETICS

PROFFESSIONAL ELECTIVE -V

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A4EE44	PEC	3	0	0	3	30	70	100

COURSE OBJECTIVE:

- To discuss analytical methods and solving of field equations.
- To learn finite difference and finite element method
- To learn applications of computational electromagnetics.

COURSE OUTCOMES:

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

- Understand the basic concepts of electromagnetics.
- Understand computational techniques for computing fields.
- Apply the techniques to simple real-life problems.

SYLLABUS

UNIT - 1: Introduction : **Classes: 10**

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.

UNIT -2: 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.

UNIT- 3: Finite Difference Method (FDM): **Classes: 10**

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

UNIT-4: Finite Element Method (FEM) : **Classes: 10**

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.

UNIT-5: Special Topics: **Classes: 10**

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

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

Text/Reference Books

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

COMPUTER NETWORKS

PROFFESSIONAL ELECTIVE -V

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A4EE45	PEC	3	0	0	3	30	70	100

COURSE OVERVIEW:

A series of exercises and experiments covering bottom-up structural design and top-down behavioral design using Verilog and System Verilog (IEEE Std. 1800) for circuit description and design verification. Lab exercises emphasize use of professional compilation and simulation tools for design validation.

PREREQUISITE(S) :

Students need a thorough understanding of Boolean algebra, combinational and sequential digital circuits and number systems (binary, hexadecimal).

COURSE OBJECTIVE: The main objective of this course is to train the students to meet the industrial needs.

COURSE OUTCOMES:

At the end of this course, students will demonstrate the ability to
- Understand the basic concepts of electromagnetics.
- Understand computational techniques for computing fields.
- Apply the techniques to simple real-life problems.

SYLLABUS

Unit- 1: Data communication Components: **Classes: 10**

Representation of data and its flow Networks , Various Connection Topology, Protocols and Standards, OSI model, Transmission Media, LAN: Wired LAN, Wireless LANs, Connecting LAN and Virtual LAN, Techniques for Bandwidth utilization: Multiplexing - Frequency division, Time division and Wave division, Concepts on spread spectrum.

Unit- 2: Data Link Layer and Medium Access Sub Layer: **Classes: 12**

Error Detection and Error Correction - Fundamentals, Block coding, Hamming Distance, CRC; Flow Control and Error control protocols - Stop and Wait, Go back – N ARQ, Selective Repeat ARQ, Sliding Window, Piggybacking, Random Access, Multiple access protocols -Pure ALOHA, Slotted ALOHA, CSMA/CD,CDMA/CA

Unit-3: Network Layer: **Classes: 8**

Switching, Logical addressing – IPV4, IPV6; Address mapping – ARP, RARP, BOOTP and DHCP–Delivery, Forwarding and Unicast Routing protocols.

Unit- 4: Transport Layer: **Classes: 10**

Process to Process Communication, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), SCTP Congestion Control; Quality of Service, QoS improving techniques: Leaky Bucket and Token Bucket algorithm.

Unit- 5: Application Layer: **Classes: 10**

Domain Name Space (DNS), DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls, Basic concepts of Cryptography

Suggested books

1. Data Communication and Networking, 4th Edition, Behrouz A. Forouzan, McGrawHill.
2. Data and Computer Communication, 8th Edition, William Stallings, Pearson Prentice Hall India.

Suggested reference books

1. Computer Networks, 8th Edition, Andrew S. Tanenbaum, Pearson New International Edition.
2. Internetworking with TCP/IP, Volume 1, 6th Edition Douglas Comer, Prentice Hall of India.
3. TCP/IP Illustrated, Volume 1, W. Richard Stevens, Addison-Wesley, United States of America.

ADVANCED ELECTRIC DRIVES

PROFFESSIONAL ELECTIVE -V

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A4EE46	PEC	3	0	0	3	30	70	100

COURSE OVERVIEW:

A series of exercises and experiments covering bottom-up structural design and top-down behavioral design using Verilog and System Verilog (IEEE Std. 1800) for circuit description and design verification. Lab exercises emphasize use of professional compilation and simulation tools for design validation.

PREREQUISITE(S) :

Students need a thorough understanding of Boolean algebra, combinational and sequential digital circuits and number systems (binary, hexadecimal).

COURSE OBJECTIVE: The main objective of this course is to train the students to meet the industrial needs.

COURSE OUTCOMES:

At the end of this course, students will demonstrate the ability to
- Understand the basic concepts of electromagnetics.
- Understand computational techniques for computing fields.
- Apply the techniques to simple real-life problems.

SYLLABUS

Unit- 1: Power Converters for AC drives: **Classes: 10**

PWM control of inverter, selected harmonic elimination, space vector modulation, current control of VSI, three level inverter, Different topologies, SVM for 3 level inverter, Diode rectifier with boost chopper, PWM converter as line side rectifier, current fed inverters with self-commutated devices. Control of CSI, H bridge as a 4-Q drive.

Unit- 2: Induction motor drives: **Classes: 10**

Different transformations and reference frame theory, modeling of induction machines, voltage fed inverter control-v/f control, vector control, direct torque and flux control(DTC).

Unit- 3: Synchronous motor drives: **Classes: 10**

Modeling of synchronous machines, open loop v/f control, vector control, direct torque control, CSI fed synchronous motor drives.

Unit- 4: Permanent magnet motor drives: **Classes: 10**

Introduction to various PM motors, BLDC and PMSM drive configuration, comparison, block diagrams, Speed and torque control in BLDC and PMSM.

Unit- 5: Switched reluctance motor drives: **Classes: 10**

Evolution of switched reluctance motors, various topologies for SRM drives, comparison, Closed loop speed and torque control of SRM. DSP based motion control:s Use of DSPs in motion control, various DSPs available, realization of some basic blocks in DSP for implementation of DSP based motion control.

Text / References:

1. B. K. Bose, "Modern Power Electronics and AC Drives", Pearson Education, Asia, 2003.
2. P. C. Krause, O. Wasynczuk and S. D. Sudhoff, "Analysis of Electric Machinery and Drive Systems", John Wiley & Sons, 2013.
3. H. A. Taliyat and S. G. Campbell, "DSP based Electromechanical Motion Control", CRC press, 2003.
4. R. Krishnan, "Permanent Magnet Synchronous and Brushless DC motor Drives", CRC Press, 2009

FLEXIBLE ALTERNATING CURRENT TRANSMISSION SYSTEMS

PROFFESSIONAL ELECTIVE -V

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A4EE47	PEC	3	0	0	3	30	70	100

COURSE OVERVIEW:

A series of exercises and experiments covering bottom-up structural design and top-down behavioral design using Verilog and System Verilog (IEEE Std. 1800) for circuit description and design verification. Lab exercises emphasize use of professional compilation and simulation tools for design validation.

PREREQUISITE(S) :

Students need a thorough understanding of Boolean algebra, combinational and sequential digital circuits and number systems (binary, hexadecimal).

COURSE OBJECTIVE: The main objective of this course is to train the students to meet the industrial needs.

COURSE OUTCOMES:

At the end of this course, students will demonstrate the ability to
- Understand the basic concepts of electromagnetics.
- Understand computational techniques for computing fields.
- Apply the techniques to simple real-life problems.

SYLLABUS

Unit- 1: Transmission Lines and Series/Shunt Reactive Power Compensation: **Classes: 8**
Basics of AC Transmission. Analysis of uncompensated AC transmission lines. Passive Reactive Power Compensation. Shunt and series compensation at the mid-point of an AC line. Comparison of Series and Shunt Compensation.

Unit- 2: Thyristor-based Flexible AC Transmission Controllers (FACTS): **Classes: 10**
Description and Characteristics of Thyristor-based FACTS devices: Static VAR Compensator (SVC), Thyristor Controlled Series Capacitor (TCSC), Thyristor Controlled Braking Resistor and Single Pole Single Throw (SPST) Switch. Configurations/Modes of Operation, Harmonics and control of SVC and TCSC. Fault Current Limiter.

Unit- 3: Voltage Source Converter based (FACTS) controllers: **Classes: 12**
Voltage Source Converters (VSC): Six Pulse VSC, Multi-pulse and Multi-level Converters, Pulse-Width Modulation for VSCs. Selective Harmonic Elimination, Sinusoidal PWM and Space

Vector Modulation. STATCOM: Principle of Operation, Reactive Power Control: Type I and Type II controllers, Static Synchronous Series Compensator (SSSC) and Unified Power Flow Controller (UPFC): Principle of Operation and Control. Working principle of Interphase Power Flow Controller. Other Devices: GTO Controlled Series Compensator. Fault Current Limiter.

Unit- 4: Application of FACTS: **Classes: 8**

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.

Unit-5: DSTATCOM: **Classes: 12**

Reactive Power Compensation, Harmonics and Unbalance mitigation in Distribution Systems using DSTATCOM and Shunt Active Filters. Synchronous Reference Frame Extraction of Reference Currents. Current Control Techniques in for DSTATCOM.
Dynamic Voltage Restorer and Unified Power Quality Conditioner: Voltage Sag/Swell mitigation: Dynamic Voltage Restorer – Working Principle and Control Strategies. Series Active Filtering. Unified Power Quality Conditioner (UPQC): Working Principle. Capabilities and Control Strategies

Text/References

1. N. G. Hingorani and L. Gyugyi, “Understanding FACTS: Concepts and Technology of FACTS Systems”, Wiley-IEEE Press, 1999.
2. K. R. Padiyar, “FACTS Controllers in Power Transmission and Distribution”, New Age International (P) Ltd. 2007.
3. T. J. E. Miller, “Reactive Power Control in Electric Systems”, John Wiley and Sons, New York, 1983.
4. R. C. Dugan, “Electrical Power Systems Quality”, McGraw Hill Education, 2012. 5. G. T. Heydt, “Electric Power Quality”, Stars in a Circle Publications, 1991

SPECIAL ELECTRICAL MACHINES
PROFFESSIONAL ELECTIVE –VI

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A4EE48	PEC	3	0	0	3	30	70	100

COURSE OVERVIEW:

PREREQUISITE(S) :

COURSE OBJECTIVES:

- To impart knowledge on Construction, principle of operation and performance of synchronous reluctance motors.
- To impart knowledge on the Construction, principle of operation, control and performance of stepping motors.
- To impart knowledge on the Construction, principle of operation, control and performance of switched reluctance motors.
- To impart knowledge on the Construction, principle of operation, control and performance of permanent magnet brushless D.C. motors.
- To impart knowledge on the Construction, principle of operation and performance of permanent magnet synchronous motors.

COURSE OUTCOMES : Ability to model and analyze electrical apparatus and their application to power system

SYLLABUS

UNIT I SYNCHRONOUS RELUCTANCE MOTORS : **Classes: 10**

Constructional features – Types – Axial and Radial flux motors – Operating principles – Variable Reluctance Motors – Voltage and Torque Equations - Phasor diagram - performance characteristics – Applications.

UNIT II STEPPER MOTORS : **Classes: 10**

Constructional features – Principle of operation – Variablereluctance 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.

UNIT III SWITCHED RELUCTANCE MOTORS (SRM): **Classes: 10**

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.

UNIT IV PERMANENT MAGNET BRUSHLESS D.C. MOTORS: **Classes: 10**

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.

UNIT V PERMANENT MAGNET SYNCHRONOUS MOTORS (PMSM): **Classes: 10**

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, 2008.
2. T.J.E. Miller, 'Brushless Permanent Magnet and Reluctance Motor Drives', Clarendon Press, Oxford, 1989.
3. T. Kenjo, 'Stepping Motors and Their Microprocessor Controls', Clarendon Press London, 1984.

REFERENCES:

1. R.Krishnan, 'Switched Reluctance Motor Drives – Modeling, Simulation, Analysis, Design and Application', CRC Press, New York, 2001.
2. P.P. Aearnley, 'Stepping Motors – A Guide to Motor Theory and Practice', Peter Perengrinus London, 1982.
3. T. Kenjo and S. Nagamori, 'Permanent Magnet and Brushless DC Motors', Clarendon Press, London, 1988.
4. E.G. Janardanan, 'Special electrical machines', PHI learning Private Limited, Delhi, 2014.

ADVANCED CONTROL SYSTEMS

(PROFESSIONAL ELECTIVE- VI)

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A4EE49	PEC	3	0	0	3	30	70	100

COURSE OVERVIEW:

To understand the concept of state variable and stability analysis.

PREREQUISITE(S): Basics on control systems, Laplace transform and other transformation

COURSE OBJECTIVES:

I. Apply phase plane analysis to linear and non linear control systems.

II. Analyze the stability of the systems using different techniques.

III. Illustrate the design of optimal controller.

IV. Demonstrate state variable analysis, non-linear systems and optimal control.

COURSE OUTCOMES:

After going through this course the student will be able to

I. Apply phase plane analysis to linear and non linear control systems.

II. Analyze the stability of the systems using different techniques.

III. Illustrate the design of optimal controller.

IV. Demonstrate state variable analysis, non-linear systems and optimal control.

SYLLABUS

UNIT- I STATE VARIABLE ANALYSIS: **Classes: 10**

Concept of state , state variable and state model, state models for linear and continuous time systems,solution of state and output equation, controllability and observability, pole placement, state observer design of control systems with observers

UNIT-II PHASE LINE ANALYSIS: **Classes: 10**

Features of linear and non linear systems, common physical non linearity's, methods of linearising non linear systems, concept of phase portraits, singular points, limit cycles, construction of phase portraits, phase plane analysis of linear and non linear systems, isoclines method

UNIT -III DESCRIBING FUNCTION ANALYSIS: **Classes: 10**

Basic concepts, derivation of describing functions for common non-linearities. Describing function analysis of non-linear systems, Conditions for stability, Stability of oscillation

UNIT - IV STABILITY ANALYSIS: **Classes: 10**

Introduction, Liapunov‟s stability concept, Liapunov‟s direct method, Lure‟s transformation, Aizerman‟s and Kaman‟s conjecture, Popov‟s criterion, Circle criterion.

UNIT – V OPTIMAL CONTROL: **Classes: 10**

Introduction, decoupling, time varying optimal control, linear quadratic regulator (LQR), steady state optimal control, optimal estimation, multivariable control design

TEXT BOOKS:

I. J Nagrath and M Gopal, „Control Systems Engineering‟, New Age International Publishers

2.Ashish Tewari, „Modern control Design with Matlab and Simulink‟, John Wiley, 2nd Edition, 2002

REFERENCE BOOKS:

1.George J Thaler, “Automatic Control Systems”, Jaico Publishers, 1st Edition, 1993.

2.M Gopal, “Modern control system theory”, New Age International Publishers, 1st Edition, 2002.

3.Gene F Franklin, J David Powell, Abbasemami-Naeini, “Feedback Control of Dynamic Systems”, 4th

Edition, Pearson Education, 1st Edition 2002.

MODELLING AND ANALYSIS OF ELECTRICAL MACHINES
(PROFESSIONAL ELECTIVE- V1)

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A4EE50	PEC	3	0	0	3	30	70	100

-

COURSE OBJECTIVES:

- To learn about the basic concepts of AC/ DC machine modelling.
- To study about the dynamic modelling and phase transformation.
- To understand the modelling of synchronous machine modelling.
- To learn the performance and dynamic modelling of synchronous machines

OUTCOMES:

- Ability to understand the various electrical parameters in mathematical form.
- Ability to understand the different types of reference frame theories and transformation relationships.
- Ability to find the electrical machine equivalent circuit parameters and modelling of electrical machines.

SYLLABUS

UNIT I :PRINCIPLES OF ELECTROMAGNETIC ENERGY CONVERSION : **Classes: 10**

Magnetic circuits, permanent magnet, stored magnetic energy, co-energy – force and torque in singly and doubly excited systems – machine windings and air gap mmf – winding inductances and voltage equations.

UNIT II: DC MACHINES : **Classes: 10**

Elementary DC machine and analysis of steady state operation – Voltage and torque equations – dynamic characteristics of permanent magnet and shunt d.c. motors – Time domain block diagrams – solution of dynamic characteristic by Laplace transformation – digital computer simulation of permanent magnet and shunt D.C. machines.

UNIT III :REFERENCE FRAME THEORY : **Classes: 10**

Historical background – phase transformation and commutator transformation – transformation of variables from stationary to arbitrary reference frame – variables observed from several frames of reference.

UNIT IV :INDUCTION MACHINES *:* **Classes: 10**

Three phase induction machine, equivalent circuit and analysis of steady state operation – free acceleration characteristics – voltage and torque equations in machine variables and arbitrary reference frame variables – analysis of dynamic performance for load torque variations – digital computer simulation.

UNIT V: SYNCHRONOUS MACHINES: **Classes: 10**

Three phase synchronous machine and analysis of steady state operation – voltage and torque equations in machine variables and rotor reference frame variables (Park's equations) – analysis of dynamic performance for load torque variations – Generalized theory of rotating electrical machine and Krons primitive machine.

TEXT BOOK/REFERENCES:

1. Paul C.Krause, Oleg Wasyzczuk, Scott S, Sudhoff, "Analysis of Electric Machinery and Drive Systems", John Wiley, Second Edition, 2010..
2. P S Bimbhra, "Generalized Theory of Electrical Machines", Khanna Publishers, 2008
3. A.E, Fitzgerald, Charles Kingsley, Jr, and Stephan D, Umanx, " Electric Machinery",Tata McGraw Hill, 5th Edition, 1992
4. R. Krishnan, Electric Motor & Drives: Modeling, Analysis and Control, New Delhi, Prentice Hall of India, 2001

SMART GRID TECHNOLOGIES

(PROFESSIONAL ELECTIVE- V1)

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A4EE51	PCC	3	0	0	3	30	70	100

Course Objectives:

- To understand various aspects of smart grid
- To study various smart transmission and distribution technologies
- To appreciate distribution generation and smart consumption
- To know the regulations and market models for smart grid

Course Outcomes: Upon the completion of the subject, the student will be able to

- Understand technologies for smart grid
- Appreciate the smart transmission as well distribution systems
- Realize the distribution generation and smart consumption
- Know the regulations and market models for smart grid

UNIT – I: Introduction to Smart Grids: Definition, justification for smart grids, smart grid conceptual model, smart grid architectures, Interoperability, communication technologies, role of smart grids standards, intelligrid initiative, national smart grid mission (NSGM) by Govt. of India

UNIT – II: Smart Transmission Technologies: Substation automation, Supervisory control and data acquisition (SCADA), energy management system (EMS), phasor measurement units (PMU), Wide area measurement systems (WAMS)

UNIT – III: Smart Distribution Technologies: Distribution automation, outage management systems, automated meter reading (AMR), automated metering infrastructure (AMI), fault location isolation and service restoration (FLISR), Outage Management Systems (OMS), Energy Storage, Renewable Integration

UNIT – IV: Distributed Generation and Smart Consumption: Distributed energy resources (DERs), smart appliances, low voltage DC (LVDC) distribution in homes / buildings, home energy management system (HEMS), Net Metering, Building to Grid B2G, Vehicle to Grid V2G, Solar to Grid, Microgrid

UNIT – V: Regulations and Market Models for Smart Grid: Demand Response, Tariff Design, Time of the day pricing (TOD), Time of use pricing (TOU), Consumer privacy and data protection, consumer engagement etc. Cost benefit analysis of smart grid projects.

TEXT BOOKS:

Clark W Gellings, "The Smart Grid, Enabling Energy Efficiency and Demand Side Response"- CRC Press, 2009.

Jean Claude Sabonnadière, Nouredine Hadjsaïd, "Smart Grids", Wiley-ISTE, IEEE Press, May 2012

REFERENCES:

- Janaka Ekanayake, Kithsiri Liyanage, Jianzhong. Wu, Akihiko Yokoyama, Nick Jenkins, "Smart Grid: Technology and Applications"- Wiley, 2012.
- James Momoh, "Smart Grid: Fundamentals of Design and Analysis" – Wiley, IEEE Press, 2012.
- India Smart Grid Knowledge Portal

OPEN ELECTIVES
OFFERED BY
DEPT.OF ELECTRICAL &ELCTRONICS ENGINEERING

ELECTRICAL WIRING AND SAFETY MEASURES

V Semester: OPEN ELECTIVE –I

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A4EE52	OEC	3	-	-	3	30	70	100

COURSE OBJECTIVES

1. To Study the wiring diagram of residential.
2. To understand the Safety measures of Electrical wiring

COURSE OUTCOMES:

The students should be able to

1. Know safety measures & state safety precautions.
2. Test single phase, three phase transformer, DC & AC machine as per IS.
3. Ascertain the condition of insulation & varnishing if necessary
4. Identify faults & measures to repair faults.

UNIT-I	BASICS OF ELECTRICAL INSTALLATIONS	Classes: 12

Electric Supply System, Three phase four wire distribution system, Protection of Electric Installation against over load, short circuit and Earth fault, General requirements of electrical installations, testing of installations, 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, Guide lines for Installation of Fittings, Load Assessment, Permissible voltage drops and sizes of wires, estimating and costing of Electric installations.

UNIT-II	EARTHING	Classes: 08

Introduction & importance, Factors affecting Earth Resistance, Methods of earthling Substation and Transmission tower earthling, Neutral and Earth wire, Transformer Neutral Earthling.

UNIT-III	SAFETY & PREVENTION OF ACCIDENTS	Classes: 08

Definition of terminology used in safety , I.E. Act & statutory regulations for safety of persons &equipments working with electrical installation . Dos & don'ts for substation operators as listedin IS. Meaning & causes of electrical accidents factors on which severity of shock depends.

UNIT-IV	RESIDENTIAL BUILDING ELECTRIFICATION	Classes: 10

General rules guidelines for wiring of Residential Installation and positioning of equipments. Principles of circuit design in lighting and power circuits. Procedures for designing the circuits and deciding the number of sub-circuits. Method of drawing single line diagram & wiring diagram.

UNIT-V	R ENDS& SUBSTATION AND METERS	Classes: 12

Rule 28 : Voltage level definitions. Rule 30: Service lines & apparatus on consumer premises.

Rule 31: Cut-out on consumer's premises.

Rule46: Periodical inspection & testing of consumer's installation.

Rule 47: Testing of consumer's installation.

Rule 54: Declared voltage of supply to consumer.

Rule 55: Declared frequency of supply to consumer.

Rule 56: Sealing of meters &cut-outs.

Rule 77: Clearances above ground of the lowest conductor.

Rule 79: Clearances between conductors & trolley wires.

Rule 87: Lines crossing or approaching each other.

Rule 88: Guarding.

Text Books:

1. K.B. Raina, S.K.Bhattacharya Electrical Design;Estimating and costing New Age International (p) Limited, New Delhi Surjit Singh.

2. Electrical Estimating and costing Dhanpat Rai and company, New Delhi .J.B.Gupta

3.A course in Electrical Installation, Estimating & costing S.K.Kataria&sons,S.L. Uappal .

4. Electrical wiringEstimating and costing Khanna Publication. ,A.K.Sawhney

Reference Books:

1.Electrical Machine Design Danpat Rai & co.

2. The Electricity Rule 2005Universal Law Publishing Co. Pvt. Ltd. N. AlagapanS. Ekambaram

3. Electrical Estimating and costing Tata Mc Graw Hill Publication, New Delhi ,Surjit Singh

4. TarlokSibgh Installation, Commissioning & Maintenance of Electrical Equipment S.K.Kataria& Sons

5. B.V.S.Rao Operation & Maintenance of Electrical Machines Vol I & II Media Promoters & Publisher Ltd. Mumbai

Web References:

1. https://electrical-engineering-portal.com › Technical Articles
2. https://www.st-andrews.ac.uk/staff/policy/healthandsafety/publications/electricalsafety/
3. https://www.cpwd.gov.in/Publication/Internal2013.pdf

E-Text Books:

1. https://books.google.co.in/books?isbn=0323170064
2. https://www.jove.com/science.../electrical-safety-precautions-and-basic-equipment

MOOC Course

1. https://nptel.ac.in/courses/103106071/5
2. https://nptel.ac.in/courses/108108099/28
3. https://nptel.ac.in/courses/124107001/

ELECTRICAL MATERIALS

V Semester: OPEN ELECTIVE –I

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A4EE53	OEC	3	-	-	3	30	70	100

COURSE OBJECTIVES

To understand about various electrical engineering material

COURSE OUTCOMES:

The students should be able to

1. Analyze the various engineering materials.
2. Application of various engineering materials.

UNIT-I	CONDUCTORS	Classes: 10

Classification: High conductivity, high resistivity materials, fundamental requirements ofhigh conductivity materials and high resistivity materials, mobility of electron in metals,commonly used high conducting materials, copper, aluminum, bronze brass, properties, characteristics, constantan, platinum, nichrome, properties, characteristics and applications,materials used for contacts.

UNIT-II	SEMICONDUCTORS	Classes: 08

General concepts, energy bands, types of semiconductors, Fermi Dirac distribution, intrinsicSemi-conductors, extrinsic Semi-conductors, hall effect, drift, mobility, diffusion in Semiconductors,Semi-conductorsand their applications, superconductors.

UNIT-III	DIELECTRICS AND INSULATORS	Classes: 12

Properties of gaseous, liquid and solid dielectric, dielectric as a field medium, electric conduction in gaseous, liquid and solid dielectric, breakdown in dielectric materials, mechanical and electrical properties of dielectric materials, effect of temperature on dielectric materials, polarization, loss angle and dielectric loss, petroleum based insulating oils, transformer oil, capacitor oils, properties, solid electrical insulating materials, fibrous, paper boards, yarns, cloth tapes, sleeving wood, impregnation, plastics, filling and bounding materials, fibrous, film, mica, rubber, mica based materials, ceramic materials, classification of insulation (solid) and application in AC and DC machines.

UNIT-IV	MAGNETIC MATERIALS	Classes: 10

Soft and hard magnetic materials, diamagnetic, paramagnetic and ferromagnetic materials, electric steel, sheet steel, cold rolled grain oriented silicon steel, hot rolled grain oriented silicon steel, hot rolled silicon steel sheet, hysteresis loop, hysteresis loss, magnetic susceptibility, coercive force, curie temperature, magneto-striction.

UNIT-V	OPTICAL PROPERTIES OF SOLIDS	Classes: 10

Photo emission, photo emission materials, electro luminescence junction diode, photo emitters, photo transistor, photo resistors, injunction lasers, optical properties of semiconductors, application of photo sensitive materials (CRT, Tube light, photo panels etc.).

Text Books:

1. "Electrical Engineering Materials",Dekker,PHIPbs.
2. "Electrical Engineering Materials", Indulkar,S.Chand

Reference Books:

1. "Electrical Engineering Materials", Tareev
2. "Electrical Engineering Materials", Yu. Koritsky.
3. "Electrical Engineering Materials", R.K.Rajput, LaxmiPbs

Web References:

1. https://physics.info/dielectrics/
2. https://www.oxfordreference.com/view/10.1093/oi/authority.20110803095631265
3. web.mit.edu/course/6/6.732/www/6.732-pt2.pdf

E-Text Books:

1. https://easyengineering.net/electrical-engineering-materials-by-dekker/
2. https://www.oreilly.com/library/view/dielectric-materials-for/9781118619780/

MOOC Course

1. 1. https://nptel.ac.in/courses/108108076/
2. https://nptel.ac.in/courses/112104203/3
3. https://onlinecourses.nptel.ac.in/noc18_ee14/

NEW TRENDS IN ELECTRICAL ENERGY

V Semester: OPEN ELECTIVE –I

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A4EE54	OEC	3	-	-	3	30	70	100

COURSE OBJECTIVES

1. The fundamental principles of wireless power transfer (WPT) for cable-free transfer of power.
2. Theories for inductive power transfer (IPT) based on the coupled inductor model and low-order circuit compensation.
3. Specific converter topologies for lighting and battery charging applications.
4. Technology trends in the adoption of WPT for key consumer applications.

COURSE OUTCOMES:

The students should be able to

1. Understand the characteristics of power transfer through coupled inductors and the significance of leakage inductance.
2. Analyze and design appropriate compensation circuits and efficient power converters for WPT applications.
3. Understand technical requirements for applications involving solid-state loads and battery loads using WPT technologies.
4. Appreciate the factors affecting adoption of WPT in consumer applications including lightings, charging of smartphones and electric vehicles.

UNIT-I	BASIC CIRCUIT THEORY	Classes: 10

Review of transformers. Leakage inductance. Circuit compensation principles. Low-order compensations; series and parallel compensations. Resonance and operating frequency. Efficiency equation.

UNIT-II	POWER CONVERTERS FUNDAMENTALS	Classes: 10

DC-DC converters. AC-DC converters and inverters. PWM and soft switching principles. Basic topologies with transformers. Input, output and transfer characteristics of power converters. Incorporation of leaky transformer. Control methods.

UNIT-III	COMPENSATION CONFIGURATIONS	Classes: 10

Types of compensation for inductor power transfer. Characteristics for various termination requirements. Design for load-independence output voltage and output current. Efficiency optimization.

UNIT-IV	APPLICATIONS	Classes: 10

Circuit requirements for various loading conditions. Characteristics of LED loads, resistors and battery loads. Appropriate compensation design. Lighting systems. Battery charging profiles. Electric vehicle charging. Energy efficiency metric for charging.

UNIT-V	TECHNOLOGY TRENDS	Classes: 10

Demand for safe power transfer and durable operation. Portable and smart devices. Mobile communication devices. IoT devices and systems. Sensors. Solid-state lighting development. Battery technologies. Electric vehicle development. Renewable source integration trends. Future trends and demand for wireless power transfer.

Text Books:

1. C. T. Rim and C. Mi, Wireless Power Transfer for Electric Vehicles and Mobile Devices, New York: IEEE Press-Wiley, 2017.
2. J. I. Agbinya, Wireless Power Transfer, River Publishers, 2015

Reference Books:

1. Z. Huang, S. C. Wong, and C. K. Tse, "Design of a single-stage inductivepower-transfer converter for efficient EV battery charging," IEEE Transactions on Vehicular Technology, vol. 66, no. 7, pp. 5808-5821, July 2017.
2. L. Xu, Q. Chen, X. Ren, S. C. Wong, and C. K. Tse, "Self-oscillating resonant converter with contactless power transfer and integrated current sensing transformer," IEEE Transactions on Power Electronics, vol. 32, no. 6, pp. 4839-4851, June 2017.
3. W. Zhang, S. C. Wong, C. K. Tse, and Q. Chen, "Load-independent duality of current and voltage outputs of a series or parallel compensated inductive power transfer converter with optimized efficiency," IEEE Journal of Emerging and Selected Topics in Power Electronics, vol. 3, no. 1, pp. 137-146, March 2015.
4. J. Hou, Q. Chen. X. Ren, X. Ruan, S. C. Wong, and C. K. Tse, "Precise characteristics analysis of series/series-parallel compensated contactless resonant converter," IEEE Journal of Emerging and Selected Topics in Power Electronics, vol. 3, no. 1, 101-110, March 2015.

Web References:

1. https://www.researchgate.net/.../267512972_Wireless_Power_Transmission_Trends
2. https://ieeexplore.ieee.org/document/6403386
3. https://www.cse.wustl.edu/~jain/cse574-14/ftp/power/

E-Text Books:

1. https://books.google.co.in/books/about/Wireless_Power_Transfer.html?id...
2. https://www.intechopen.com/books/wireless-power-transfer-principles-and-engineering-explorations

MOOC Course:

1. https://ocw.mit.edu/.../6-452-principles-of-wireless-communications-spring-2006/
2. www.iitg.ac.in/e_mobility/WPT.html
3. https://nptel.ac.in/courses/117102062/
4. https://nptel.ac.in/courses/117104099/2
5. https://nptel.ac.in/courses/117106108/150

POWER PLANT ENGINEERING

VI Semester: OPEN ELECTIVE –II

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A4EE55	OEC	3	-	-	3	30	70	100

COURSE OBJECTIVES

1. To Study the wiring diagram of residential.

2. To understand the Safety measures of Electrical wiring

COURSE OUTCOMES:

The students should be able to

1. Know safety measures & state safety precautions.

2. Test single phase, three phase transformer, DC & AC machine as per IS.

3. Ascertain the condition of insulation & varnishing if necessary

4. Identify faults & measures to repair faults.

UNIT-I	INTRODUCTION TO THE SOURCES OF ENERGY	Classes: 10

Resources and Development of Power in India. Steam Power Plant: Plant Layout, Working of different Circuits, Fuel and handling equipment, types of coals, coal handling, choice of handling equipment, coal storage, Ash handling systems.Combustion Process: Properties of coal — overfeed and underfeed fuel beds, traveling grate stokers, spreader stokers, retort stokers, pulverized fuel burning system and its components, combustion needs and drought system, cyclone furnace, design and construction, Dust collectors, cooling towers and heat rejection. Corrosion and feed water treatment.

UNIT-II	INTERNAL COMBUSTION ENGINE PLANT	Classes: 10

DIESEL POWER PLANT: Introduction — IC Engines, types, construction— Plant layout with auxiliaries fuel supply system, air starting equipment,

lubrication and cooling system-super charging. Gas Turbine Plant:

Introduction — classification – construction — Layout with auxiliaries — Principles of working of closed and open cycle gas turbines. Combined Cycle Power Plants and comparison. Direct Energy Conversion: Solar energy, Fuel cells, Thermo electric and Thermo ionic, MHD generation.

UNIT-III	HYDRO ELECTRIC POWER PLANT	Classes: 08

Water power — Hydro logical cycle / flow measurement — drainage area characteristics — Hydro graphs — storage and Poundage — classification of dams and spill ways.

Hydro Projects And Plant: Classification — Typical layouts — plant auxiliaries — plant operation pumped storage plants. Power From Non-Conventional Sources: Utilization of Solar- Collectors- Principle of Working, Wind Energy — types — HAWT, VAWT Tidal Energy.

UNIT-IV	NUCLEAR POWER STATION	Classes: 10

Nuclear fuel — breeding and fertile materials — Nuclear reactor — reactor operation. Types of Reactors: Pressurized water reactor, Boiling water reactor, sodium-graphite reactor, fast Breeder Reactor, homogeneous Reactor, Gas cooled Reactor, Radiation hazards and shielding radioactive waste disposal.

UNIT-V	POWER PLANT ECONOMICS AND ENVIRONMENTAL CONSIDERATIONS	Classes: 12

Capital cost, investment of fixed charges, operating costs, general arrangement of power distribution, Load curves, load duration curve. Definitions of connected load, Maximum demand, demand factor, average load, load factor, diversity factor — related exercises. Effluents from power plants and Impact on environment — pollutants and pollution standards — Methods of Pollution control.

Text Books:

1. Power Plant Engineering! P.C.Sharma / S.K.Kataria Pub.
2. A Course in Power Plant Engineering: I Arora and S. Domkundwar.

Reference Books:

1. A Text Book of Power Plant Engineering I Rajput I Laxmi Publications.
2. Power Plant Engineering: P.K.Nag/ II Edition /TMH.
3. An Introduction to Power Plant Technology I G.D. Rai/Khanna Publishers.
4. Power plant Engg I Elanchezhian/ l.K. International Pub.
5. Power plant Engineering! Ramalingam / Scietech Publishers.

Web References:

1. www.cbspd.co.in/power-plant-engineering-9788123919461-black-veatch.html
2. https://www.semcomaritime.com/en-en/references/power-generation

E-Text Books:

1. https://www.intechopen.com/books/subject/power-plant-engineering
2. https://books.google.co.in/books?isbn=1482221519

MOOC Course

1. https://nptel.ac.in/courses/108105058/8
2. www.nptelvideos.in/2012/11/energy-resources-and-technology.html
3. www.ignou.ac.in/upload/Unit-2-58.pdf

ANALYSIS OF LINEAR SYSTEMS

VI Semester: OPEN ELECTIVE –II

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A4EE56	OEC	3	-	-	3	30	70	100

COURSE OBJECTIVES

1. To develop ability to analyze linear systems and signals
2. To develop critical understanding of mathematical methods to analyze linear systems and signals

COURSE OUTCOMES:

The students should be able to

1. Use mathematical modeling tools to represent linear systems
2. Use mathematical modeling tools to analyze linear systems

UNIT-I	STATE VARIABLE ANALYSIS	Classes: 08

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.

UNIT-II	FOURIER SERIES AND FOURIER TRANSFORM REPRESENTATION	Classes: 12

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.

UNIT-III	LAPLACE TRANSFORM APPLICATIONS	Classes: 10

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

UNIT-IV	SAMPLING	Classes: 10

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.

UNIT-V	Z-TRANSFORMS	Classes: 10

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://archive.org/details/introductiontoli00brow
2. https://ieeexplore.ieee.org/iel5/9/24171/01101971.pdf

E-Text Books:

1. www.cds.caltech.edu/~murray/books/AM08/pdf/am08-complete_04Mar10.pdf
2. https://www.springer.com/gp/book/9780387975733

MOOC Course:

1. www.nptelvideos.in/2012/11/estimation-of-signals-and-systems.html
2. https://nptel.ac.in/courses/108104100/6

NEURAL NETWORKS AND FUZZY LOGIC

VI Semester: OPEN ELECTIVE –II

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A4EE57	OEC	3	-	-	3	30	70	100

COURSE OBJECTIVES

1. To understand the fundamental theory and concepts of neural networks, neuro-modeling, several neural network paradigms and its applications.
2. To understand the concepts of fuzzy sets, knowledge representation using fuzzy rules, approximate reasoning, fuzzy inference systems, and fuzzy logic control and other machine intelligence applications of fuzzy logic.
3. To understand the basics of an evolutionary computing paradigm known as genetic algorithms and its application to engineering optimization problems.

COURSE OUTCOMES:

The students should be able to

1. Comprehend the concepts of feed forward neural networks
2. Analyze the various feedback network.
3. Understand the concept of fuzziness involved in various systems and fuzzy set theory.
4. Comprehend the fuzzy logic control and adaptive fuzzy logic and to design the fuzzy control using genetic algorithm.
5. Analyze the application of fuzzy logic control to real time systems.

UNIT-I	INTRODUCTION & ESSENTIALS TO NEURAL NETWORKS	Classes: 12

Introduction, Humans and Computers, Organization of the Brain, Biological Neuron, Biological and Artificial Neuron Models, Hodgkin-Huxley Neuron Model, Integrate-and-Fire Neuron Model, Spiking Neuron Model, Characteristics of ANN, McCullochPiUs Model, Historical Developments, Potential Applications of ANN. Artificial Neuron Model, Operations of Artificial Neuron, Types of Neuron Activation Function, ANN Architectures, Classification Taxonomy of ANN — Connectivity, Neural Dynamics (Activation and Synaptic), Learning Strategy (Supervised, Unsupervised, Reinforcement), Learning Rules, Types of Application

UNIT-II	SINGLE & MULTI LAYER FEED FORWARD NEURAL NETWORKS	Classes: 10

Introduction, Perceptron Models: Discrete, Continuous and Multi-Category, Training.

Algorithms:

Discrete and Continuous Perceptron Networks, Perceptron Convergence theorem, Limitations of the Perceptron Model, Applications. Credit Assignment Problem, Generalized Delta Rule, and Derivation of Back-propagation (BP) Training, Summary of Back-propagation Algorithm, Kolmogorov Theorem, Learning Difficulties and Improvements.

UNIT-III	ASSOCIATIVE MEMORIES-I	Classes: 08

Paradigms of Associative Memory, Pattern Mathematics, Hebbian Learning, General Concepts of Associative Memory (Associative Matrix, Association Rules, Hamming Distance, The Linear Associator, Matrix Memories, Content Addressable Memory).

UNIT-IV	ASSOCIATIVE MEMORIES-II	Classes: 10

Bidirectional Associative Memory (BAM) Architecture, BAM Training Algorithms: Storage and Recall Algorithm, BAM Energy Function, Proof of BAM Stability Theorem. Architecture of Hoptield

Network: Discrete and Continuous versions, Storage and Recall Algorithm, Stability Analysis, Capacity of the Hopfield Network Summary and Discussion of Instance/Memory Based Learning Algorithms, Applications

UNIT-V	FUZZY LOGIC	Classes: 10

Classical & Fuzzy Sets: Introduction to classical sets – properties, Operations and relations; Fuzzy sets, Membership, Uncertainty, Operations, properties, fuzzy relations, cardinalities, membership functions.

Fuzzy Logic System Components:Fuzzification, Membership value assignment, development of rule base and decision making system, Def uzzification to crisp sets, De—fuzzification methods.

Text Books:

1. Neural Networks, Fuzzy logic, Genetic algorithms: synthesis and applications, Rajasekharan and Pal, PHI.
2. Neural Networks and Fuzzy Logic, C. Naga Bhaskar, G. Vijay Kumar, BS Publicatior-is.

Reference Books:

1. Artificial Neural Networks, B. Yegnanarayana, PHI.
2. Artificial Neural Networks, Zaruda, PHI.
3. Neural Networks and Fuzzy Logic System, Bail Kosko, PHI.
4. Fuzzy Logic and Neural Networks, M. Amirthavalli, Scitech Publications India Pvt. Ltd.
5. Neural Networks, James A Freeman and Davis Skapura, Pearson Education.
6. Neural networks by satish Kumar, TIVIH, 2004
7. Neural Networks, Simon Hakins , Pearson Education.
8. Neural Engineering, C.Eliasmith and CH.Anderson, PHI.

Web References:

1. users.monash.edu/~app/CSE5301/Lnts/LaD.pdf
2. https://engineering.purdue.edu/~tsoukala/rational.html
3. https://pdfs.semanticscholar.org/5e31/c55a00eb3945e3e483caa2e146a95c12f5aa.pdf

E-Text Books:

1. https://www.mheducation.co.in/computer.../neural-networks-fuzzy-systems/text-book
2. www.crectirupati.com/sites/default/files/lecture_notes/NNFL.pdf
3. www.vssut.ac.in/lecture_notes/lecture1423723637.pdf

MOOC Course:

1. https://nptel.ac.in/noc/individual_course.php?id=noc19-ge07
2. https://nptel.ac.in/courses/108104049/16
3. https://nptel.ac.in/courses/117105084/
4. https://nptel.ac.in/syllabus/127105006/

ELECTRICAL ENGINEERING MATERIALS

VII Semester: OPEN ELECTIVE –III

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A4EE58	OEC	3	-	-	3	30	70	100

COURSE OBJECTIVES

To understand about various electrical engineering material

COURSE OUTCOMES:

The students should be able to

1. Analyze the various engineering materials.
2. Application of various engineering materials.

UNIT-I	CONDUCTORS	Classes: 10

Classification: High conductivity, high resistivity materials, fundamental requirements ofhigh conductivity materials and high resistivity materials, mobility of electron in metals,commonly used high conducting materials, copper, aluminum, bronze brass, properties, characteristics, constantan, platinum, nichrome, properties, characteristics and applications,materials used for contacts.

UNIT-II	SEMICONDUCTORS	Classes: 08

General concepts, energy bands, types of semiconductors, Fermi Dirac distribution, intrinsicSemi-conductors, extrinsic Semi-conductors, hall effect, drift, mobility, diffusion in Semiconductors,Semi-conductorsand their applications, superconductors.

UNIT-III	DIELECTRICS AND INSULATORS	Classes: 12

Properties of gaseous, liquid and solid dielectric, dielectric as a field medium, electric conduction in gaseous, liquid and solid dielectric, breakdown in dielectric materials, mechanical and electrical properties of dielectric materials, effect of temperature on dielectric materials, polarization, loss angle and dielectric loss, petroleum based insulating oils, transformer oil, capacitor oils, properties, solid electrical insulating materials, fibrous, paper boards, yarns, cloth tapes, sleeving wood, impregnation, plastics, filling and bounding materials, fibrous, film, mica, rubber, mica based materials, ceramic materials, classification of insulation (solid) and application in AC and DC machines.

UNIT-IV	MAGNETIC MATERIALS	Classes: 10

Soft and hard magnetic materials, diamagnetic, paramagnetic and ferromagnetic materials, electric steel, sheet steel, cold rolled grain oriented silicon steel, hot rolled grain oriented silicon steel, hot rolled silicon steel sheet, hysteresis loop, hysteresis loss, magnetic susceptibility, coercive force, curie temperature, magneto-striction.

UNIT-V	OPTICAL PROPERTIES OF SOLIDS	Classes: 10

Photo emission, photo emission materials, electro luminescence junction diode, photo emitters, photo transistor, photo resistors, injunction lasers, optical properties of semiconductors, application of photo sensitive materials (CRT, Tube light, photo panels etc.).

Text Books:

1. "Electrical Engineering Materials",Dekker,PHIPbs.
2. "Electrical Engineering Materials", Indulkar,S.Chand

Reference Books:

1. "Electrical Engineering Materials", Tareev
2. "Electrical Engineering Materials", Yu. Koritsky.
3. "Electrical Engineering Materials", R.K.Rajput, LaxmiPbs

Web References:

4. https://physics.info/dielectrics/
5. https://www.oxfordreference.com/view/10.1093/oi/authority.20110803095631265
6. web.mit.edu/course/6/6.732/www/6.732-pt2.pdf

E-Text Books:

4. https://easyengineering.net/electrical-engineering-materials-by-dekker/
5. https://www.oreilly.com/library/view/dielectric-materials-for/9781118619780/

MOOC Course

3. 1. https://nptel.ac.in/courses/108108076/
2. https://nptel.ac.in/courses/112104203/3
6. https://onlinecourses.nptel.ac.in/noc18_ee14/

NON CONVENTIONAL POWER GENERATION

VII Semester: OPEN ELECTIVE –III

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A4EE59	OEC	3	-	-	3	30	70	100

COURSE OBJECTIVES

1. Demonstrate power generation systems including major subsystems.
2. Understand basic working principles of nuclear power generation systems.
3. Apply knowledge of solar power generation systems in design and implementation to obtain clean energy.

COURSE OUTCOMES:

The students should be able to

1. Understand basic working principles of nuclear power generation systems.
2. Apply knowledge of solar power generation systems in design and implementation to obtain clean energy.

UNIT-I	PRINCIPLES OF SOLAR RADIATION	Classes: 08

Role and potential of new and renewable source, the solar energy option,Environmental impact of solar power, physics of the sun, the solar constant, extraterrestrial and terrestrial solar radiation, solar radiation on titled surface, instruments for measuring solar radiation and Sun shine, solar radiation data.

UNIT-II	SOLAR ENERGY COLLECTORS	Classes: 10

Flat plate and concentrating collectors, classification of concentrating collectors,orientation and thermal analysis, advanced collectors.

STORAGE AND APPLICATIONS: Different methods of solar energy storage, Sensible, latent heat and stratified storage,solar ponds. Solar Applications- solar heating /cooling technique, solar distillation and drying.

UNIT-III	PHOTO VOLTAICS (PV)	Classes: 12

Fundamentals of solar cells, types of solar cells, semiconducting materials, band gap theory,absorption of photons, excitations and photoemission of electrons, band engineering.

PV CELL PROPERTIES: Solar cell properties and design, p-n junction photodiodes, depletion region, electrostatic fieldacross the depletion layer, electron and holes transports, device physics, charge carrier generation, recombination and other losses, I-V characteristics, output power.

UNIT-IV	SOLAR CELL APPLICATIONS	Classes: 10

PV cell interconnection, module structure and module fabrication, Equivalent circuits, loadmatching, efficiency,

fill factor and optimization for maximum power, Design of stand-alone PV systems, system sizing, device structures, device construction, DC to AC conversion, inverters, on-site storage and grid connections.

UNIT-V	COST ANALYSIS AND ENVIRONMENTAL ISSUES	Classes: 10

Cost analysis and pay back calculations for different types of solar panelsand collectors, installation and operating costs, Environmental and safety issues, protection systems, performance monitoring.

ALTERNATIVE ENERGY SOURCES: Solar Energy: Types of devices for Solar Energy Collection, Thermal Storage System.Control Systems, Wind Energy, Availability, Wind Devices, Wind Characteristics, Performance of Turbines and systems.

Text Books:

11. G. D. Rai (2009), *Non-Conventional Energy Sources*, 4th edition, Khanna Publishers, New Delhi.

2. Martin A. Green (2008), *Solar Cells: Operating Principles, Technology and system Applications*, 1st edition, Prentice Hall, New Delhi.

Reference Books:

1Sukatme (2008), Solar Energy, 3rd Edition, McGraw Hill Companies, New Delhi.

2. D. Yogi gosuami, Frank Kreith, Jan F. Kreider (2000), Principles of Solar Engineering, 2nd edition, Taylor & Francis, USA.

Web References:

1. https://nptel.ac.in/courses/Webcourse-contents/IISc-BANG/notused/Non-Conventional%20Energy%20Systems-/Learning%20Materail%20-%20NCES.pdf
2. https://www.ukessays.com/essays/environmental-sciences/promoting-non-conventional-energy-resource

E-Text Books:

1. bie.telangana.gov.in/files/Nonconventionalenergysourses.pdf
2. https://www.researchgate.net/.../236857095_Non_Conventional_Energy_Resources

MOOC Course

1. https://nptel.ac.in/courses/108102047/
2. https://onlinecourses.nptel.ac.in/noc19_ge11/course
3. https://nptel.ac.in/downloads/108108078/

SOLAR ENERGY AND APPLICATIONS

VII Semester: OPEN ELECTIVE –III

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A4EE60	OEC	3	-	-	3	30	70	100

COURSE OBJECTIVES

1. To Study about solar modules and PV system design and their applications
2. To Deal with grid connected PV systems
3. To Discuss about different energy storage systems

COURSE OUTCOMES:

The students should be able to

1. Understanding on solar energy storage systems
2. Basic knowledge on standalone PV system
3. Understand the issues in grid connected PV systems
4. Study about the modelling of different energy storage systems and their performances
5. Attain more on different applications of solar energy

UNIT-I	INTRODUCTION	Classes: 10

Characteristics of sunlight – semiconductors and P-N junctions –behavior of solar cells – cell properties – PV cell interconnection

UNIT-II	STAND ALONE PV SYSTEM	Classes: 10

Solar modules – storage systems – power conditioning and regulation - MPPT- protection – stand alone PV systems design – sizing

UNIT-III	GRID CONNECTED PV SYSTEMS	Classes: 10

PV systems in buildings – design issues for central power stations – safety – Economic aspect – Efficiency and performance - International PV programs

UNIT-IV	ENERGY STORAGE SYSTEMS	Classes: 10

Impact of intermittent generation – Battery energy storage – solar thermal energy storage – pumped hydroelectric

energy storage

UNIT-V	APPLICATIONS	Classes: 10

Water pumping – battery chargers – solar car – direct-drive applications –Space – Telecommunications.

Text Books:

1. Solanki C.S., "Solar Photovoltaics: Fundamentals, Technologies And Applications", PHI Learning Pvt. Ltd.,2015.
2. Stuart R.Wenham, Martin A.Green, Muriel E. Watt and Richard Corkish, "Applied Photovoltaics", 2007,Earthscan, UK. Eduardo Lorenzo G. Araujo, "Solar electricity engineering of photovoltaic systems", Progensa,1994

Reference Books:

1. Frank S. Barnes & Jonah G. Levine, "Large Energy storage Systems Handbook", CRC Press, 2011.
2. McNeils, Frenkel, Desai, "Solar & Wind Energy Technologies", Wiley Eastern, 1990 5 S.P. Sukhatme , "Solar Energy", Tata McGraw Hill,1987.

Web References:

1. https://www.loc.gov/rr/scitech/tracer-bullets/solar-updatetb.html
2. https://www.oxfordreference.com/view/10.1093/oi/authority.20110803100516798
3. https://link.springer.com/journal/11949

E-Text Books:

1. https://courses.edx.org/c4x/DelftX/ET.3034TU/asset/solar_energy_v1.1.pdf
2. bookstore.teri.res.in/books/9788179935736

MOOC Course:

1. https://nptel.ac.in/courses/112105051/
2. https://nptel.ac.in/courses/121106014/18
3. https://nptel.ac.in/courses/112105050/

4. https://nptel.ac.in/syllabus/112105051/

INSTRUMENTATION AND CONTROL

VIII Semester: OPEN ELECTIVE –IV

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A4EE61	OEC	3	-	-	3	30	70	100

COURSE OBJECTIVES

1. To introduce the basic principles of all measuring instruments
2. To deal with the measurement of voltage, current measurements
3. To understand students how different types of meters work and their construction
4. To understand the different ways of system representations such as Transfer function representation and state space representations and to assess the system dynamic response
5. To assess the system performance using time domain analysis and methods for improving it

COURSE OUTCOMES:

The students should be able to

1. Identify the instruments suitable for typical measurements.
2. Apply the knowledge about transducers and instrument transformers to use them effectively.
3. Improve the system performance by selecting a suitable controller for a specific application
4. Apply various time domain techniques to assess the system performance

UNIT-I	INTRODUCTION TO MEASURING INSTRUMENTS	Classes: 10

Classification —deflecting, control and damping torques — Ammeters and Voltmeters — PMMC, moving iron type instruments — expression for the deflecting torque and control torque — Errors and compensations, extension of range using shunts and series resistance. Electrostatic Voltmeters-electrometer type and attracted disc type — Extension of range of E.S. Voltmeters.

UNIT-II	POTENTIOMETERS & INSTRUMENT TRANSFORMERS	Classes: 08

Principle and operation of D.C. Crompton's potentiometer—standardisation — Measurement of unknown resistance, current, voltage. A.C. Potentiometers: polar and coordinate types standardisation — applications. CT and PT — Ratio and phase angle errors.

UNIT-III	TRANSDUCERS & OSCILLOSCOPES	Classes: 12

Definition of transducers, Classification of transducers, Advantages of Electrical transducers, Characteristics and choice of transducers; Principle operation of LVDT and capacitor transducers; LVDT Applications, Strain gauge and its principle of operation, gauge factor, Thermistors, Thermo couples, Piezo electric transducers, photovoltaic, photo conductive cells, photo diodes.

CRO: 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.

UNIT-IV	CLASSIFICATION OF CONTROL SYSTEMS	Classes: 10

Concepts of Control Systems- Open Loop and closed loop control systems and their differences- Different examples of control systems- Classification of control systems

Feed-Back Characteristics, Effects of feedback. Mathematical models – Differential equations – Impulse Response and transfer functions .Block diagram algebra – Representation by Signal flow graph – Reduction using mason's gain formula.

UNIT-V	TIME RESPONSE ANALYSIS	Classes: 10

Standard test signals – Time response of first order systems –Characteristic Equation of Feedback control systems, Transient response of second order systems – Time domain specifications .Effects of proportional derivative, proportional integral systems.

Text Books:

1. Electrical and Electronic Measurements and Instrumentation, R. K. Rajput, S. Chand & Company Ltd.
2. Electrical Measuring Instruments and Measurements, S. C. Bhargava, BS Publications.
3. I. J. Nagrath and M. Gopal", "Control Systems Engineering", New Age International (P) Limited, Publishers, 5th edition, 2009
4. "B. C. Kuo", "Automatic Control Systems", John wiley and sons, 8th edition, 2003.

Reference Books:

1. Electrical & Electronic Measurement & Instruments, A.K.Sawhney Dhanpat Rai & Co. Publications.
2. Electrical and Electronic Measurements, G. K. Banerjee, PHI Learning Pvt. Ltd.
3. Electrical Measurements and Measuring Instruments, Golding and Widdis, Reem Publications.
4. N. K. Sinha", "Control Systems", New Age International (P) Limited Publishers, 3rdEdition, 1998.
5. "NISE", "Control Systems Engineering", John wiley, 6th Edition, 2011.
6. "Katsuhiko Ogata", "Modern Control Engineering", Prentice Hall of India Pvt. Ltd., 3rd edition, 1998.

Web References:

1. home.mit.bme.hu/~virosztek/docs/mt.../Principles_of_electrical_measurement.pdf
2. https://www.mccdaq.com/handbook/chapt_4.aspx

E-Text Books:

1. www.vssut.ac.in/lecture_notes/lecture1423813026.pdf
2. www.vssut.ac.in/lecture_notes/lecture1423904331.pdf

3. www.ent.mrt.ac.lk/~rohan/teaching/EN5001/Reading/DORFCH1.pdf

MOOC Course:

1. https://nptel.ac.in/syllabus/108106070/
2. https://nptel.ac.in/courses/108105064/
3. https://nptel.ac.in/courses/108101037/
4. https://nptel.ac.in/courses/107106081/

ENERGY AUDIT AND MANAGEMENT SYSTEMS

VIII Semester: OPEN ELECTIVE –IV

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A4EE62	OEC	3	-	-	3	30	70	100

COURSE OBJECTIVES

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

COURSE OUTCOMES:

The students should be able to

1. Explain energy efficiency, conservation and various technologies.
2. Design energy efficient lighting systems.
3. Calculate power factor of systems and propose suitable compensation techniques.
4. Explain energy conservation in HVAC systems.
5. Calculate life cycle costing analysis and return on investment on energy efficient technologies.

UNIT-I	ENERGY AUDIT AND MANAGEMENT ENERGY AUDIT	Classes: 12

Basic Principles of Energy Audit and management Energy audit – Definitions – Concept – Types of audit – Energy index – Cost index – Pie charts – Sankey diagrams – Load profiles – Energy conservation schemes and energy saving potential – Numerical problems – Principles of energy management –Initiating, planning, controlling, promoting, monitoring, reporting – Energy manager – Qualities and functions – Language – Questionnaire – Check list for top management.

UNIT-II	LIGHTING	Classes: 10

Modification of existing systems – Replacement of existing systems – Priorities: Definition of terms and units – Luminous efficiency – Polar curve – Calculation of illumination level – Illumination of inclined surface to beam – Luminance or brightness – Types of lamps – Types of lighting – Electric lighting fittings (luminaries) – Flood lighting – White light LED and conducting Polymers – Energy conservation measures.

UNIT-III	POWER FACTOR AND ENERGY INSTRUMENTS	Classes: 08

Power factor – Methods of improvement – Location of capacitors – Power factor with non linear loads – Effect of harmonics on Power factor – Numerical problems. Energy Instruments – Watt–hour meter – Data loggers – Thermocouples – Pyrometers – Lux meters – Tong testers – Power analyzer.

UNIT-IV	SPACE HEATING AND VENTILATION	Classes: 08

Ventilation – Air–Conditioning (HVAC) and Water Heating: Introduction – Heating of buildings – Transfer of Heat–Space heating methods – Ventilation and air–conditioning – Insulation–Cooling load – Electric water heating systems – Energy conservation methods.

UNIT-V	ECONOMIC ASPECTS AND ANALYSIS	Classes: 12

Economics Analysis – Depreciation Methods – Time value of money – Rate of return – Present worth method – Replacement analysis – Life cycle costing analysis – Energy efficient motors (basic concepts)
Computation of Economic Aspects : Calculation of simple payback method – Net present worth method – Power factor correction – Lighting – Applications of life cycle costing analysis – Return on investment.

Text Books:

1. Energy management by W.R. Murphy & G. Mckay Butter worth, Elsevier publications. 2012
2. Energy efficient electric motors by John .C. Andreas, Marcel Dekker Inc Ltd–2nd edition, 1995

Reference Books:

1. Electric Energy Utilization and Conservation by S C Tripathy, Tata McGraw hill publishing company Ltd. New Delhi.
2. Energy management by Paul o' Callaghan, Mc–Graw Hill Book company–1st edition, 1998.
3. Energy management hand book by W.C.Turner, John wiley and sons.
4. Energy management and conservation –k v Sharma and pvenkataseshaiah-I K International Publishing House pvt.ltd,2011.

Web References:

1. https://beeindia.gov.in/sites/default/files/1Ch3.pdf
2. https://www.researchgate.net/publication/309463130_Energy_Audit_Management

E-Text Books:

1. lab.fs.uni-lj.si/kes/erasmus/Energy%20Management%20Handbook.pdf

2. https://fenix.tecnico.ulisboa.pt/downloadFile/.../Energy%20Audit%202013.pdf

3. enersupply.euke.sk/wp-content/uploads/Introduction-to-EM-and-EA_P1_Fotini.pdf

MOOC Course:

1. https://nptel.ac.in/courses/108106022

2. https://nptel.ac.in/courses/105107156/12

3. shodhganga.inflibnet.ac.in/bitstream/10603/46067/11/11_chapter%201.pdf

ENERGY STORAGE SYSTEMS

VIII Semester: OPEN ELECTIVE –IV

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A4EE63	OEC	3	-	-	3	30	70	100

COURSE OBJECTIVES

1. To enable the student to understand the need for energy storage, devices and technologies available and their applications

COURSE OUTCOMES:

The students should be able to

1. Analyze the characteristics of energy from various sources and need for storage
2. Classify various types of energy storage and various devices used for the purpose
3. Identify various real time applications.

UNIT-I	ELECTRICAL ENERGY STORAGE TECHNOLOGIES	Classes: 12

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.

UNIT-II	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.

UNIT-III	FEATURES OF ENERGY STORAGE SYSTEMS	Classes: 08

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).

UNIT-IV	TYPES OF ELECTRICAL ENERGY STORAGE SYSTEMS	Classes: 10

Electrical storage systems, Double-layer capacitors (DLC) ,Superconducting magnetic energy storage (SMES),Thermal storage systems, Standards for EES,Technical comparison of EES technologies.

UNIT-V	APPLICATIONS	Classes: 12

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.

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://onlinelibrary.wiley.com/doi/abs/10.1002/9781118991978.hces212

E-Text Books:

1. https://www.pewtrusts.org/~/media/.../energy_storage-backs_up_power_supply.pdf
2. https://energy.mit.edu/wp-content/uploads/2018/04/Energy-Storage-for-the-Grid.pdf
3. https://www.adb.org/sites/default/files/.../handbook-battery-energy-storage-system.pdf

MOOC Course:

1. nptel.ac.in/courses/112105221/56
2. nptel.ac.in/courses/108108036/9
3. https://nptel.ac.in/courses/108102047/7
4. https://nptel.ac.in/courses/108105058/37