

**ACADEMIC REGULATIONS, COURSE STRUCTURE  
AND DETAILED SYLLABUS**

**R18**

**M.Tech (POWER ELECTRONICS AND ELECTRIC DRIVES)**

**FOR  
MASTER OF TECHNOLOGY TWO YEAR POST GRADUATE COURSE  
(Applicable for the batches admitted from 2018-2019)**



**ANURAG GROUP OF INSTITUTIONS  
(AUTONOMOUS)  
Venkatapur, Ghatkesar, Hyderabad – 500 088**

## **R 18 - ACADEMIC REGULATIONS (CBCS) FOR M. Tech. (REGULAR) DEGREE PROGRAMMES**

Applicable for the students of M. Tech. (Regular) programme from the Academic Year **2018-19** and onwards

The M.Tech. Degree of Jawaharlal Nehru Technological University Hyderabad shall be conferred on candidates who are admitted to the programme and who fulfill all the requirements for the award of the Degree.

### **1.0 ELIGIBILITY FOR ADMISSIONS**

Admission to the above programme shall be made subject to eligibility, qualification and specialization as prescribed by the University from time to time.

Admissions shall be made on the basis of merit/rank obtained by the candidates at the qualifying Entrance Test conducted by the University or on the basis of any other order of merit as approved by the University, subject to reservations as laid down by the Govt. from time to time.

### **2.0 AWARD OF M.Tech. DEGREE**

- 2.1 A student shall be declared eligible for the award of the M.Tech. Degree, if he pursues a course of study in not less than two and not more than four academic years, failing which he shall forfeit his seat in M.Tech. programme.
- 2.2 The student shall register for all 88 credits and secure all the 88 credits.
- 2.3 The minimum instruction days in each semester are 90.

### **3.0 COURSES OF STUDY**

The following specializations are offered at present for the M.Tech. programme of study.

1. CAD/CAM
2. Computer Networks and Information Security
3. Computer Science
4. Computer Science and Engineering
5. Construction Management
6. Electrical Power Systems
7. Electronics and Communication Engineering
8. Embedded Systems
9. Machine Design
10. Power Electronics and Electrical Drives
11. Software Engineering
12. Structural Engineering
13. VLSI System Design
14. Wireless and Mobile communication

## **4 Course Registration**

- 4.1** A 'Faculty Advisor or Counselor' shall be assigned to each student, who will advise him on the Post Graduate Programme (PGP), its Course Structure and Curriculum, Choice/Option for Subjects/ Courses, based on his competence, progress, pre-requisites and interest.
- 4.2** Academic Section of the College invites 'Registration Forms' from students with in 15 days from the commencement of class work through 'ON-LINE SUBMISSIONS', ensuring 'DATE and TIME Stamping'. The ON-LINE Registration Requests for any 'CURRENT SEMESTER' shall be completed BEFORE the commencement of SEEs (Semester End Examinations) of the 'PRECEDING SEMESTER'.
- 4.3** A Student can apply for ON-LINE Registration, ONLY AFTER obtaining the 'WRITTEN APPROVAL' from his Faculty Advisor, which should be submitted to the College Academic Section through the Head of Department (a copy of it being retained with Head of Department, Faculty Advisor and the Student).
- 4.4** If the Student submits ambiguous choices or multiple options or erroneous entries - during ON-LINE Registration for the Subject(s) / Course(s) under a given/ specified Course Group/ Category as listed in the Course Structure, only the first mentioned Subject/ Course in that Category will be taken into consideration.
- 4.5** Subject/ Course Options exercised through ON-LINE Registration are final and CANNOT be changed, nor can they be inter-changed; further, alternate choices will also not be considered. However, if the Subject/ 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 the Head of Department, with due notification and time-framed schedule, within the FIRST WEEK from the commencement of Class-work for that Semester.

## **5 ATTENDANCE**

The programmes are offered on a unit basis with each subject being considered a unit.

- 5.1** Attendance in all classes (Lectures/Laboratories etc.) is compulsory. The minimum required attendance in each theory / Laboratory etc. is 75% including the days of attendance in sports, games, NCC and NSS activities for appearing for the End Semester examination. A student shall not be permitted to appear for the Semester End Examinations (SEE) if attendance is less than 75%.
- 5.2** Condonation of shortage of attendance in each subject up to 10% (65% and above and below 75%) in each semester shall be granted by the College Academic Committee on genuine medical grounds and valid reasons on representation by the candidate with supporting evidence.
- 5.3** Shortage of Attendance below 65% in each subject shall not be condoned.

- 5.4 Students whose shortage of attendance is not condoned in any subject are not eligible to write their end semester examination of that subject and their registration shall stand cancelled.
- 5.5 A prescribed fees hall be payable towards condonation of shortage of attendance.
- 5.6 A candidate shall get minimum required attendance at least in three (3) theory subjects in the present semester to get promoted to the next semester. In order to qualify for the award of the M.Tech. Degree, the candidate shall complete all the academic requirements of the subjects, as per the course structure.
- 5.7 A student shall not be promoted to the next semester unless he satisfies the attendance requirement of the present Semester, as applicable. They may seek readmission into that semester when offered next. If any candidate fulfills the attendance requirement in the present semester, he shall not be eligible for readmission in to the same class.

## **6 EVALUATION**

The performance of the candidate in each semester shall be evaluated subject-wise, with a maximum of 100 marks for theory and 100 marks for practical, on the basis of Internal Evaluation and End Semester Examination.

- 6.1 For the theory subjects 75 marks shall be awarded for the performance in the Semester End Examination and 25 marks shall be awarded for Continuous Internal Evaluation (CIE). The Continuous Internal Evaluation shall be made based on the average of the marks secured in the two Mid Term-Examinations conducted, one in the middle of the Semester and the other, immediately after the completion of Semester instructions. Each mid-term examination shall be conducted for a total duration of 120 minutes with Part A as compulsory question (10 marks) consisting of 5 sub-questions carrying 2 marks each, and Part B with 3 questions to be answered out of 5 questions, each question carrying 5 marks.

There shall be an optional third midterm examination during the preparation cum external practical examinations period subject to the following.

- i. Interested students have to register for the third mid examination by paying prescribed registration fee.
- ii. Third midterm examination covers entire semester syllabus carrying 25 marks. The average of best two midterm examinations shall be taken as the final marks secured by each candidate. If he/she is absent for any test, he/she shall be awarded zero marks for that test.

The details of the Question Paper pattern for End Examination (Theory) are given below:

- The Semester End Examination will be conducted for 75 marks. It consists of two parts. i) Part-A for 25 marks, ii) Part-B for 50 marks.
  - Part-A is a compulsory question consisting of 5 questions, one from each unit and carries 5 marks each.
  - Part-B to be answered 5 questions carrying 10 marks each. There will be two questions from each unit and only one should be answered.
- 6.2 For practical subjects, 75 marks shall be awarded for performance in the Semester End Examinations and 25 marks shall be awarded for day-to-day performance as Internal Marks.
- 6.3 The practical end semester examination shall be conducted with an external examiner and the laboratory teacher. The external examiner shall be appointed by the Principal from the panel of examiners recommended by Chairman, Board of Studies in respective Branches.
- 6.4 There shall be two seminar presentations during I year I semester and II semester. For seminar, a student under the supervision of a faculty member, shall collect the literature on a topic and critically review the literature and submit it to the department in a report form and shall make an oral presentation before the Departmental Academic Committee consisting of Head of the Department, Supervisor and two other senior faculty members of the department. For each Seminar there will be only internal evaluation of 100 marks. A candidate has to secure a minimum of 50% of marks to be declared successful. If he fails to fulfill minimum marks, he has to reappear during the supplementary examinations.
- 6.5 There shall be a Comprehensive Viva-Voce in II year I Semester. The Comprehensive Viva-Voce is intended to assess the students' understanding of various subjects he has studied during the M.Tech. course of study. The Head of the Department shall be associated with the conduct of the Comprehensive Viva-Voce through a Committee. The Committee consisting of Head of the Department, one senior faculty member and an external examiner. The external examiner shall be appointed by the Principal from the panel of 3 examiners recommended by Chairman, Board of Studies in respective Branches. There are no internal marks for the Comprehensive Viva-Voce and evaluates for maximum of 100 marks. A candidate has to secure a minimum of 50% of marks to be declared successful. If he fails to fulfill minimum marks, he has to reappear during the supplementary examinations.
- 6.6 Technical Paper Writing shall cover concepts of abstract, introduction, material and methods, conclusion, references, acknowledgement etc of advanced topics in a branch of Engineering through the medium of attending seminars/ referring to peer reviewed journals, which will enhance the skill of writing technical reports. The students shall not be required to give oral presentation of technical paper. The report shall be presented as a printed document for evaluation. Evaluation shall be made solely by the teacher, but may be moderated by committees appointed by the Head of the Department.

- 6.7 A candidate shall be deemed to have secured the minimum academic requirement in a subject if he secures a minimum of 40% of marks in the Semester End Examination and a minimum aggregate of 50% of the total marks in the Semester End Examination and Continuous Internal Evaluation taken together.
- 6.8 In case the candidate does not secure the minimum academic requirement in any subject (as specified in 6.7) he has to reappear for the Semester End Examination in that subject.
- 6.9 A candidate shall be given one chance to re-register for the subjects if the internal marks secured by a candidate is less than 50% and failed in that subject for maximum of two subjects and should register within four weeks of commencement of the class work. In such a case, the candidate must re-register for the subjects and secure the required minimum attendance. The candidate's attendance in the re-registered subject(s) shall be calculated separately to decide upon his eligibility for writing the Semester End Examination in those subjects. In the event of the student taking another chance, his Continuous Internal Evaluation (internal) marks and Semester End Examination marks obtained in the previous attempt stands cancelled.
- 6.10 In case the candidate secures less than the required attendance in any subject, he shall not be permitted to write the Semester End Examination in that subject. He shall re-register for the subject when next offered.

## 7 Examinations and Assessment - The Grading System

- 7.1 Marks will be awarded to indicate the performance of each student in each Theory Subject, or Lab/Practicals, or Seminar, or Project, etc., based on the % marks obtained in CIE + SEE (Continuous Internal Evaluation + Semester End Examination, both taken together) as specified in Item 6 above, and a corresponding Letter Grade shall be given.
- 7.2 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 ( $\geq 90\%$ , $\leq 100\%$ )	O (Outstanding)	10
Below 90% but not less than 80% ( $\geq 80\%$ , $< 90\%$ )	A <sup>+</sup> (Excellent)	9
Below 80% but not less than 70% ( $\geq 70\%$ , $< 80\%$ )	A (Very Good)	8
Below 70% but not less than 60% ( $\geq 60\%$ , $< 70\%$ )	B <sup>+</sup> (Good)	7

Below 60% but not less than 50% ( $\geq 50\%$ , $< 60\%$ )	<b>B</b> ( Above Average)	6
Below 50% ( $< 50\%$ )	F (Fail)	0
Absent	Ab	0

- 7.3 A student obtaining F Grade in any Subject shall be considered ‘failed’ and is be required to reappear as ‘Supplementary Candidate’ in the Semester End Examination (SEE), as and when offered. In such cases, his Internal Marks (CIE Marks) in those Subjects will remain the same as those he obtained earlier.
- 7.4 A student not appeared for examination then ‘Ab’ Grade will be allocated in any Subject shall be considered ‘failed’ and will be required to reappear as ‘Supplementary Candidate’ in the Semester End Examination (SEE), as and when offered.
- 7.5 A Letter Grade does not imply any specific Marks percentage and it will be the range of marks percentage.
- 7.6 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’.
- 7.7 A student earns Grade Point (GP) in each Subject/ Course, on the basis of the Letter Grade obtained by him in that Subject/ Course. 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**

- 7.8 The Student passes the Subject/ Course only when he **gets  $GP \geq 6$ (B Grade or above)**.
- 7.9 The Semester Grade Point Average (SGPA) is calculated by dividing the Sum of Credit Points ( $\Sigma CP$ ) 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

$$\mathbf{SGPA} = \left\{ \sum_{i=1}^N C_i G_i \right\} / \left\{ \sum_{i=1}^N C_i \right\} \mathbf{For\ each\ Semester,}$$

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 is the no. of Credits allotted to the ith Subject, and G represents the Grade Points (GP) corresponding to the Letter Grade awarded for that i<sup>th</sup> Subject.

- 7.10 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

$$\text{CGPA} = \left\{ \sum_{j=1}^M C_j G_j \right\} / \left\{ \sum_{j=1}^M C_j \right\} \dots \text{for all } S \text{ Semesters registered}$$

**(ie., upto and inclusive of S Semesters,  $S \geq 2$ ),**

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 upto 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 is the no. of Credits allotted to the jth Subject, and G 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.

**7.11** For Calculations listed in Item 7.6 – 7.10, 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.

## **8. EVALUATION OF PROJECT/DISSERTATION WORK**

Every candidate shall be required to submit a thesis or dissertation on a topic approved by the Project Review Committee.

8.1 A Project Review Committee (PRC) shall be constituted with Head of the Department as Chairperson, Project Supervisor and one senior faculty member of the Departments offering the M.Tech. Programme.

8.2 Registration of Project Work: A candidate is permitted to register for the project work after satisfying the attendance requirement of all the subjects, both theory and practical.

8.3 After satisfying 8.2, a candidate has to submit, in consultation with his Project Supervisor, the title, objective and plan of action of his project work to the PRC for approval. Only after obtaining the approval of the PRC the student can initiate the Project work.

8.4 If a candidate wishes to change his supervisor or topic of the project, he can do so with the approval of the PRC. However, the PRC shall examine whether or not the change of topic/supervisor leads to a major change of his initial plans of project proposal. If yes, his date of registration for the project work starts from the date of change of Supervisor or topic as the case may be.

8.5 A candidate shall submit his project status report in two stages at least with a gap of 3 months between them.



- 8.6 The work on the project shall be initiated at the beginning of the II year and the duration of the project is two semesters. A candidate is permitted to submit Project Thesis only after successful completion of all theory and practical courses with the approval of PRC not earlier than 40 weeks from the date of registration of the project work. For the approval of PRC the candidate shall submit the draft copy of thesis to the Head of the Department and make an oral presentation before the PRC.
- 8.7 Three copies of the Project Thesis certified by the supervisor shall be submitted to the College/School/Institute.
- 8.8 For Project work **Review I** in II Year I Sem. there is an internal marks of 100, the evaluation should be done by the PRC for 50 marks and Supervisor will evaluate for 50 marks. The Supervisor and PRC will examine the Problem Definition, Objectives, Scope of Work, Literature Survey in the same domain. A candidate has to secure a minimum of 50% of marks to be declared successful for Project Work Review I. If he fails to fulfill minimum marks, he has to reappear as per the recommendations of the PRC.
- 8.9 For Project work **Review II** in II Year II Sem. there is an internal marks of 100, the evaluation should be done by the PRC for 50 marks and Supervisor will evaluate for 50 marks. The PRC will examine the overall progress of the Project Work and decide the Project is eligible for final submission or not. A candidate has to secure a minimum of 50% of marks to be declared successful for Project Work Review II. If he fails to fulfill minimum marks, he has to reappear as per the recommendations of the PRC.
- 8.10 After approval from the PRC, a soft copy of the thesis should be submitted for ANTI-PLAGIARISM check and the plagiarism report should be submitted to the examination branch and be included in the final thesis. The thesis will be accepted for submission, if the similarity index is less than **30%**. If the similarity index has more than the required percentage, the student is advised to modify accordingly and re-submit the soft copy of the thesis after one month. The maximum number of re-submissions of thesis after plagiarism check is limited to TWO. The candidate has to register for the project work and work for two semesters. After attempts, the admission is liable to be cancelled. The college authorities are advised to make plagiarism check of every soft copy of thesis before submissions.
- 8.11 Three copies of the Project Thesis certified by the supervisor shall be submitted to the College, after submission of a research paper related to the project work in a UGC approved journal. A copy of the submitted research paper shall be attached to thesis.
- 8.12 For Project Evaluation (Viva Voce) in II Year II Sem. there is an external mark of 100 and the same evaluated by the External examiner appointed by the Institution. The candidate has to secure minimum of 50% marks in Project Evaluation (Viva-Voce) examination.
- 8.13 If he fails to fulfill as specified in 8.12, he will reappear for the Viva-Voce examination only after three months. In the reappeared examination also, fails to fulfill, he will not be eligible for the award of the degree.
- 8.14 The thesis shall be adjudicated by one examiner selected by the Institution. For

this, Chairmen, BOS of the respective departments shall submit a panel of 3 examiners, who are eminent in that field with the help of the concerned guide and senior faculty of the department.

8.15 If the report of the examiner is not favourable, the candidate shall revise and resubmit the Thesis. If the report of the examiner is un favourable again, the thesis shall be summarily rejected.

8.16 If the report of the examiner is favourable, Project Viva-Voce examination shall be conducted by a board consisting of the Supervisor, Head of the Department and the external examiner who adjudicated the Thesis.

8.17 The Head of the Department shall coordinate and make arrangements for the conduct of Project Viva- Voce examination.

## **9. AWARD OF DEGREE AND CLASS**

9.1 A Student who registers for all the specified Subjects/ Courses as listed in the Course Structure, satisfies all the Course Requirements, and passes the examinations prescribed in the entire PG Programme (PGP), and secures the required number of Credits 88 (with CGPA  $\geq 6.0$ ), shall be declared to have 'QUALIFIED' for the award of the M.Tech. Degree in the chosen Branch of Engineering and Technology with specialization as he admitted.

### **9.2 Award of Class**

After a student has satisfied the requirements prescribed for the completion of the programme and is eligible for the award of M.Tech. Degree, he shall be placed in one of the following three classes based on the CGPA:

<b>Class Awarded</b>	<b>CGPA</b>
First Class with Distinction	$\geq 7.75$
First Class	$6.75 \leq \text{CGPA} < 7.75$
Second Class	$6.00 \leq \text{CGPA} < 6.75$

9.3 A student with final CGPA (at the end of the PGP)  $< 6.00$  will not be eligible for the Award of Degree.

## **10. WITHHOLDING OF RESULTS**

If the student has not paid the dues, if any, to the institution or if any case of indiscipline is pending against him, the result of the student will be withheld and he will not be allowed into the next semester. His degree will be withheld in such cases.

## **11. TRANSITORY REGULATIONS**

11.1 If any candidate is detained due to shortage of attendance in one or more subjects, they are eligible for re-registration to maximum of two earlier or equivalent subjects at a time as and when offered.

11.2 The candidate who fails in any subject will be given two chances to pass the same

subject; otherwise, he has to identify an equivalent subject as per R18 Academic Regulations.

## **12**      **GENERAL**

- 12.1 **Credit:** A unit by which the course work is measured. It determines the number of hours of instructions required per week. One credit is equivalent to one hour of teaching (lecture or tutorial) or two hours of practical work/field work per week.
- 12.2 **Credit Point:** It is the product of grade point and number of credits for a course.
- 12.3 Wherever the words “he”, “him”, “his”, occur in the regulations, they include “she”, “her”.
- 12.4 The academic regulation should be read as a whole for the purpose of any interpretation.
- 12.5 In the case of any doubt or ambiguity in the interpretation of the above rules, the Decision of the Academic Council is final.
- 12.6 The Academic Council may change or amend the academic regulations or syllabi at any time and the changes or amendments made shall be applicable to all the students with effect from the dates notified by the Academic Council.

**MALPRACTICES RULES**  
**DISCIPLINARY ACTION FOR IMPROPER CONDUCT IN EXAMINATIONS**

	Nature of Malpractices/Improper conduct	Punishment
	If the candidate:	
1. (a)	Possesses or keeps accessible in examination hall, any paper, note book, programmable calculators, cell phones, pager, palm, computers or any other form of material concerned with or related to the subject of the examination (theory or practical) in which he is appearing but has not made use of (material shall include any marks on the body of the candidate which can be used as an aid in the subject of the examination)	Expulsion from the examination hall and cancellation of the performance in that subject only
(b)	Gives assistance or guidance or receives it from any other candidate orally or by any other body language methods or communicates through cell phones with any candidate or persons in or outside the exam hall in respect of any matter.	Expulsion from the examination hall and cancellation of the performance in that subject only of all the candidates involved. In case of an outsider, he will be handed over to the police and a case is registered against him.
2.	Has copied in the examination hall from any paper, book, programmable calculators, palm computers or any other form of material relevant to the subject of the examination (theory or practical) in which the candidate is appearing.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the subjects of that semester/year. The hall ticket of the candidate is to be cancelled and sent to the controller of examinations, AGI.
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 semester 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 the performance in that subject and all other subjects the candidates has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all semester examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
5.	Uses objectionable, abusive or offensive language in the answer paper or in letters to the examiners or writes to the examiner requesting him to award pass marks.	Cancellation of the performance in that subject.
6.	Refuses to obey the orders of the Chief Superintendent/Assistant-Superintendent/ any officer on duty or misbehaves or creates disturbance of any kind in and around the examination hall or organizes a walk out or instigates others to walk out, or threatens the officer-in-charge or any person on duty in or outside the examination hall of any injury to his person or to any office relations whether by words, either spoken or written or by signs or by visible representation, assaults the officer-in-charge, or any person on duty in or outside the examination hall or any of his relations, or indulges in any other act of misconduct or mischief which result in damage to or destruction of property in the examination hall or any part of the college campus or engages in any other act which in the opinion of the officer on duty amounts to use of unfair means or misconduct or has the tendency to disrupt the orderly conduct of the examination.	In case of students of the college, they shall be expelled from examination halls and cancellation of their performance in that subjects and all other subjects the candidate(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the subjects of that semester/year. The candidates also are debarred and forfeit their seats. In case of outsiders. They will be handed over to the police and a police case is registered against them.
7.	Leaves the exam hall taking away answer script or intentionally tears 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 candidates has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all

		semester examinations. The continuation of the course by the candidate is subject to the academic regulation in connection with forfeiture of seat.
8.	Posses any lethal weapon or firearm in the examination hall.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidates 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 college indulges in any malpractice or improper conduct mentioned in clause 6 to 8	Student of the college's expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidates 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 forfeiture 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 performance in that subject and all the other subjects the candidates 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 the 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 Malpractices committee, AGI for further action to award suitable punishment.	



# ANURAG GROUP OF INSTITUTIONS

(Formerly CVSR College of Engineering)

Venkatapur (V), Ghatkesar (M), Medchal (dist)

Department of Electrical and Electronics Engineering

M. TECH (POWER ELECTRONICS AND ELECTRIC DRIVES)

## COURSE STRUCTURE AND SYLLABUS

### I Semester

Category	Course Title	Int. marks	Ext. marks	L	T	P	C
A31021	Machine Modeling and Analysis	25	75	4	0	0	4
A31022	Modern Control Theory	25	75	4	0	0	4
A31023	Power Electronic Control of Drives	25	75	4	0	0	4
A31024 A31025 A31026	1. Special Machines 2. High Frequency Magnetic Components 3. Programmable Logic Controllers and Applications	25	75	3	0	0	3
A31027 A31028 A31029	1. HVDC & FACTS 2. Switched Mode Power Supplies (SMPS) 3. AI Techniques in Electrical Engineering	25	75	3	0	0	3
	<b>*Open Elective – I</b>	25	75	3	0	0	3
A31205	Power Converters and Drives Lab	25	75	0	0	3	2
A31206	Seminar - I	100	0	0	0	3	2
<b>Total</b>		<b>275</b>	<b>525</b>	<b>21</b>	<b>0</b>	<b>6</b>	<b>25</b>

### II Semester

Category	Course Title	Int. marks	Ext. marks	L	T	P	C
A32021	Power Electronic Applications to Renewable Energy	25	75	4	0	0	4
A32022	Embedded Systems for Power Electronic Applications	25	75	4	0	0	4
A32023	Advanced Power Electronic Devices and Converters	25	75	4	0	0	4
A32024 A32025 A32026	1. Electric Traction systems 2. Advanced Digital Signal Processing 3. Digital Control Systems	25	75	3	0	0	3
A32027 A32028 A32029	1. Dynamics of Electrical Machines 2. Hybrid Electric Vehicles 3. Smart Grid Technologies	25	75	3	0	0	3
	<b>*Open Elective – II</b>	25	75	3	0	0	3
A32205	Power Converters Simulation Lab	25	75	0	0	3	2
A32206	Seminar -II	100	0	0	0	3	2
<b>Total</b>		<b>275</b>	<b>525</b>	<b>21</b>	<b>0</b>	<b>6</b>	<b>25</b>

**III Semester**

	<b>Course Title</b>	<b>Int. marks</b>	<b>Ext. marks</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
A33207	Technical Paper Writing	100	0	0	3	0	2
A33208	Comprehensive Viva-Voce	0	100	0	0	0	4
A33209	Project work Review II	100	0	0	0	22	8
<b>Total</b>		<b>200</b>	<b>100</b>	<b>0</b>	<b>3</b>	<b>22</b>	<b>14</b>

**IV Semester**

	<b>Course Title</b>	<b>Int. marks</b>	<b>Ext. marks</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
A34205	Project work Review III	100	0	0	0	24	8
A34206	Project Evaluation (Viva-Voce)	0	100	0	0	0	16
	<b>Total</b>	<b>100</b>	<b>100</b>	<b>0</b>	<b>0</b>	<b>24</b>	<b>24</b>

**\*Open Elective subjects must be chosen from the list of open electives offered by OTHER departments.**

**# For Project review I, please refer 7.10 in R17 Academic Regulations.**



**M. Tech – I Year – I Sem. (PEED)**  
**MACHINE MODELLING AND ANALYSIS**  
**(Professional core - I)**

**Prerequisites: Electrical Machines (DC and AC), control theory**

**Course Objectives:**

- To comprehend the basic two-pole machine.
- To identify the methods and assumptions in modeling of machines.
- To write voltage and torque equations for different machines.
- To recognize the different frames for modeling of different AC machines.
- To express the voltage and torque equations in State space form

**Course Outcomes:**

- Upon the completion of the course the student will be able to
- Write the voltage equation and torque equations for different machines like dc machine, induction motor and Synchronous machines.
- Model different machines using phase and Active transformations.
- Identify the different reference frames for modeling of machines.

**Unit-I:**

Basic Two-pole DC machine - primitive 2-axis machine – Voltage and Current relationship – Torque equation.

**Unit-II:**

Mathematical model of separately excited DC motor and DC Series motor in state variable form – Transfer function of the motor - Numerical problems.

Mathematical model of D.C. shunt motor D.C. Compound motor in state variable form – Transfer function of the motor - Numerical Problems

**Unit-III:**

Liner transformation – Phase transformation (a, b, c to  $\alpha$ ,  $\beta$ , o) – Active transformation ( $\alpha$ ,  $\beta$ , o to d, q).  
Circuit model of a 3 phase Induction motor – Linear transformation - Phase Transformation – Transformation to a Reference frame – Two axis models for induction motor. dq model based DOL starting of Induction Motors.

**Unit-IV:**

Voltage and current Equations in stator reference frame – equation in Rotor reference frame – equations in a synchronously rotating frame – Torque equation - Equations I state – space form.

**Unit-V:**

Circuits model of a 3ph Synchronous motor – Two axis representation of Syn. Motor.

Voltage and current Equations in state – space variable form – Torque equation.

dq model based short circuit fault analysis- emphasis on voltage, frequency and recovery time.

**TEXT BOOKS:**

1. Matrix Analysis of electrical Machines Asok Kumar Mukhopadhyay. New age International (p) Ltd 2007.
2. Generalized Machine theory P.S. Bimbhra, Khanna Publishers, 2002

**REFERENCES:**

1. Thyristor control of Electric Drives - Vedam Subramanyam, Tata McGraw-Hill Education, 1988
2. Power System Stability and Control – Prabha Kundur, EPRI.
3. Analysis of electric machinery and Drive systems- Paul C. Krause , Oleg Wasynezuk, Scott D. Sudhoff, third edition, IEEE press

**M. Tech – I Year – I Sem. (PEED)**  
**MODERN CONTROL THEORY**  
**(Professional core - II)**

**Prerequisites:** Linear control systems

**Course Objectives:**

- To explain the concepts of basic and modern control system for the real time analysis and design of control systems.
- To explain and apply concepts of state variables analysis. To study and analyze non linear systems.
- To analyze the concept of stability of nonlinear systems and categorization.
- To apply the comprehensive knowledge of optimal theory for Control Systems.

**Course Outcomes:**

- Upon the completion of the course the student will be able to
- Understand the concepts of state variable analysis
- Apply the knowledge of basic and modern control system for the real time analysis and design of control systems.
- Analyze the concept of stability of nonlinear systems and optimal control

**UNIT-I:**

**Mathematical Preliminaries:** Fields, Vectors and Vector Spaces – Linear combinations and Bases – Linear Transformations and Matrices – Scalar Product and Norms – Eigen-values, Eigen Vectors and a Canonical form representation of Linear operators – The concept of state – State Equations for Dynamic systems – Time invariance and Linearity – Non-uniqueness of state model – State diagrams for Continuous-Time State models.

**UNIT-II:**

**State Variable Analysis:** Linear Continuous time models for Physical systems– Existence and Uniqueness of Solutions to Continuous-Time State Equations – Solutions of Linear Time Invariant Continuous-Time State Equations – State transition matrix and its properties. General concept of controllability – General concept of Observability – Controllability tests for Continuous-Time Invariant Systems – Observability tests for Continuous-Time Invariant Systems – Controllability and Observability of State Model in Jordan Canonical form – Controllability and Observability Canonical forms of State model.

**UNIT-III:**

**Non Linear Systems:** Introduction – Non Linear Systems - Types of Non-Linearities – Saturation – Dead-Zone - Backlash – Jump Phenomenon etc;– Singular Points – Introduction to Linearization of nonlinear systems, Properties of Non-Linear systems – Describing function–describing function analysis of nonlinear systems – Stability analysis of Non-Linear systems through describing functions. Introduction to phase-plane analysis, Method of Isoclines for Constructing Trajectories, singular points, phase-plane analysis of nonlinear control systems.

**UNIT-IV:**

**Stability Analysis:** Stability in the sense of Lyapunov, Lyapunov's stability, and Lyapunov's instability theorems - Stability Analysis of the Linear continuous time invariant systems by Lyapunov second method – Generation of Lyapunov functions – Variable gradient method – Krasooviski's method.

State feedback controller design through Pole Assignment – State observers: Full order and Reduced order.

**UNIT-V:**

**Optimal Control:** Introduction to optimal control - Formulation of optimal control problems – calculus of variations – fundamental concepts, functional, variation of functional – fundamental theorem of theorem of Calculus of variations – boundary conditions – constrained minimization – formulation using Hamiltonian method – Linear Quadratic regulator.

**TEXT BOOKS:**

1. Modern Control System Theory by M.Gopal – New Age International -1984
2. Control System Engineering, Nagrath and Gopal - New Age International – Fourth Edition

**REFERENCES:**

1. Modern Control Engineering by Ogata. K – Prentice Hall - 1997
2. Advanced Control Theory A. Nagoor Kani, RBA Publications, 1999
3. Optimal control by Kirck , Dover Publications

**M. Tech – I Year – I Sem. (PEED)**  
**POWER ELECTRONIC CONTROL OF DRIVES**  
**(Professional core - III)**

**Prerequisites:** Power Electronics, AC and DC Machines, Control Systems

**Course Objectives**

- To understand the drive system and converter, chopper fed DC separately excited motor
- To understand principle operation of scalar control of ac motor and corresponding speed-torque-slip characteristics
- To comprehend the vector control for ac motor drive (IM and SM)
- To explain the static resistance control and Slip power recovery drive
- To explain synchronous motor drive characteristics and its control strategies
- To comprehend the brushless dc motor principle of operation.

**Course Outcomes:**

- Upon the completion of the course the student will be able to
- Analyze drive characteristics and converter as well chopper fed dc drives
- Develop induction motor for variable speed operations using scalar and vector control techniques.
- Identify the difference between the rotor resistance control and static rotor resistance control method and significance of slip power recovery drives
- Develop Controllers for synchronous motor and variable reluctance motor can be developed

**UNIT- I:**

Introduction to drive systems: Basic power electronic drive system, components – Single Phase semi & full converter fed separately excited DC motor for continuous & discontinuous modes of operation.

**DC Motor Speed Control:** Three Phase full converter fed separately excited motor for one, two and four quadrant applications for speed control, closed loop operation; dc chopper controlled separately excited motor for one, two and four quadrant application for speed control of closed loop operation

**UNIT- II:**

**Stator Side Control of Induction Drives:** Scalar control – Voltage fed inverter control – Open loop volts/Hz control – speed control slip regulation – speed control with torque and flux control – current controlled voltage fed inverter drive – current – fed inverter control – Independent current and frequency control – Speed and flux control in Current –Fed inverter drive – Volts/Hz control of Current –fed inverter drive.

**UNIT– III:**

**Rotor Side Control of Induction Drives:** Slip power recovery drives – Static Kramer Drive – Phasor diagram – Torque expression – speed control of Kramer Drive – Static Scheribus Drive – modes of operation.

**Vector control of Induction Motor Drives:** Principles of Vector control – Vector control methods – Direct methods of vector control – Indirect methods of vector control

**UNIT – IV:**

**Vector Control of PMSM:**

Model of PMSM. Vector control PMSM drive– Control strategies – Constant torque angle control – Unity power factor control – Constant mutual flux linkage control.

**Controllers:** Flux weakening operation – Maximum speed – Direct flux weakening algorithm – Constant Torque mode controller – Flux Weakening controller – indirect flux weakening – Maximum permissible torque.

**UNIT – V:**

**Variable Reluctance Motor Drive:** Variable Reluctance motor drive – Torque production in the variable reluctance motor Drive characteristics and control principles – Current control variable reluctance motor servo drive.

**Brushless DC Motor Drives:** Three phase full wave Brushless dc motor – Sinusoidal type of Brushless dc motor- current controlled Brushless dc motor Servo drive.

**REFERENCES:**

1. Fundamentals of Electrical Drives – G. K. Dubey – Narora publications – 1995.
2. Electric Motor Drives Pearson Modeling, Analysis and control – R. Krishnan – Publications – 1<sup>st</sup> edition – 2002.
3. Modern Power Electronics and AC Drives B K Bose – Pearson Publications 1<sup>st</sup> edition
4. Power Electronics and Control of AC Motors – MD Murthy and FG Turn Bull Pergman Press 1<sup>st</sup> edition
5. Power Electronics and AC Drives – BK Bose – Prentice Hall Eagle wood diffs New Jersey - 1<sup>st</sup> edition
6. Power Electronic circuits Deices and Applications – M H Rashid – PHI – 1995.

**M. Tech – I Year – I Sem. (PEED)**  
**SPECIAL MACHINES**  
**(Professional Elective – I)**

**Course objectives:**

- To understand the working and construction of special machines
- To know the use of special machines in different feed-back systems
- To understand the use of digital controllers for different machines

**Course Outcomes:**

- Upon the completion of this subject, the student will be able
- To understand the operation of different special machines
- To select different special machines as part of control system components
- To use special machines as transducers for converting physical signals into electrical signals
- To design digital controllers for different machines

**UNIT-I:**

**Stepper Motors:** Introduction-synchronous inductor (or hybrid stepper motor), Hybrid stepping motor, construction, principles of operation, energization with two phase at a time- essential conditions for the satisfactory operation of a 2-phase hybrid step motor - very slow - speed synchronous motor for servo control-different configurations for switching the phase windings-control circuits for stepping motors-an open-loop controller for a 2-phase stepping motor.

**UNIT-II:**

**Variable Reluctance Stepping Motors:** Variable reluctance ( VR ) Stepping motors, single-stack VR step motors, Multiple stack VR motors-Open-loop control of 3-phase VR step motor-closed-Loop control of step motor, discriminator ( or rotor position sensor ) transilator, major loop-characteristics of step motor in open-loop drive – comparison between open-loop position control with step motor and a position control servo using a conventional ( dc or ac ) servo motor- Suitability and areas of application of stepping motors-5- phase hybrid stepping motor - single phase - stepping motor, the construction, operating principle torque developed in the motor.

**Switched Reluctance Motor:** Introduction – improvements in the design of conventional reluctance motors- Some distinctive differences between SR and conventional reluctance motors-principle of operation of SRM- Some design aspects of stator and rotor pole arcs, design of stator and rotor and pole arcs in SR motor-determination of  $L(\theta)$ - $\theta$  profile - power converter for SR motor-A numerical example – Rotor sensing mechanism and logic control, drive and power circuits, position sensing of rotor with Hall problems-derivation of torque expression, general linear case.

**UNIT-III:**

**Permanent Magnet Materials and PM DC Machines:** Introduction, Hysteresis loops and recoil line-stator frames (pole and yoke - part) of conventional PM dc Motors, Equivalent circuit of PM Generator and Motor-Development of Electronically commutated dc motor from conventional dc motor.

**Brushless DC Motor:** Types of construction – principle of operation of BLDM- sensing and switching logic scheme, sensing logic controller, lockout pulses –drive and power circuits, Base drive circuits, power converter circuit-Theoretical analysis and performance prediction, modeling and magnet circuit d-q analysis of BLDM -transient analysis formulation in terms of flux linkages as state variables-Approximate solution for current and torque under steady state –Theory of BLDM as variable speed synchronous motor ( assuming sinusoidal flux distribution )- Methods or reducing Torque Pulsations, 180 degrees pole arc and 120 degree current sheet.

**UNIT-IV:**

**Linear Induction Motor:** Development of a double sided LIM from rotary type IM- A schematic of LIM drive for electric traction development of one sided LIM with back iron-field analysis of a DSLIM fundamental assumptions.

**UNIT-V:**

**Permanent Magnet Axial Flux (Pmaf) Machines:** Construction, Armature windings – Toroidal Stator and Trapezoidal Stator Windings, Torque and EMF equations, Phasor diagram and output equation.

**TEXT BOOKS:**

1. Special electrical machines, K. Venkataratnam, - University press.
2. Special electrical machines, E. G. Janardanan, - PHI.
3. R. K. Rajput, "Electrical machines"-5th edition.
4. V. V. Athani, "Stepper motor: Fundamentals, Applications and Design"- New age International pub.



**M. Tech – I Year – I Sem. (PEED)**  
**HIGH FREQUENCY MAGNETIC COMPONENTS**  
**(Professional Elective – I)**

**Course objectives:**

- To understand the fundamentals of magnetic devices
- To know the skin and proximity effects in windings
- To design high frequency transformers
- To analyze and design the various components of converters

**Course Outcomes:**

- Upon the completion of this subject, the student will be able
- To understand the operation of magnetic devices
- To appreciate the skin and proximity effects in various windings
- To analyze and design the components in power electronic converters
- To design transformers of High frequency used in converters

**Unit-I:**

**Fundamentals of Magnetic Devices:** Introduction, Magnetic Relationships, Magnetic Circuits, Magnetic Laws, Eddy Currents, Core Saturation, Volt-Second Balance, Inductance, Inductance Factor, Magnetic Energy, Self-Resonant Frequency, Classification of Power Losses in Magnetic Components, Non-inductive Coils.

**Magnetic Cores:** Introduction, Properties of Core Materials, Magnetic Dipoles, Magnetic Domains, Curie Temperature, Magnetization, Magnetic Materials, Hysteresis, Core Permeability, Core Geometries, Iron Alloy Cores, Amorphous Alloy Cores, Nickel-Iron and Cobalt-Iron Cores, Ferrite Cores, Powder Cores, Nano-crystalline Cores, Superconductors, Hysteresis Core Loss, Eddy-Current Core Loss, Total Core Loss, Complex Permeability.

**Unit-II:**

**Skin Effect & Proximity Effect:** Introduction, Magnet Wire, Wire Insulation, Skin Depth, Ratio of AC-to-DC Winding Resistance, Skin Effect in Long Single Round Conductor, Current Density in Single Round Conductor, Impedance of Round Conductor, Magnetic Field Intensity for Round Wire, Other Methods of Determining the Round Wire Inductance, Power Density in Round Conductor, Skin Effect on Single Rectangular Plate. Proximity and Skin Effects in Two Parallel Plates, Anti-proximity and Skin Effects in Two Parallel Plates, Proximity Effect in Multiple-Layer Inductor, Appendix: Derivation of Proximity Power Loss.

**Winding Resistance at High Frequencies:** Introduction, Winding Resistance, Square and Round Conductors, Winding Resistance of Rectangular Conductor, Winding Resistance of Square Wire, Winding Resistance of Round Wire, Leakage Inductance, Solution for Round Conductor Winding in Cylindrical Coordinates, Litz Wire, Winding Power Loss for Inductor Current with Harmonics, Effective Winding Resistance for Non-sinusoidal Inductor Current, Thermal Model of Inductors.

**Unit-III:**

**Transformers:** Introduction, Neumann's Formula for Mutual Inductance, Mutual Inductance, Energy Stored in Coupled Inductors, Magnetizing Inductance, Leakage Inductance, Measurement of Transformer Inductances, Stray Capacitance, High-Frequency Transformer Model, Non-interleaved Windings, Interleaved Windings, AC Current Transformers, Winding Power Losses with Harmonics, Thermal Model of Transformers.

**Design of Transformers:** Introduction, Area Product Method, Optimum Flux Density, Transformer Design for Fly-back Converter in CCM, Transformer Design for Fly-back Converter in DCM,

Transformer Design for Fly-back Converter in CCM, Transformer Design for Fly-back Converter in DCM.

**Unit-IV:**

**Integrated Inductors:** Introduction, Resistance of Rectangular Trace, Inductance of Straight Rectangular Trace, Construction of Integrated Inductors, Meander Inductors, Inductance of Straight Round Conductor, Inductance of Circular Round Wire Loop, Inductance of Two-Parallel Wire Loop, Inductance of Rectangle of Round Wire, Inductance of Polygon Round Wire Loop, Bond-wire Inductors, Single-Turn Planar Inductor, Inductance of Planar Square Loop, Planar Spiral Inductors, Multi-metal Spiral Inductors, Planar Transformers, MEMS Inductors, Inductance of Coaxial Cable, Inductance of Two-Wire Transmission Line, Eddy Currents in Integrated Inductors, Model of RF Integrated Inductors, PCB Inductors.

**Design of Inductors:** Introduction, Restrictions on Inductors, Window Utilization Factor, Temperature Rise of Inductors, Mean Turn Length of Inductors, Area Product Method, AC Inductor Design, Inductor Design for Buck Converter in CCM, Inductor Design for Buck Converter in DCM method.

**Unit-V:**

**Self-Capacitance:** Introduction, High-Frequency Inductor Model, Self-Capacitance Components, Capacitance of Parallel-Plate Capacitor, Self-Capacitance of Foil Winding Inductors, Capacitance of Two Parallel Round Conductors, Capacitance of Round Conductor and Conducting Plane, Self-Capacitance of Single-Layer Inductors, Self-Capacitance of Multi-layer Inductors, Capacitance of Coaxial Cable.

**TEXT BOOK:**

1. Design of Magnetic Components for Switched Mode Power Converters, Umanand L., Bhat, S.R., ISBN: 978-81-224-0339-8, Wiley Eastern Publication, 1992.

**REFERENCES:**

1. High-Frequency Magnetic Components, Marian K. Kazimierczuk, ISBN: 978-0-470-71453-9 John Wiley & Sons, Inc.
2. G. C. Chryssis, High frequency switching power supplies, McGraw Hill, 1989 (2nd Ed.)
3. Eric Lowdon, Practical Transformer Design Handbook, Howard W. Sams & Co., Inc., 1980
4. "Thompson --- Electrodynamical Magnetic Suspension.pdf"
5. Witulski --- "Introduction to modeling of transformers and coupled inductors" Beattie --- "Inductance 101.pdf"
6. P. L. Dowell, "Effects of eddy currents in transformer windings.pdf"
7. Dixon--- "Eddy current losses in transformer windings.pdf"
8. J J Ding, J S Buckkeridge, "Design Considerations For A Sustainable Hybrid Energy System" IPENZ Transactions, 2000, Vol. 27, No. 1/EMCh.
9. Texas Instruments --- "Windings.pdf"
10. Texas Instruments --- "Magnetic core characteristics.pdf"
11. Ferroxcube --- "3f3 ferrite datasheet.pdf"
12. Ferroxcube --- "Ferrite selection guide.pdf"
13. Magnetics, Inc., Ferrite Cores (www.mag-inc.com).

**M. Tech – I Year – I Sem. (PEED)**  
**PROGRAMMABLE LOGIC CONTROLLERS AND APPLICATIONS**  
**(Professional Elective – I)**

**Course Objectives:**

- To understand the generic architecture and constituent components of a Programmable Logic Controller.
- To develop a software program using modern engineering tools and technique for PLC.
- To apply knowledge gained about PLCs to identify few real life industrial applications

**Course Outcomes:**

- Upon the completion of the course the student will be able to
- Develop and explain the working of PLC with the help of a block diagram.
- Execute, debug and test the programs developed for digital and analog operations.
- Reproduce block diagram representation on industrial applications using PLC.

**Unit-I:**

PLC Basics PLC system, I/O modules and interfacing CPU processor programming equipment programming formats, construction of PLC ladder diagrams, devices connected to I/O modules.

**Unit-II:**

PLC Programming input instructions, outputs, operational procedures, programming examples using contacts and coils. Drill-press operation.

Digital logic gates programming in the Boolean algebra system, conversion examples Ladder diagrams for process control Ladder diagrams and sequence listings, ladder diagram construction, and flow chart for spray process system.

**Unit-III:**

PLC Registers: Characteristics of Registers module addressing holding registers input registers, output registers. PLC Functions Timer functions and industrial applications counters counter function industrial applications, Architecture functions, Number comparison functions, number conversion functions.

**Unit-IV:**

Data handling functions: SKIP, Master control Relay Jump Move FIFO, FAL, ONS, CLR and Sweep functions and their applications. Bit Pattern and changing a bit shift register, sequence functions and applications, controlling of two axes and three axis Robots with PLC, Matrix functions.

**Unit-V:**

Analog PLC operation: Analog modules and systems Analog signal processing multi bit data processing , analog output application examples, PID principles position indicator with PID control, PID modules, PID tuning, PID functions

**REFERENCE BOOKS:**

1. Programmable Logic Controllers – Principle and Applications by John W Webb and Ronald A Reiss Fifth edition, PHI
2. Programmable Logic Controllers – Programming Method and Applications by JR Hackworth and F.D Hackworth – Jr- Pearson, 2004.

**M. Tech – I Year – I Sem. (PEED)**  
**HVDC & FACTS**  
**(Professional Elective – II)**

**Prerequisites:** Power Electronics, Power Systems

**Course Objectives:**

- To understand the control aspects of HVDC System
- To study HVDC Transmission system
- To know the importance of controllable parameters and types of FACTS controllers & their benefits
- To understand the fundamentals of FACTS Controllers,

**Course Outcomes: Upon the completion of the course the student will be able to**

- Compare EHV AC and HVDC system and to describe various types of DC links
- Describe various methods for the control of HVDC systems and to perform power flow analysis in AC/DC systems
- Choose proper FACTS controller for the specific application based on system requirements
- Analyze the control circuits of Shunt Controllers, Series controllers & Combined controllers for various functions viz. Transient stability Enhancement, voltage instability prevention and power oscillation damping

**UNIT - I**

**HVDC transmission:** HVDC Transmission system: Introduction, comparison of AC and DC systems, applications of DC transmission, types of DC links, Layout of HVDC Converter station and various equipments. HVDC Converters, analysis of bridge converters with and without overlap, inverter operation, equivalent circuit representation of rectifier and inverter configurations

**UNIT -II**

**Control of HVDC system:** Principles of control, desired features of control, converter control characteristics, power reversal, Ignition angle control, current and extinction angle control. Harmonics-introduction, generation, ac filters and dc filters.

Introduction to multiterminal DC systems and applications, comparison of series and parallel MTDC systems,

Voltage Source Converter based HVDC systems

**UNIT - III**

**Facts concepts:** Reactive power control in electrical power transmission, principles of conventional reactive power compensators. Introduction to FACTS, flow of power in AC parallel paths, meshed systems, basic types of FACTS controllers, definitions of FACTS controllers, brief description of FACTS controllers.

**UNIT - IV**

**Static shunt and series compensators:** Shunt compensation - objectives of shunt compensation, methods of controllable VAR generation, static VAR compensators - SVC, STATCOM, SVC and STATCOM comparison. Series compensation - objectives of series compensation, thyristor switched series capacitors (TCSC), static series synchronous compensator (SSSC), power angle characteristics, and basic operating control schemes.

**UNIT - V**

**Combined compensators:** Unified power flow controller (UPFC) - Introduction, operating principle, independent real and reactive power flow controller and control structure. Interline power flow controller

(IPFC), Introduction to Active power filtering, Concepts relating to Reactive power compensation and harmonic current compensation using Active power filters.

**TEXT BOOKS:**

- 1 Hingorani ,L.Gyugyi, 'Concepts and Technology of Flexible AC Transmission System', IEEE Press New York, 2000 ISBN –078033 4588.
- 2 Padiyar, K.R., 'HVDC transmission systems', Wiley Eastern Ltd., 2010.

**REFERENCES:**

- 1 Song, Y.H. and Allan T. Johns, 'Flexible AC Transmission Systems (FACTS)', Institution of Electrical Engineers Press, London, 1999.
- 2 Mohan Mathur R. and Rajiv K.Varma , 'Thyristor - based FACTS controllers for Electrical Transmission systems', IEEE press, Wiley Inter science , 2002.
- 3 Padiyar K.R., 'FACTS controllers for Transmission and Distribution systems' New Age International Publishers, 1st Edition, 2007.
- 5 Enrique Acha, Claudio R.Fuerte-Esqivel, Hugo Ambriz-Perez, Cesar Angeles-Camacho 'FACTS – Modeling and simulation in Power Networks' John Wiley & Sons, 2002.
- 6 Jos Arrillaga, 'High voltage Direct Current Transmission' IET Power and Energy Series 29

**M. Tech – I Year – I Sem. (PEED)**  
**SWITCHED MODE POWER SUPPLIES (SMPS)**  
**(Professional Elective – II)**

**Prerequisites:** Power Electronics, Electronic devices and circuits

**Course objectives:**

- To understand various modes of operation of DC-DC Converter
- To analyze control aspects of converter
- To design various Switched Mode Power Supply components
- To get awareness on EMI, Protection of converter system

**Course Outcomes:**

- Upon the completion of the course the student will be able to
- Analyze various modes of operation of Dc-Dc converter Design different controllers for converter
- Design various components of dc-dc converter
- Analyze dc-dc converter in view of EMI and thermal considerations

**UNIT – I**

**Basic Converter Circuits:** Buck Regulator, Buck- Boost Regulator, Boost Regulator, Cuk Converters and Resonant Converters. Choice of switching frequency.

**UNIT – II**

**Isolated SMPS:** Fly back Converter, Forward Converter, Half-Bridge and Full Bridge Converters, Push-Pull Converter and SMPS with multiple outputs. Choice of switching frequency.

**UNIT – III**

**Control Aspects:** PWM Controllers, Isolation in feedback loop, Power Supplies with multiple output. Stability analysis using Bode Diagrams.

**UNIT – IV**

**Design Considerations:** Selection of output filter capacitor, Selection of energy storage inductor, Design of High Frequency Inductor and High frequency Transformer, Selection of switches. Snubber circuit design, Design of driver circuits.

**UNIT – V**

**Electro Magnetic Interference (EMI):** EMI Filter Components, Conducted EMI suppression, Radiated EMI suppression, Measurement.

**Protection:** Over current protection, over voltage protection, Inrush current protection.

**Thermal Model:** Thermal Resistance, Cooling Considerations, Selection of Heat sinks, Simple Heat sink calculations.

**TEXT BOOKS:**

- 1 Switched Mode Power Supplies, Design and Construction, H. W. Whittington, B. W. Flynn and D. E. MacPherson, Universities Press, 2009 Edition.
- 2 Mohan N. Undeland . T & Robbins W., Power Electronics Converters, Application and Design. John Wiley, 3rd edition, 2002
- 3 Umanand L., Bhat S.R., Design of magnetic components for switched Mode Power Converters. , Wiley Eastern Ltd.,1992
- 4 Robert. W. Erickson, D. Maksimovic .Fundamentals of Power Electronics., Springer International Edition, 2005

5 Course Material on Switched Mode Power Conversion, V. Ramanarayanan.

**REFERENCE BOOKS:**

1. Krein P.T .Elements of Power Electronics., Oxford University Press
2. M. H. Rashid, Power Electronics. Prentice-Hall of India

**M. Tech – I Year – I Sem. (PEED)**  
**AI Techniques in Electrical Engineering**  
**(Professional Elective – II)**

**Course Objectives:**

- To locate soft commanding methodologies, such as artificial neural networks, Fuzzy logic and genetic Algorithms.
- To observe the concepts of feed forward neural networks and about feedback neural networks.
- To practice the concept of fuzziness involved in various systems and comprehensive knowledge of fuzzy logic control and to design the fuzzy control
- To analyze genetic algorithm, genetic operations and genetic mutations.

**Course Outcomes:**

- Upon the completion of this course, the student will be able to
- Understand feed forward neural networks, feedback neural networks and learning techniques.
- Analyze fuzziness involved in various systems and fuzzy set theory.
- Develop fuzzy logic control for applications in electrical engineering
- Develop genetic algorithm for applications in electrical engineering.

**UNIT – I:**

**Artificial Neural Networks:** Introduction-Models of Neural Network - Architectures – Knowledge representation – Artificial Intelligence and Neural networks – Learning process – Error correction learning – Hebbian learning – Competitive learning – Boltzman learning – Supervised learning – Unsupervised learning – Reinforcement learning - learning tasks.

**UNIT- II:**

**ANN Paradigms :** Multi – layer perceptron using Back propagation Algorithm-Self – organizing Map – Radial Basis Function Network – Functional link, network – Hopfield Network.

**UNIT – III:**

**Fuzzy Logic:** Introduction – Fuzzy versus crisp – Fuzzy sets - Membership function – Basic Fuzzy set operations – Properties of Fuzzy sets – Fuzzy cartesian Product – Operations on Fuzzy relations – Fuzzy logic – Fuzzy Quantifiers - Fuzzy Inference - Fuzzy Rule based system - Defuzzification methods.

**UNIT – IV:**

**Genetic Algorithms:** Introduction-Encoding – Fitness Function-Reproduction operators - Genetic Modeling – Genetic operators - Crossover - Single-site crossover – Two-point crossover – Multi point crossover-Uniform crossover – Matrix crossover - Crossover Rate - Inversion & Deletion – Mutation operator –Mutation – Mutation Rate-Bit-wise operators - Generational cycle-convergence of Genetic Algorithm.

**UNIT-V:**

**Applications of AI Techniques:** Load forecasting – Load flow studies – Economic load dispatch – Load frequency control – Single area system and two area system – Small Signal Stability (Dynamic stability) Reactive power control – speed control of DC and AC Motors.

**TEXT BOOK:**

- 1 S. Rajasekaran and G. A. V. Pai, “Neural Networks, Fuzzy Logic & Genetic Algorithms”- PHI, New Delhi, 2003.



**REFERENCES:**

- 1 P. D. Wasserman, Van Nostrand Reinhold, "Neural Computing Theory & Practice" - New York, 1989.
- 2 Bart Kosko, "Neural Network & Fuzzy System" Prentice Hall, 1992.
- 3 G. J. Klir and T. A. Folger, "Fuzzy sets, Uncertainty and Information"-PHI, Pvt.Ltd,1994.
- 4 D. E. Goldberg," Genetic Algorithms"- Addison Wesley 1999

**M. Tech – I Year – I Sem. (PEED)**  
**POWER CONVERTERS AND DRIVES LAB**

**Pre-requisites:** All core subjects

**Course Objectives:**

- Show awareness of the impact of power electronic control circuits on utility supply
- To observe the difference of the conventional and power electronic control of drives.
- Have a better understanding of the close relationship between hardware and simulation models of actual systems.
- To familiarize the student with various power electronic converter topologies and their speed Control application (open loop and closed loop operation)

**Course Outcomes:** Student will be able to

- Conduct experiments on drives for different modes of operation using different converter topologies.
- Select the suitable controller for getting the desired speed performance of drive.
- Validate the results

**List of Experiments**

1. Speed Measurement and closed loop control using PMDC motor.
2. Thyristorised drive for PMDC Motor with speed measurement and closed Loop control.
3. IGBT used single 4 quadrant chopper drive for PMDC motor with speed measurement and closed loop control.
4. Thyristorised drive for 1Hp DC motor with closed loop control.
5. 3-Phase input, thyristorised drive, 3 Hp DC motor with closed loop
6. 3-Phase input IGBT, 4 quadrant chopper drive for DC motor with closed Loop control equipment.
7. Cyclo-converter based AC Induction motor control equipment.
8. Speed control of 3 phase wound rotor Induction motor.
9. Single-phase fully controlled converter with inductive load.
10. Single phase half wave controlled converter with inductive load.
11. Isolated Gate Drive circuits for MOSFET / IGBT based circuits.
12. Characteristics of solar PV Systems.
13. Maximum Power Point Tracking Charge Controllers.
14. Inverter control for Solar PV based systems.

**Note: Any ten experiments can be conducted.**

# Anurag Group of Institutions

## M. TECH. I YEAR I SEMESTER

### List of Open Electives Offered by Various Departments, Effective from AY 2018- 19

S. No	Name of the Department	Open Elective (S) Offered for Other Departments	Subject Code
1	Civil Engineering (Open Elective – I)	Computational Methods in Engineering	A31010
2	Electronics and Communication Engineering (Open Elective – I)	Principles of Electronic Communications	A31050
3	Electrical and Electronics Engineering (Open Elective – I)	1. Renewable Energy Systems, 2. Electrical Installation & Safety	A31051 A31052
4	Mechanical Engineering (Open Elective – I)	Computer Oriented Numerical Methods	A31053
5	Computer Science and Engineering (Open Elective – I)	1. Fundamentals of Cyber Security 2. Database Management System	A31054 A31011

## CIVIL ENGINEERING

M.Tech I Year – I Sem.

### OPEN ELECTIVE – I

#### COMPUTATIONAL METHODS IN ENGINEERING

##### UNIT-I:

**INTRODUCTION TO NUMERICAL METHODS APPLIED TO ENGINEERING PROBLEMS:** Examples, solving sets of equation – Matrix notation – Determination and inversion – Iterative methods – Relaxation methods – System of non-linear equations – computer programs. **Numerical integration:** Newton-Cotes integration formulas – Simpson's rules, Gaussian quadrature. Adaptive integration.

##### UNIT-II:

**OPTIMIZATION:** One dimensional unconstrained optimization, multidimensional unconstrained optimization – direct methods and gradient search methods, constrained optimization.

**Boundary value problems and characteristic value problems:** Shooting method – Solution through a set of equations – Derivative boundary conditions – Rayleigh - Ritz method – Characteristic value problems,

##### UNIT-III:

**NUMERICAL SOLUTIONS OF PARTIAL DIFFERENTIAL EQUATIONS:** Laplace's equations – Representation as a difference equation – Iterative methods for Laplace's equations – poisson equation – Examples – Derivative boundary conditions – Irregular and non-rectangular grids – Matrix patterns, sparseness – ADI method – Finite element method.

**Parabolic partial differential equations:** Explicit method – Crank-Nickelson method – Derivative boundary condition – Stability and convergence criteria – Finite element for heat flow – computer programs.

##### UNIT-IV:

**HYPERBOLIC PARTIAL DIFFERENTIAL EQUATIONS:** Solving wave equation by finite differences- stability of numerical method – method of characteristics wave equation in two space dimension-computer programs.

##### UNIT- V:

**Curve fitting and approximation of functions:** Least square approximation fitting of non-linear curves by least squares – regression analysis – multiple linear regression, non linear regression – computer programs.

##### REFERENCES:

1. Numerical Methods for Engineers/ Steven C.Chapra, Raymond P.Canale/ Tata Ma-Graw Hill
2. Applied numerical analysis / Curtis F.Gerald, partick.O.Wheatly /Addison-wesley,1989
3. Numerical methods / Douglas J.Faires, Riched Burden / Brooks-cole publishing company, 1998 Second edition.
4. Numerical mathematics and computing/ Ward cheney & David Kincaid / Brooks-cole publishing company 1999 fourth edition
5. Mathematical methods for physics and engineering / Riley K.F.M.P.Hobson & Bence S.J./ Cambridge university press,1999.

**ELECTRONICS AND COMMUNICATION ENGINEERING**  
**PRINCIPLES OF ELECTRONIC COMMUNICATIONS**  
**(Open Elective -1)**

**UNIT - I**

**Introduction:** Need for Modulation, Frequency translation, Electromagnetic spectrum, Gain, Attenuation and decibels.

**UNIT - II**

**Simple description on Modulation:** Analog Modulation-AM, FM, Pulse Modulation-PAM, PWM, PCM, Digital Modulation Techniques-ASK, FSK, PSK, QPSK modulation and demodulation schemes.

**UNIT - III**

**Telecommunication Systems:** Telephones Telephone system, Paging systems, Internet Telephony.  
**Networking and Local Area Networks:** Network fundamentals, LAN hardware, Ethernet LANs, Token Ring LAN.

**UNIT - IV**

**Satellite Communication:** Satellite Orbits, satellite communication systems, satellite subsystems, Ground Stations Satellite Applications, Global Positioning systems.  
**Optical Communication:** Optical Principles, Optical Communication Systems, Fiber –Optic Cables, Optical Transmitters & Receivers, Wavelength Division Multiplexing.

**UNIT - V**

**Cellular and Mobile Communications:** Cellular telephone systems, AMPS, GSM, CDMA, WCDMA.  
**Wireless Technologies:** Wireless LAN, PANs and Bluetooth, ZigBee and Mesh Wireless networks, Wimax and MANs, Infrared wireless, RFID communication, UWB.

**TEXT BOOKS**

1. Louis E. Frenzel, "Principles of Electronic Communication Systems", 3<sup>rd</sup> Ed., McGraw Hill publications, 2008.
2. Kennady, Davis, "Electronic Communications systems", 4Ed., TMH, 1999

**REFERENCE BOOKS**

1. Tarmo Anttalainen, "Introduction to Telecommunications Network Engineering", Artech House Telecommunications Library.
2. Theodore Rappaport, "Wireless Communications-Principles and practice", Prentice Hall, 2002.
3. Roger L. Freeman, "Fundamentals of Telecommunications", 2 Ed. Wiley publications.
4. Wayne Tomasi, "Introduction to data communications and networking", Pearson Education, 2005.

**ELECTRICAL AND ELECTRONICS ENGINEERING  
RENEWABLE ENERGY SYSTEMS  
(Open Elective - I)**

**Course Objectives:**

- To recognize the awareness of energy conservation in students
- To identify the use of renewable energy sources for electrical power generation
- To collect different energy storage methods
- To detect about environmental effects of energy conversion

**Course Outcomes:**

- Upon the completion of this course, the student will be able to
- find different renewable energy sources to produce electrical power
- estimate the use of conventional energy sources to produce electrical energy role-play the fact that the conventional energy resources are depleted
- arrange Store energy and to avoid the environmental pollution

**Unit-I:**

Photo voltaic power generation ,spectral distribution of energy in solar radiation, solar cell configurations, voltage developed by solar cell, photo current and load current, practical solar cell performance, commercial photo voltaic systems, test specifications for PV systems, applications of super conducting materials in electrical equipment systems.

**Unit-II:**

Principles of MHD power generation, ideal MHD generator performance, practical MHD generator, MHD technology.

**Wind Energy conversion:** Power from wind, properties of air and wind, types of wind Turbines, operating characteristics.

**Unit-III:**

Tides and tidal power stations, modes of operation, tidal project examples, turbines and generators for tidal power generation.

**Wave energy conversion:** properties of waves and power content, vertex motion of Waves, device applications. Types of ocean thermal energy conversion systems Application of OTEC systems examples,

**Unit-IV:**

**Miscellaneous energy conversion systems:** coal gasification and liquefaction, biomass conversion, geothermal energy, thermo electric energy conversion, principles of EMF generation, description of fuel cells, Co-generation and energy storage, combined cycle co-generation, energy storage.

**Global energy position and environmental effects:** energy units, global energy position.

**Unit-V:**

Types of fuel cells, H<sub>2</sub>-O<sub>2</sub> Fuel cells, Application of fuel cells – Batteries, Description of batteries, Battery application for large power. Environmental effects of energy conversion systems, pollution from coal and preventive measures steam stations and pollution, pollution free energy systems.

**TEXT BOOKS:**

- 1 "Energy conversion systems" by Rakosh das Begamudre, New age International publishers, New Delhi - 2000.
- 2 "Renewable Energy Resources" by John Twidell and Tony Weir, 2<sup>nd</sup> Edition, Fspan & Co.

**REFERENCES:**

1. "Understanding Renewable Energy Systems" by Volker Quaschnig, 2005, UK.
2. "Renewable Energy Systems-Advanced Conversion, Technologies & Applications" by Faner Lin Luo Honer Ye, CRC press, Taylor & Francis group.

## **ELECTRICAL INSTALLATION & SAFETY**

### **(Open Elective - I)**

#### **Course Objectives:**

- The course should enable the students to:
- Understand Electrical Wiring with IE rules. Residential Building Electrification, Electrification of commercial Installation, Electrification of factory unit Installation
- Protection against electric shocks, Safety Measures & Prevention of Accidents

#### **Course Outcomes:**

- The students will be able to:
- Acquire the knowledge of different types wires and wiring systems, I.E. rules and Electric supply act.
- Explain the importance of earthing, rating of wires & cables, procedures for residential, commercial electrification.
- Able to estimate the length of wire, cable, conduit, earth wire, and earthing and also cost of residential, commercial electrification.

#### **Unit-I: Electrical Wiring with IE rules.**

Introduction, Define types of wires; Different types of wiring system; Comparison of different types of wiring; Different types and specifications of wiring materials; Accessories and wiring tools; Prepare I.E. rules for wiring, including Electricity supply act 2003& 2005;

#### **Unit-II : Residential Building Electrification**

General rules guidelines for wiring of Residential Installation and positioning of equipment's; Principles of circuit design in lighting and power circuits.; Procedures for designing the circuits and deciding the number of circuits.; Method of drawing single line diagram.; Selection of type of wiring and rating of wires & cables.; Load calculations and selection of size of conductor.; Selection of rating of main switch, distributions board, protective switchgear ELCB and MCB and wiring accessories.; Earthing of Residential Installation.

#### **Unit-III: Electrification of commercial Installation**

Concept of commercial Installation.; Differentiate between electrification of Residential and commercial Installation.; Fundamental considerations for planning of an electrical Installation system for commercial building.; Design considerations of electrical Installation system for commercial building.; Load calculations & selection of size of service connection and nature of supply.; Deciding the size of cables, bus bar and bus bar chambers.; Mounting arrangements and positioning of switch boards, distribution boards main switch etc.; Earthing of the electrical Installation; Selection of type wire, wiring system & layout.

#### **Unit-IV: Electrification of factory unit Installation**

Concept of Industrial load; Concept of Motor wiring circuit and single line diagram. Important guidelines about power wiring and Motor wiring.; Design consideration of Electrical Installation in small Industry/Factory/workshop.; Motor current calculations.; Selection and rating of wire, cable size 7. conduct.; Deciding fuse rating, starter, distribution boards main switch etc.; Deciding the cable route, determination of length of wire, cable, conduit, earth wire, and earthing.

#### **Unit-V: Protection against electric shocks**

Electric shock- General , Protection against direct contact, Protection against indirect contact, Protection of goods in case of insulation fault, Implementation of the TT system, Implementation of the TN system, Implementation of the IT system. Protection provided for enclosed equipment: codes IP



and IK, IP code definition, Elements of the IP Code and their meanings, IK Code definition, IP and IK code specifications for distribution switchboards

**Safety Measures & Prevention of Accidents-** Concept of electrical safety, electrical accidents, its causes & preventions.; Safety signs and symbols used in industry.; Electrical shocks and factors affecting the severity of it, method of rescuing electrocuted person & different methods of artificial respiration.; Electrical safety as per I.E. Rules 1956.; Do's & don'ts regarding safety while working on electrical installations.; Concept of Permit system, its preparation & regulation for attending to electrical work.; Precautions to be taken to avoid fire due to electrical reasons, operation of fire extinguishers, types of fire extinguishers.

**TEXT BOOKS:**

1. Dr. S.L. Uppal of Electrical Wiring, Estimating and Costing, New Age International (p) Limited, New Delhi.
2. Electrical Design Estimating and Costing, K.B. Raina & S.K. Battacharya, new age international (p) limited. Publishers
3. Electrical estimating & costing 2<sup>nd</sup> addition By Surjit singh
4. Electrical Installation Estimating & Costing, Gupta, J.B., S. K. Kataria & Sons, New Delhi

**MECHANICAL ENGINEERING**  
**COMPUTER ORIENTED NUMERICAL METHODS**  
**(Open Elective – 1)**

**Unit - I:**

Solutions of linear equations: Direct method – Cramer's rule, Gauss – Elimination method- Gauss – Jordan elimination – Triangulation (LU Decomposition) method – Iterative methods Jacobi – Iteration method – Gauss – Siedel iteration, Successive over –relaxation method.

Eigen values and Eigen vectors; Jacobi method for symmetric matrices- Given's method for symmetric matrices-Householder's method for symmetric matrices-Rutishauser method of arbitrary matrices – Power method.

**UNIT - II:**

Interpolation: Linear Interpolation – Higher order Interpolation – Lagrange Interpolation – Interpolating polynomials using finites differences- Hermite Interpolation –piece-wise and spline Interpolation.

**Unit - III**

Finite Difference and their Applications: Introduction- Differentiation formulas by Interpolating parabolas – Backward and forward and central differences- Derivation of Differentiation formulae using Taylor series- Boundary conditions- Beam deflection – Solution of characteristic value problems- Richardson's extrapolation- Use of unevenly spaced pivotal points- Integration formulae by interpolating parabolas- Numerical solution to spatial differential equations – Applications to Simply Supported Beams, Columns and Rectangular Plates.

**UNIT - IV**

Numerical Differentiation: Difference methods based on undetermined coefficients- optimum choice of step length– Partial differentiation.

Numerical Integration: Method based on interpolation-method based on undetermined coefficient – Gauss – Lagrange interpolation method- Radaua integration method- composite integration method – Double integration using Trapezoidal and Simpson's method – New Marks Method and Application to Beams – Calculation of Slopes and Deflections.

**UNIT - V**

Ordinary Differential Equation: Euler's method – Backward Euler method – Midpoint method – single step method, Taylor's series method- Boundary value problems.

**TEXT BOOKS:**

- 1 Numerical methods for scientific and engineering computations. M.K. Jain-S.R.K. Iyengar – R.K. Jain Willey Eastern Limited
- 2 Numerical Methods for Engineering Problems, N. Krishna Raju, KU Muthu, Mac-Millan publishers

**REFERENCES:**

- 1 Introductory Numerical Methods by S.S. Shastri, PHI Learning Pvt. Ltd.
- 2 Applied numerical analysis by – Curtis I. Gerala- Addison Wasley – published campus.
- 3 Numerical methods for Engineers Stevan C. Chopra, Raymond P. Canal Mc. Graw Hill Book Company.
- 4 C Language and Numerical methods by C. Xavier – New age international publisher.
- 5 Computer based numerical analysis by Dr. M. Shanta Kumar, Khanna Book publishers, New Delhi.

**COMPUTER SCIENCE AND ENGINEERING  
FUNDAMENTALS OF CYBER SECURITY  
(Open Elective - I)**

**Course Objective:**

This course is aimed to generate interest and awareness in cyber security field, which is important in the world of information security due to the wide variety of computer crimes that take place in cyber space. The course deals with various types of attacks framed by an attacker, and the security which need to be implemented at various levels along with latest trends in cyber security.

**UNIT-I:**

Cyber Security Basics – Sphere, Terminology, Vulnerability in the Cyber Structure and Infrastructure, Cyber threats and Weaponry, Cyber Defense, Cyber Attack Detection and Prevention, Information Security Testing, Cyber Security Investigation/assessment, Cyber-Deterrence.

**UNIT-II:**

Cyber Crimes and Cyber Laws – Introduction, IT laws & Cyber Crimes – Internet, Hacking, Password Cracking, Viruses, Virus Attacks, Pornography, Software Privacy, Intellectual Property, Legal System of Information Technology, Social Engineering, Phishing, Denial of Service attack, Malicious Code, Mail Bombs, Worms, Logic Bombs, Botnet, Trojan, Bug Exploits.

**UNIT-III:**

**End point Security:** Desktop and Laptop Security, Cell Phone and PDA Security, Bluetooth Security, Patch and Vulnerability Management, Password Management, Security for Full Virtualization Technologies, Media Sanitization, Security Radio Frequency Identification (RFID) Systems. **Network Security:** Intrusion Detection & Prevention Systems, Firewalls and Firewall Policy, Computer Security Log Management, Enterprise Tele work and Remote Access Security, Securing WiMAX Wireless Communication. **Web Security:** Server Security, Web authentication, SSL and SET, Securing Public Web Servers, Secure Deployment of IPv6, Secure Domain name System (DNS) Deployment, SSL VPNs, Unified Threat Management (UTM).;

**UNIT-IV:**

**Application Security:** Active Content and Mobile Code, E-commerce Security, Email Security (PGP, S/MIME), Web Security, Web Application Security, OWASP; **Data Security:** Data Management, Database Security, Data Encryption, Data Leakage Prevention (DLP), Data Destruction; **Software Security:** Software Flaws, Malware, Software based Attacks; Insecurity in Software: SRE, Software Tamper Resistance, DRM, Software Development.

**Operating System Security:** Security Functions, Software Updates and Patches, OS Integrity Checks, Account management, Antivirus Software, Security in Ordinary Operating Systems, Design of Secure OS, OS hardening, Configuring the OS for security, Security kernels, Secure Virtual machine Systems, Trusted Operating System, NGSCB.

**UNIT-V:**

Recent Trends in Cyber Security – Zero – day Malware, Trojan Wars, New Ways to Monetize Non-Financial Data, Fraud-as-a-service, Out-of-band Methods forcing Cybercriminals to Innovate, The Rise of Hactivism, Attacks in mobile devices, social media and cloud computing; Insider threats, Increased regulatory security, Cyber-Terrorism, Cyber –War and Cyber-Peace. Topological Vulnerability Analysis, Cyber Situational Awareness, Secure Composition of Systems, Autonomic Recovery, Secure Data Centers, Cloud Computing Security, Privacy in location-Based Applications.

**TEXT BOOKS:**

- 1 Cyber Security, Edward Amoroso, kindle Edition, 2007
- 2 Cyber Security ,Understanding Cyber crimes, Computer Forensics and Legal Perspectives, Sunita Belapure and Nina Godbole, Wiley India Pvt Ltd. 2011

**REFERENCES:**

1. Computer Security, Dirter Gollmann, John Wiley & Sons Publication, 2011
2. Cyber Security Essentials, James Graham, Richard Howrad, Ryan Olson, CRC Press, 2011

**ANURAG GROUP OF INSTITUTIONS**  
**M.Tech I Year – I Sem. (Machine Design)**

**OPEN ELECTIVE – I**  
**DATA BASE MANAGEMENT SYSTEM**

**UNIT-I**

Database System Applications, database system VS file system- view of data- data abstraction – instances and schemas – data models – the ER Model – Relational model – other models – Database languages – DDL – DML – database Access for applications programs – database users and administrator – transaction management – database system structure – storage manager – the query processor – history of database systems – database design and ER diagrams – Beyond ER design entities of ER model – concept design with the ER model – conceptual design for large enterprises.

**UNIT-II**

**RELATIONAL MODEL:** introduction to the relational model – integrity constraint over relations – enforcing integrity constraints – querying relational data – logical database design  
– introduction to views – destroying / altering tables and views.

**Relational Algebra and Calculus :** relational algebra – selection and projection set operations – renaming – joins – division – examples of algebra overviews – relational calculus – tuple relational calculus – domain relational calculus – expressive power of algebra and calculus.

**UNIT – III**

Form of basic SQL Query – examples of basic SQL Queries – introduction to nested queries – correlated nested queries set – comparison operators – Aggressive operators -Null values – comparison using null values – logical connectivity's – AND, OR and NOTR – impact on SQL constructs – Outer joins – disallowing NULL values – complex integrity constraints in SQL Triggers and Active Database. Schema refinement – problems caused by redundancy – decompositions – problem related to decomposition – reasoning about FDS – FIRST, SECOND, THIRD Normal forms – BCNF – Lossless join decomposition – Dependency preserving Decomposition – Schema refinement in database design – Multi valued dependencies – forth Normal Form.

**UNIT-IV**

**OVERVIEW OF TRANSACTION MANAGEMENT:** ACID properties – Transactions and schedules – concurrent execution of transaction – lock based concurrency control – performance locking – transaction support in SQL – Introduction to crash recovery. **Concurrency Control:** serializability and recoverability – introduction to lock management

– lock conversions dealing with dead locks – specialized locking techniques concurrency without locking.

**Crash recovery :** introduction to ARIES – the log – other recovery related structures – the write- Ahead Log Protocol – check pointing – recovering form a system crash – media recovery – other approaches and interaction with concurrency control.

**UNIT-V**

**OVERVIEW OF STORAGE AND INDEXING :** data on external storage – File organization and indexing – cluster indexing, primary and secondary indexes – index data structures – hash based indexing tree base indexing –comparison of file organizations – indexes and performance Tuning.

**Storage data: Disks and Files:** the Memory Hierarchy – redundant Arrays of independent – Disks – disk space management – buffer manager – files of records – page formats – record formats.

**Tree structure Indexing :** introduction for tree indexes – indexed sequential access methods (ISAM)-B+ Tress: A dynamic Index structure.

**Hash based Indexing:** Static Hashing – extendable hashing – Linear Hashing – Extendable vs Linear hashing.

**REFERENCES:**

1. Database Management Systems/ Raghurama Krishnan, Johannes Gehrke/ TATA McGraw hills 3rd Edition.
2. Database systems Concepts/ Silberschatz, Korth/ McGraw hill, IV Edition
3. Database Management Systems/ P.Radha Krishna/ Hi-TECH Publications 2005
4. Introduction to Database Management Systems / C.J.Date/ Pearson Education
5. Database Systems design, Implementantion and Management/ Rob & Coronel/ 5th Edition, Thomson.
6. Database Management Systems/ Elmasri Navrate/ Pearson Education.
7. Database Management Systems /Mathew Leon, Leon Vikas/
8. Database Systems / Connoley/ Pearson Education

**M. Tech – I Year – II Sem. (PEED)**  
**POWER ELECTRONIC APPLICATIONS TO RENEWABLE ENERGY**  
**(Professional core - IV)**

**Course Objectives:**

- To understand the various Non-Conventional sources of energy
- To explain the DC to DC converters for Solar PV source of energy
- To explain the inverters and its control techniques for a grid connected system To understand the characteristics of a solar PV and wind power sources
- To explain the types of distributed generators and batteries in DG and micro grid system

**Course Outcomes:**

- Upon the completion of the course the student will be able to
- To acquire knowledge on Non-Conventional energy sources
- To analyze various technologies and for renewable energy systems
- To develop stand alone DG sets and micro grid systems from renewable energy sources

**UNIT - I**

Introduction to renewable sources: world energy scenario, Wind, solar, hydro, geothermal, availability and power extraction.

Introduction to solar energy: Photovoltaic effect, basics of power generation, P-V & I-V characteristics, effect of insolation, temperature, diurnal variation, shading, Modules, connections, ratings, Power extraction (MPP) tracking and MPPT schemes; standalone systems, grid interface, storage, AC-DC loads.

**UNIT - II**

DC-DC converters for solar PV: buck/boost/buck-boost /flyback /forward/cuk, bidirectional converters, Interleaved and multi-input converters.

**UNIT - III**

Grid connected Inverters: 1ph, 3ph inverters with & w/o x'mer, Heric, H6, Multilevel Neutral point clamp, Modular multilevel, CSI; Control schemes: unipolar, bipolar, PLL and synchronization, power balancing / bypass, Parallel power processing; Grid connection issues: leakage current, Islanding, harmonics, active/reactive power feeding, unbalance.

**UNIT - IV**

Introduction to wind energy: P-V, I-V characteristic, wind power system: turbine-generator-inverter, mechanical control, ratings; Power extraction (MPP) and MPPT schemes. Generators for wind: DC generator with DC to AC converters; Induction generator with & w/o converter.

**UNIT - V**

Synchronous generator with back to back controlled/ uncontrolled converter; Doubly fed induction generator with rotor side converter topologies; permanent magnet based generators. Battery: Types, charging discharging. Introduction to AC and DC microgrids.

**TEXT BOOKS:**

Sudipta Chakraborty, Marcelo G. Simes, and William E. Kramer. Power Electronics for Renewable and Distributed Energy Systems: A Sourcebook of Topologies, Control and Integration. Springer Science & Business, 2013.

Nicola Femia, Giovanni Petrone, Giovanni Spagnuolo, Massimo Vitelli, Power Electronics and control for maximum Energy Harvesting in Photovoltaic Systems, CRC Press, 2013.

Chetan Singh Solanki, Solar Photovoltaics: fundamentals, Technologies and Applications, Prentice Hall of India, 2011.

**REFERENCE BOOKS:**

1. N. Mohan, T.M. Undeland & W. P. Robbins, Power Electronics: Converter, Applications & Design, John Wiley & Sons, 1989
2. Muhammad H. Rashid, Power Electronics: Circuits, Devices, and Applications, Pearson Education India, 2004
3. E. Guba, P. Sanchis, A. Ursa, J. Lpez, and L. Marroyo, Ground currents in single-phase transformerless photovoltaic systems, Progress in Photovoltaics: Research and Applications, vol. 15, no. 7, 2007.
4. Remus Teodorescu, Marco Liserre, Pedro Rodriguez, Grid Converters for Photovoltaic and Wind Power Systems, John Wiley and Sons, Ltd., 2011.
5. Ali Keyhani, Design of Smart Power Grid Renewable Energy Systems, Wiley-IEEE Press, 2011.



**M. Tech – I Year – II Sem. (PEED)**  
**EMBEDDED SYSTEMS FOR POWER ELECTRONIC APPLICATIONS**  
**(Professional core - V)**

**Course Objectives:**

- To learn the fundamentals of Embedded System Processor
- To understand the AVR family processors and its programming in assembly level
- To explain the interfacing of keyboard, conversion of analog to digital and vice versa
- To develop knowledge on the applications of embedded system programming in to drives and UPS systems

**Course Outcomes:**

- Upon the completion of the course the student will be able to
- To describe the differences between the general computing system and the embedded system, also recognize the classification of embedded systems
- To become aware of the architecture of the AVR processor and its programming aspects (Assembly Level)
- To acquire knowledge on key board interfacing, conversion from ADC and DAC
- To equipped to design and develop control of drives using embedded system programming

**UNIT - I:**

**Introduction to Embedded System:** An embedded system, processor, hardware unit, software embedded into a system, Example of an embedded system, Real time and embedded OS. Structural unit in a processor selection for embedded systems.

**UNIT - II**

AVR system - AVR family processors, Architecture, Addressing modes, Instruction overview, Branch, Call, and Time Delay Loop, AVR I/O Port Programming.

**UNIT - III**

Assembly level programming, Higher level language programming, AVR Programming in C, Timer Programming, Interrupt Programming.

**UNIT - IV**

AVR LCD and Keyboard Interfacing, ADC, DAC, and different Sensor Interfacing, Relay, Opt isolator interface.

**UNIT - V**

Stepper Motor Interfacing, Servo motor interfacing, PWM Programming, RTC, PC interface, data acquisition system.

**Case studies**

DC motor control, Induction Motor control ( VSI and CSI fed ) , UPS Applications , Special Machine control( PMSBLDC).

**TEXT BOOKS:**

1. M A Mazidi, S Naimi "AVR Microcontroller and Embedded Systems: Using Assembly and C"
2. Rajkamal "Embedded System Architecture: Programming & Design", TMH Edition, 2007.
3. J. W. Valvano, "Embedded Microcomputer System: Real time interfacing", Cengage-Engineering, 1st Edition, 2000.

**M. Tech – I Year – II Sem. (PEED)**  
**ADVANCED POWER ELECTRONIC DEVICES AND CONVERTERS**  
**(Professional core - VI)**

**Course Objectives:**

- To understand the characteristics and principle of operation of modern power semi conductor devices.
- To analyze and design switched mode regulator for various industrial applications.
- To analyze different power converters and know their applications

**Course Outcomes:**

- Upon the completion of the course the student will be able
- To choose appropriate device for a particular converter topology.
- To analyze and design various power converters and controllers

**UNIT-I:**

**Modern Power Semiconductor Devices:** Modern power semiconductor devices – MOS turn Off Thyristor (MTO) – Emitter Turn off Thyristor (ETO) – Integrated Gate-Commutated thyristor (IGCTs) – MOS-controlled Thyristors (MCTs) – Insulated Gate Bipolar Transistor (IGBT) – MOSFET – comparison of their features.

**Unit-II:**

**D.C. to D.C. Converters:** Analysis of step – down and step-up dc to dc converters with resistive and Resistive –inductive loads – Switched mode regulators – Analysis of Buck Regulators – Boost regulators – buck and boost regulators – Cuk regulators – Condition for Continuous inductor current and capacitor voltage – comparison of regulators – Multi-output boost converters – Advantages - Applications.

**Unit-III:**

**PWM Techniques:** single PWM – Multiple PWM – sinusoidal PWM – modified PWM – phase displacement Control – Advanced modulation techniques for improved performance – Trapezoidal, staircase, stepped, harmonic injection and delta modulations – Advantage – application. Third Harmonic PWM – 60 degree PWM – space vector modulation – Comparison of PWM techniques – harmonic reductions.

**UNIT-IV:**

**Multilevel Inverters:** Two level voltage source inverter - Multilevel concept – Classification of multilevel inverters – Diode clamped multilevel inverter – principle of operation – main features – improved diode Clamped inverter – principle of operation – Flying capacitors multilevel inverter – principle of operation – main features. Cascaded multilevel inverter – principle of operation – main features – Multilevel inverter applications – reactive power compensation – back to back intertie system – adjustable drives – Switching device currents – de link capacitor voltage balancing – features of Multilevel inverters – comparisons of multilevel converters.

**UNIT-V:**

**Resonant Pulse Inverters:** Resonant pulse inverters – series resonant inverters – series resonant inverters with unidirectional switches – series resonant inverters with bidirectional Switches – analysis of half bridge resonant inverter - evaluation of currents and Voltages of a simple resonant inverter – analysis of half bridge and full bridge resonant inverter with bidirectional switches – Frequency response of series resonant inverters – for series loaded inverter – for parallel loaded inverter – For

series and parallel loaded inverters – parallel resonant inverters – Voltage control of resonant inverters.

**Resonant converters:** Resonant converters – Zero current switching resonant converters – L type ZCS resonant converter – M type ZCS resonant converter – zero voltage switching resonant converters – comparison between ZCS and ZVS resonant Converters – Two quadrant ZVS resonant converters – resonant de-link Inverters – evaluation of L and C for a zero current switching inverter.

**TEXT BOOKS:**

1. Power Electronics – Mohammed H. Rashid – Pearson Education Third Edition – First Indian reprint 2004.
2. Power Electronics – Ned Mohan, Tore M. Undeland and William P. Robbins – John Wiley and Sons – Second Edition.

**REFERENCE BOOKS:**

1. Power Electronics – Daniel W. Hart, McGraw Hill Publications.
2. Power Electronics Devices, Circuits and Industrial applications, V. R. Moorthi, Oxford University Press
3. Power Electronics, Dr. P. S. Bimbhra, Khanna Publishers.
4. Elements of Power Electronics, Philip T. Krein, Oxford University Press.
5. Power Electronics, M. S. Jamil Asghar, PHI Private Limited.
6. Principles of Power Electronics, John G. Kassakian, Martin F. Schlect, Geroge C. Verghese, Pearson Education.
7. Fundamentals of Power Electronics, Robert W. Erickson, Dragan and Maksimobic, Springer.

**M. Tech – I Year – II Sem. (PEED)**  
**ELECTRIC TRACTION SYSTEMS**  
**(Professional Elective - III)**

**Course Objectives:**

- To understand various systems of track electrification, power supply system and mechanics of electric train.
- To identify a suitable drive for electric traction.

**Course Outcomes:**

- Upon the completion of the course the student will be able to
- Understand Traction systems and its mechanics
- Identify the power supply equipment for traction systems
- Analyze various types of motors used in traction and differentiate AC and DC traction drives

**UNIT – I**

**Traction Systems :** Electric drives - Advantages & disadvantages - System of track electrification - d.c., 1-Phase low frequency, 3-Phase low frequency and composite systems, Problems of 1-phase traction system - Current unbalance, Voltage unbalance, Production of harmonics, Induction effects, Booster transformer - Rail connected booster transformer. Comparison between ac. and d.c. systems.

**UNIT – II**

**Traction mechanics:** Types of services, Speed - time curves - Construction of quadrilateral and trapezoidal speed time curves, Average & schedule speeds. Tractive effort - Speed characteristic, Power of traction motor, specific energy consumption - Factors affecting specific energy consumption, Coefficient of adhesion, slip - Factors affecting slip, magnetically suspended trains.

**UNIT – III**

**Power supply arrangements :** High voltage supply, Constituents of supply system - Substations, Feeding post, Feeding & sectioning arrangements, Remote control center, Design considerations of substations, Over head equipment - principle of design of OHE, Polygonal OHE - Different types of constructions, Basic sag & tension calculations, Dropper design, Current collection gear for OHE.

**UNIT – IV**

**Traction motors :** Desirable characteristics, D.C. series motors, A.C. series motors, 3-Phase induction motors, linear induction motors, D.C. motor series & parallel control - Shunt bridge transition – Drum controller, Contact type bridge transition control, Energy saving, Types of braking in a.c. and d.c. drives, Conditions for regenerative braking, Stability of motors under regenerative braking.

**UNIT – V**

**Semi conductor converter controlled drives:** Advantages of A.C. Traction - Control of d.c. motors - single and two stage converters, Control of ac. motors - CSI fed squirrel cage induction motor, PWM VSI induction motor drive, D.C. traction — Chopper controlled d.c. motors, composite braking, Diesel electric traction — D.C. generator fed d.c. series motor, Alternator fed d.c. series motor, Alternator fed squirrel cage induction motor, Locomotive and axle codes.

**TEXT BOOKS:**

1. Partab.H - Modern Electric Traction, Dhanpat Rai & Sons – 1998.
2. Dubey. G.K. - Fundamentals of Electrical Drives, Narosa Publishing House - 2001.

3. C. L. Wadhwa — Generation, Distribution and Utilization of Electrical Energy, New Age International - 2006.
4. J.B. Gupta - Utilization of Electrical Power and Electric Traction, S. K. Kataria & Sons publications, 9<sup>th</sup> edition 2004.

**M. Tech – I Year – I Sem. (PEED)**  
**ADVANCED DIGITAL SIGNAL PROCESSING**  
**(Professional Elective - III)**

**Prerequisite: Digital Signal Processing**

**Course Objectives:**

- To have an overview of signals and systems and DFT & FFT Transforms.
- To study the design of IIR & FIR filters.
- To study the applications of DSP techniques in processors.

**Course Outcomes:**

- Upon the completion of the course the student will be able to
- Understand types of digital signals and Transforms and its application to signals and systems. Design IIR & FIR filters.
- Estimate power spectrum using various methods

**UNIT-I:**

**Digital Filter Structures:** Block diagram representation – Equivalent Structures – FIR and IIR digital filter Structures All pass Filters-tunable IIR Digital Sine-cosine generator- Computational complexity of digital filter structures.

**UNIT-II:**

**Digital Filter Design:** Preliminary considerations- Bilinear transformation method of IIR filter design – design of Low pass high-pass – Band-pass, and Band stop- IIR digital filters – Spectral transformations of IIR filters – FIR filter design –based on Windowed Fourier series – design of FIR digital filters with least – mean square-error – constrained Least –square design of FIR digital filters.

**UNIT-III:**

**DSP Algorithm Implementation:** Computation of the discrete Fourier transform- Number representation – Arithmetic operations – handling of overflow – Tunable digital filters – function approximation.

**UNIT-IV:**

**Analysis Of Finite Word Length Effects:** The Quantization process and errors-Quantization of fixed – point and floating –point Numbers – Analysis of coefficient Quantization effects – Analysis of Arithmetic Round-off errors- Dynamic range scaling – signal –to- noise in Low –order IIR filters- Low – Sensitivity Digital filter – Reduction of Product round-off errors feedback – Limit cycles in IIR digital filter – Round – off errors in FFT Algorithms.

**UNIT-V:**

**Power Spectrum Estimation:** Estimation of spectra from Finite Duration Observations signals- Non-parametric methods for power spectrum Estimation- parametric method for power spectrum Estimation- Estimation of spectral form-Finite duration observation of signals- Non-parametric methods for power spectrum estimation – Walsh methods – Blackman and torchy method.

**TEXT BOOKS:**

1. Digital Signal Processing principles –algorithms and Applications- john G. Proakis –PHI – 3<sup>rd</sup> edition 2002.
2. Digital Time Signal Processing: Alan V. Oppenheim, Ronald W ,Shafer – PHI 1996 1<sup>st</sup> Edition reprint

3. Advanced Digital Signal Processing – Theory and Applications – Glenn Zelniker, Fred J. Taylor.

**REFERENCE BOOK:**

9. Digital Signal Processing – S. Salivahanan . A Vallavaraj C. Gnanapriya –TMH – 2<sup>nd</sup> reprint 2001.

**M. Tech – I Year – II Sem. (PEED)**  
**DIGITAL CONTROL SYSTEMS**  
**(Professional Elective - III)**

**Prerequisites:** Linear control systems, Z-Transforms

**Course Objectives:**

- To explain basic and digital control system for the real time analysis and design of control systems.
- To apply the knowledge state variable analysis in the design of discrete systems.
- To explain the concept of stability analysis and design of discrete time systems.

**Course Outcomes:**

- Upon the completion of the course the student will be able to
- Understand the concepts of Digital control systems.
- Analyze and design discrete systems in state variable analysis.
- Relate the concepts of stability analysis and design discrete time systems.

**UNIT – I:**

**Introduction:** Block Diagram of typical control system- advantages of sampling in control systems – examples of discrete data and digital systems – data conversion and quantization – sample and hold devices – D/A and A/D conversion – sampling theorem – reconstruction of sampled signals –ZOH.

**Z-transform:** Definition and evaluation of Z-transforms – mapping between s-plane and z-plane – inverse z-plane transform – theorems of the Z-transforms –limitations of z-transforms –pulse transfer function – pulse transfer function of ZOH –relation between  $G(s)$  and  $G(z)$  – signal flow graph method applied to digital systems.

**UNIT- II:**

**State Space Analysis:** State space modeling of digital systems with sample and hold – state transition equation of digital time in variant systems – solution of time in variant discrete state equations by the Z-Transformation – transfer function from the state model – Eigen values – Eigen vector and diagonalisation of the A-matrix – Jordan canonical form. Computation of state transition matrix-Transformation to phase to variable canonical form-The state diagram – decomposition of digital system – Response of sample data system between sampling instants using state approach. Stability: Definition of stability – stability tests – The second method of Liapunov.

**UNIT- III:**

**Time Domain Analysis:** Comparison of time response of continuous data and digital control systems- correlation between time response and root locus in the s-plane and z-plane – effect of pole-zero configuration in the z-plane upon the maximum overshoot and peak time of transient response – Root loci for digital control systems – steady state error analysis of digital control systems – Nyquits plot – Bode plot-G.M and P.M.

**UNIT- IV:**

**Design:** The digital control design with digital controller with bilinear transformation – Digital PID controller-Design with deadbeat response-Pole placement through state feedback-Design of full order state observer-Discrete Euler Lagrange Equation – Discrete maximum principle.



**UNIT-V:**

**Digital State Observer:** Design of - Full order and reduced order observers. Design by max. Principle: Discrete Euler language equation-discrete maximum principle.

**TEXT BOOKS:**

1. Discrete-Time Control systems - K. Ogata, Pearson Education/PHI, 2nd Edition.
2. Digital Control and State Variable Methods by M. Gopal, TMH.

**REFERENCE BOOKS:**

- 1 Digital Control Systems, Kuo, Oxford University Press, 2nd Edition, 2003.
- 2 Digital Control Engineering, M. Gopal

**M. Tech – I Year – II Sem. (PEED)**  
**DYNAMICS OF ELECTRICAL MACHINES**  
**(Professional Elective - IV)**

**Course Objective:** This course deals with generalized modeling and analysis of different electrical machines used for industrial drive applications.

**Course Outcomes:**

- 1 Upon the completion of this course, the student will be able to
- 2 Understand electrical machines and its characteristics
- 3 Analyse the behavior of electrical machines under steady state and transient state Model electrical machines under dynamic conditions

**UNIT- I:**

**Basic Machine Theory:** Electromechanical Analogy – Magnetic Saturation – Rotating field theory – Operation of Inductor motor – equivalent circuit – Steady state equations of DC machines – operations of synchronous motor – Power angle characteristics

**UNIT- II:**

**Electrodynamical Equation & Their Solutions:** Spring and Plunger system - Rotational motion – mutually coupled coils – Lagrange's equation – Application of Lagrange's equation solution of Electro dynamical equations.

**UNIT- III:**

**Dynamics of DC Machines:** Separately excited d. c. generators – steady state analysis – transient analysis – Separately excited d. c. motors – steady state analysis – transient analysis – interconnection of machines – Ward Leonard system of speed control.

**UNIT- IV:**

**Induction Machine Dynamics:** Induction machine dynamics during starting and braking – accelerating time – induction machine dynamic during normal operation – Equation for dynamical response of the induction motor.

**UNIT- V:**

**Synchronous Machine Dynamics:** Electromechanical equation – motor operation – generator operation – small oscillations – general equations for small oscillations – representation of the oscillation equations in state variable form.

**REFERENCE BOOKS:**

3. Sen Gupta D.P. and J. W. "Electrical Machine Dynamics" Macmillan Press Ltd 1980.
4. Bimbhra P.S. "Generalized Theory of Electrical Machines" Khanna Publishers 2002.

**M. Tech – I Year – II Sem. (PEED)**  
**HYBRID ELECTRIC VEHICLES**  
**(Professional Elective - IV)**

**Course Prerequisites:** Physics, Basic Electrical Engineering.

**Course Objectives:**

- To study the concepts and drive train configurations of electric drive vehicles To provide different electric propulsion systems and energy storage devices
- To explain the technology, design methodologies and control strategy of hybrid electric vehicles
- To emphasize battery charger topologies for plug in hybrid electric vehicles

**Course Outcomes:**

- Upon the completion of this course, the student will be able to
- Understand the concepts and drivetrain configurations of electric drive vehicles Interpret different electric propulsion systems and energy storage devices
- Appreciate the technology, design methodologies and control strategy of hybrid electric vehicles
- Realize battery charger topologies for plug in hybrid electric vehicles

**UNIT - I**

Introduction to Electric Vehicles: Sustainable Transportation - EV System - EV Advantages - Vehicle Mechanics - Performance of EVs - Electric Vehicle drivetrain - EV Transmission Configurations and components-Tractive Effort in Normal Driving - Energy Consumption - EV Market - Types of Electric Vehicle in Use Today - Electric Vehicles for the Future.

**UNIT - II**

Electric Vehicle Modelling - Consideration of Rolling Resistance - Transmission Efficiency - Consideration of Vehicle Mass - Tractive Effort - Modelling Vehicle Acceleration - Modelling Electric Vehicle Range - Aerodynamic Considerations - Ideal Gearbox Steady State Model - EV Motor Sizing - General Issues in Design.

**UNIT - III**

Introduction to electric vehicle batteries - electric vehicle battery efficiency - electric vehicle battery capacity - electric vehicle battery charging - electric vehicle battery fast charging - electric vehicle battery discharging - electric vehicle battery performance – testing.

**UNIT - IV**

Hybrid Electric Vehicles - HEV Fundamentals -Architectures of HEVs- Interdisciplinary Nature of HEVs - State of the Art of HEVs - Advantages and Disadvantages - Challenges and Key Technology of HEVs - Concept of Hybridization of the Automobile-Plug-in Hybrid Electric Vehicles - Design and Control Principles of Plug-In Hybrid Electric Vehicles - Fuel Cell Hybrid Electric Drive Train Design - HEV Applications for Military Vehicles.

**UNIT - V**

**Advanced topics** - Battery Charger Topologies, Charging Power Levels, and Infrastructure for Plug-In Electric and Hybrid Vehicles - The Impact of Plug-in Hybrid Electric Vehicles on Distribution Networks – Sizing Ultra capacitors for Hybrid Electric Vehicles.

**TEXT BOOKS:**

- 1 Modern Electric, Hybrid Electric and Fuel Cell Vehicles – Fundamentals, Theory and Design
- 2 Mehrdad Ehsani, Uimin Gao and Ali Emadi - Second Edition - CRC Press, 2010.
- 3 Electric Vehicle Technology Explained - James Larminie, John Lowry - John Wiley & Sons Ltd, - 2003.
- 4 Electric Vehicle Battery Systems – Sandeep Dhameja – Newnes - New Delhi – 2002.
- 5 Hybrid electric Vehicles Principles and applications With practical perspectives -Chris Mi, Dearborn - M. Abul Masrur, David Wenzhong Gao - A John Wiley & Sons, Ltd., - 2011.
- 6 Electric & Hybrid Vehicles – Design Fundamentals - Iqbal Hussain, Second Edition, CRC Press, 2011.

**Research Papers:**

- 1 The Impact of Plug-in Hybrid Electric Vehicles on Distribution Networks: a Review and Outlook - Robert C. Green II, Lingfeng Wang and Mansoor Alam - 2010 IEEE.
- 2 Sizing Ultracapacitors for Hybrid Electric Vehicles - H. Douglas P Pillay -2005 IEEE.
- 3 Review of Battery Charger Topologies, Charging Power Levels, and Infrastructure for Plug-In Electric and Hybrid Vehicles - Murat Yilmaz, and Philip T. Krein, - IEEE transactions on power electronics, vol. 28, no. 5, May 2013.

**M. Tech – I Year – II Sem. (PEED)**  
**SMART GRID TECHNOLOGIES**  
**(Professional Elective – IV)**

**Prerequisites:** Electrical Distribution Systems, Power Systems

**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:**

- 1 Clark W Gellings, "The Smart Grid, Enabling Energy Efficiency and Demand Side Response"- CRC Press, 2009.
- 2 Jean Claude Sabonnadière, Nouredine Hadjsaïd, "Smart Grids", Wiley-ISTE, IEEE Press, May 2012

**REFERENCES:**

- 1 Janaka Ekanayake, Kithsiri Liyanage, Jianzhong. Wu, Akihiko Yokoyama, Nick Jenkins, "Smart Grid: Technology and Applications"- Wiley, 2012.
- 2 James Momoh, "Smart Grid: Fundamentals of Design and Analysis" - Wiley, IEEE Press, 2012.
- 3 India Smart Grid Knowledge Portal

**M. Tech – I Year – II Sem. (PEED)**  
**POWER CONVERTERS SIMULATION LAB**

**Course Objectives:**

- Students must be able to write the programs for the given problem / system using suitable software
- Students must be able to model the given problem / system using suitable software

**Course Outcomes:**

- Upon the completion of this course, the student will be able to
- Acquire knowledge about potential softwares used in electrical engineering.
- Choose and simulate any problem related to Power Electronics and allied fields using appropriate soft wares
- Validate the obtained results and maintain the record

**List of Experiments:**

1. Modelling and simulation of separately excited DC motor and to study the dynamic behaviour of the machine for change in load torque
2. Modelling and simulation of separately excited Induction machine and to study the dynamic behaviour of the machine for change in load torque
3. Modelling and simulation of three phase synchronous machine and to study the dynamic behaviour of the machine for change in load torque
4. Simulation & analysis of Boost converters with RL load.
5. Simulation & analysis of Boost converters with RL load.
6. Simulation & analysis of Buck-Boost converters with RL load
7. Single-Phase Inverter using PWM Controller with RL Load.
8. Simulation & analysis of three phase PWM inverter fed Induction Motor.
9. Simulation & analysis of Multi Level inverter fed Induction Motor.
10. Mathematical Modeling of discrete time Systems
11. State Space Model For Classical Transfer Function Using MATLAB Verification
12. Obtain PID controller parameters for DC Motor Speed Control.
13. Dynamic behavior of a Induction motor using transfer function approach.
14. Dynamic behavior of a Induction motor using State Space Model approach.

**Note:** Any ten experiments can be conducted.

**Note:** Use the suitable software for simulation.

**Anurag Group of Institutions**  
**M. TECH. I YEAR II SEMESTER**

**List of Open Electives Offered by Various Departments, Effective from AY 2018 - 19**

<b>S. No</b>	<b>Name of the Department</b>	<b>Open Elective (S) Offered for Other Departments</b>	<b>Subject Code</b>
1.	Civil Engineering (Open Elective – II)	1. Finite Element Method 2. Advanced Optimization Techniques and Applications	A32050 A32010
2.	Electronics and Communication Engineering (Open Elective-II)	1. Industrial Instrumentation 2. Principles of Computer Communications and Networks 3. Signal Analysis and Condition Monitoring	A32051 A32052 A32011
4.	Electrical and Electronics Engineering (Open Elective – II)	1. Energy From Waste 2. Distributed Generation and Microgrid 3. Reliability Engineering	A32053 A32054 A32055
4.	Mechanical Engineering (Open Elective – II)	Engineering Research Methodology	A32056
5.	Computer Science and Engineering (Open Elective – II)	Machine Learning	A32057

# **CIVIL ENGINEERING FINITE ELEMENT METHOD**

**(Open Elective – II)**

**Course Objectives:** To impart knowledge about various finite element techniques and development of finite element code.

**Course Outcome:** The learner will be able to solve continuum problems using finite element analysis.

## **UNIT - I**

Introduction: Concepts of FEM - steps involved - merits and demerits - energy principles – Discretization - Raleigh - Ritz method of functional approximation. Principles of Elasticity: Stress equations - strain displacement relationships in matrix form plane stress, plane strain and axi-symmetric bodies of revolution with axi-symmetric loading.

## **UNIT - II**

One dimensional FEM: Stiffness matrix for beam and bar elements - shape functions for 1-D elements. Two dimensional FEM: Different types of elements for plane stress and plane strain analysis - displacement models - generalized coordinates - shape functions - convergent and compatibility requirements - geometric invariance - natural coordinate system - area and volume coordinates - generation of element stiffness and nodal load matrices

## **UNIT - III**

Isoparametric formulation: Concept - different isoparametric elements for 2D analysis - formulation of 4-noded and 8-noded isoparametric quadrilateral elements - Lagrange elements - serendipity elements. Axi Symmetric Analysis: bodies of revolution - axi symmetric modeling - strain displacement relationship - formulation of axi symmetric elements. Three dimensional FEM: Different 3-D elements-strain-displacement relationship –formulation of hexahedral and isoparametric solid element.

## **UNIT - IV**

Introduction to Finite Element Analysis of Plates: Basic theory of plate bending - thin plate theory - stress resultants - Mindlin's approximations - formulation of 4-noded isoperimetric quadrilateral plate element – Shell Element.



## **UNIT - V**

Introduction to non – linear finite analysis – basic methods – application to Special structures.

### **TEXT BOOKS:**

1. A First Course in a Finite Element by Daryl L .Logan, CL Engineers.
2. Concepts and Applications of Finite Element Analysis by Robert D.Cook, DavidS. Malkus and Michael E. Plesha, John Wiley & Sons.

### **REFERENCES:**

1. Introduction to Finite element Method by Tirupathi Chandra Patla and Belugunudu
2. Finite element Methods by OC Zienkiewicz
3. Finite element analysis, theory and progarmming by GS Krishna Murthy.
4. Introduction to Finite element Method by JN Reddy

**ANURAG GROUP OF INSTITUTIONS**

**M. Tech I Year – II Sem.**

**ADVANCED OPTIMIZATION TECHNIQUES AND APPLICATIONS**

**(Open Elective – II)**

**UNIT- I**

**SINGLE VARIABLE NON-LINEAR UNCONSTRAINED OPTIMIZATION:** One dimensional Optimization methods:- Uni-modal function, elimination method, Fibonacci method, golden section method, interpolation methods- quadratic & cubic interpolation methods.

**UNIT – II**

**MULTI VARIABLE NON-LINEAR UNCONSTRAINED OPTIMIZATION:** Direct search method – Univariate Method – pattern search methods – Powell's – Hook – Jeeves, Rosenbrock search methods – gradient methods, gradient of function, steepest descent method, Fletcher reeves method. Variable metric method.

**UNIT – III**

**GEOMETRIC PROGRAMMING:** Polynomials – arithmetic – geometric inequality – unconstrained G.P – constrained G.P

**DYNAMIC PROGRAMMING:** Multistage decision process, principles of optimality, examples, conversion of final problem to an initial value problem, application of dynamic programming, production inventory. Allocation, scheduling replacement.

**UNIT IV**

**LINEAR PROGRAMMING: formulation** – Sensitivity analysis. Change in the constraints, cost coefficients, coefficients of the constraints, addition and deletion of variable, constraints. Simulation – Introduction – Types – Steps – application – inventory – queuing – thermal system.

**UNIT V**

**INTEGER PROGRAMMING:** Introduction – formulation – Gomory cutting plane algorithm – Zero or one algorithm, branch and bound method.

**STOCHASTIC PROGRAMMING:** Basic concepts of probability theory, random variables – distributions – mean, variance, Correlation, co variance, joint probability distribution – stochastic linear, dynamic programming.

**REFERENCES:**

1. Optimization theory & Applications/ S.S Rao/ New Age International
2. Introductory to operation research/Kasan & Kumar/Springer
3. Optimization Techniques theory and practice / M.C Joshi, K.M Moudgalya/ Narosa Publications.
4. Operation Research/H.A. Taha/TMH
5. Optimization in operations research/R.L Rardin
6. Optimization Techniques/Benugundu & Chandraputla/Person Asia

**ELECTRONICS AND COMMUNICATION ENGINEERING**  
**INDUSTRIAL INSTRUMENTATION**  
**(Open Elective – II)**

**UNIT – I**

**METROLOGY, VELOCITY AND ACCELERATION MEASUREMENT:** Measurement of length - Gauge blocks – Plainness – Area using Simpson’s rule, Plain meter – Diameter – Roughness – Angle using Bevel protractor, sine bars and Clinometer – Mechanical, Electrical, Optical and Pneumatic Comparators. Optical Methods for length and distance measurements using Optical flats and Michelson Interferometer. Relative velocity – Translational and Rotational velocity measurements – Revolution counters and Timers - Magnetic and Photoelectric pulse counting stroboscopic methods. Accelerometers-different types, Gyroscopes-applications.

**UNIT – II**

**FORCE AND PRESSURE MEASUREMENT:** Force measurement – Different methods – Gyroscopic Force Measurement – Vibrating wire Force transducer. Basics of Pressure measurement – Manometer types – Force-Balance and Vibrating Cylinder Transducers – High and Low Pressure measurement – McLeod Gauge, Knudsen Gauge, Momentum Transfer Gauge, Thermal Conductivity Gauge, Ionization Gauge, Dual Gauge Techniques, Deadweight Gauges, Hydrostatic Pressure Measurement

**UNIT – III**

**FLOW MEASUREMENT AND LEVEL MEASUREMENT:** Flow Meters- Head type, Area type (Rota meter), electromagnetic type, Positive displacement type, mass flow meter, ultrasonic type, vortex shedding type, Hotwire anemometer type, Laser Doppler Velocity-meter. Basic Level measurements – Direct, Indirect, Pressure, Buoyancy, Weight, Capacitive Probe methods

**UNIT – IV**

**DENSITY, VISCOSITY AND OTHER MEASUREMENTS:** Density measurements – Strain Gauge load cell method – Buoyancy method - Air pressure balance method – Gamma ray method – Vibrating probe method. Units of Viscosity, specific gravity scales used in Petroleum Industries, Different Methods of measuring consistency and Viscosity –Two float viscorator –Industrial consistency meter. Sound-Level Meters, Microphones, Humidity Measurement

**UNIT – V**

**CALIBRATION AND INTERFACING:** Calibration using Master Sensors, Interfacing of Force, Pressure, Velocity, Acceleration, Flow, Density and Viscosity Sensors, Variable Frequency Drive

**TEXT BOOKS:**

1. Doebelin E.O., "Measurement Systems – Applications and Design", 4th Edition, McGraw Hill International, 1990.
2. Patranabis D, "Principles of Industrial Instrumentation", TMH. End edition 1997

**REFERENCES:**

1. Considine D. M., "Process Instruments and Control Handbook", 4th Edition, McGraw Hill International, 1993
2. Jain R.K., "Mechanical and Industrial Measurements", Khanna Publications.

**ELECTRONICS AND COMMUNICATION ENGINEERING**  
**PRINCIPLES OF COMPUTER COMMUNICATIONS AND NETWORKS**  
**(Open Elective – II)**

**Prerequisite:** Nil

**Course Objectives:**

- To understand the concept of computer communication.
- To learn about the networking concept, layered protocols.
- To understand various communications concepts.
- To get the knowledge of various networking equipment.

**Course Outcomes:** The student:

- Can get the knowledge of networking of computers, data transmission between computers.
- Will have the exposure about the various communication concepts.
- Will get awareness about the structure and equipment of computer network structures.

**UNIT – I**

**Overview of Computer Communications and Networking:** Introduction to Computer Communications and Networking, Introduction to Computer Network, Types of Computer Networks, Network Addressing, Routing, Reliability, Interoperability and Security, Network Standards, The Telephone System and Data Communications.

**UNIT – II**

**Essential Terms and Concepts:** Computer Applications and application protocols, Computer Communications and Networking models, Communication Service Methods and data transmission modes, analog and Digital Communications , Speed and capacity of a Communication Channel, Multiplexing and switching, Network architecture and the OSI reference model.

**UNIT – III**

**Analog and Digital Communication Concepts:** Representing data as analog signals, representing data as digital signals, data rate and bandwidth reduction , Digital Carrier Systems.

**UNIT – IV**

**Physical and data link layer Concepts:** The Physical and Electrical Characteristics of wire, Copper media, fiber optic media, wireless Communications. Introduction to data link Layer , the logical link control and medium access control sub-layers.

## **UNIT – V**

**Network Hardware Components:** Introduction to Connectors, Transreceivers and media convertors, repeaters, network interference cards and PC cards, bridges, switches, switches Vs Routers.

### **TEXT BOOKS:**

1. Computer Communications and Networking Technologies, Michel A. Gallo and William H. Hancock, Thomson Brooks / Cole.

### **REFERENCE BOOKS:**

1. Principles of Computer Networks and Communications, M. Barry Dumas, Morris Schwartz, Pearson.

**ANURAG GROUP OF INSTITUTIONS**

**M. Tech I Year – II Sem.**

**SIGNAL ANALYSIS AND CONDITION MONITORING  
(OPEN ELECTIVE – II)**

**UNIT-I**

**Introduction,** Basic concepts. Fourier analysis. Bandwidth. Signal types. Convolution. Signal analysis: Filter response time. Detectors. Recorders. Analog analyzer types.

**UNIT-II**

**PRACTICAL ANALYSIS OF STATIONARY SIGNALS:** Stepped filter analysis. Swept filter analysis. High speed analysis. Real-time analysis.

**UNIT-III**

**PRACTICAL ANALYSIS OF CONTINUOUS NON-STATIONARY SIGNALS:** Choice of window type. Choice of window length. Choice of incremental step. Practical details. Scaling of the results.

**UNIT-IV**

**PRACTICAL ANALYSIS OF TRANSIENTS:** Analysis as a periodic signal. Analysis by repeated playback (constant bandwidth). Analysis by repeated playback (variable bandwidth).

**UNIT-V**

**CONDITION MONITORING IN REAL SYSTEMS:** Diagnostic tools. Condition monitoring of two stage compressor. Cement mill foundation. I.D. fan. Sugar centrifugal. Cooling tower fan. Air separator. Preheater fan. Field balancing of rotors. ISO standards on vibrations.

**REFERENCES:**

1. Condition Monitoring of Mechanical Systems / Kolacat.
2. Frequency Analysis /R.B.Randall.
3. Mechanical Vibrations Practice with Basic Theory / V. Ramamurti/ Narosa Publishing House.
4. Theory of Machines and Mechanisms/ Amitabh Ghosh & AK Malik/ EWP

**ELECTRICAL AND ELECTRONICS ENGINEERING**  
**ENERGY FROM WASTE**  
**(Open Elective – II)**

**Prerequisite:** Renewable Energy Sources, Physics, Environmental Studies

**Course Objectives:**

- To classify solid waste sources
- To identify methods of solid waste disposal
- To study various energy generation methods
- To analyse biogas production methods and recycling of e-waste

**Course Outcomes:** Upon the completion of the subject, the student will be able to

- Understand technologies for generation of energy from solid waste
- Compare methods of solid waste disposal
- Identify sources of energy from bio-chemical conversion
- Analyze methods for management of e-waste

**UNIT- I**

Solid Waste Sources Solid Waste Sources, types, composition, Properties, Global warming, Municipal Solid Waste: Physical, chemical and biological properties , Waste Collection and, Transfer stations, Waste minimization and recycling of municipal waste, Segregation of waste, Size Reduction , Managing Waste. Status of technologies for generation of Energy from Waste Treatment and Disposal Aerobic composting, incineration, Furnace type and design, Medical waste /Pharmaceutical waste treatment Technologies, incineration, Environmental impacts, Measures to mitigate environmental effects due to incineration .

**UNIT – II**

Land Fill method of Solid waste disposal Land fill classification, Types, methods and Site consideration, Layout and preliminary design of landfills: Composition, characteristics, generation, Movement and control of landfill leachate and gases, Environmental monitoring system for land fill gases.

**UNIT – III**

Energy Generation from Waste Bio-chemical Conversion: Sources of energy generation, anaerobic digestion of sewage and municipal wastes, direct combustion of MSW-refuse derived solid fuel, Industrial waste, agro residues, Anaerobic Digestion.

**UNIT – IV**

Biogas production, Land fill gas generation and utilization, Thermo-chemical conversion: Sources of energy generation, Gasification of waste using Gasifiers, Briquetting, Utilization and



advantages of briquetting, Environmental benefits of Bio-chemical and Thermo- chemical conversion.

## **UNIT – V**

E-waste: e-waste in the global context – Growth of Electrical and Electronics Industry in India – Environmental concerns and health hazards – Recycling e-waste: a thriving economy of the unorganized sector – Global trade in hazardous waste – impact of hazardous e-waste in India. Management of e-waste: e-waste legislation, Government regulations on e-waste management – International experience – need for stringent health safeguards and environmental protection laws of India.

### **TEXT BOOKS:**

1. Nicholas P. Cheremisinoff. Handbook of Solid Waste Management and Waste Minimization Technologies. An Imprint of Elsevier, New Delhi (2003).
2. P. Aarne Vesilind, William A. Worrell and Debra R. Reinhart. Solid Waste Engineering. Thomson Asia Pte Ltd. Singapore (2002)
3. M. Dutta , B. P. Parida, B. K. Guha and T. R. Surkrishnan. Industrial Solid Waste Management and Landfilling practice. Narosa Publishing House, New Delhi (1999).
4. “E-waste in India: Research unit, Rajya Sabha Secretariat, New Delhi, June 2011”
5. Amalendu Bagchi. Design, construction and Monitoring of Landfills. John Wiley and Sons. New York. (1994)
6. M. L. Davis and D. A. Cornwell. Introduction to environmental engineering. Mc Graw Hill International Edition, Singapore (2008)
7. C. S. Rao. Environmental Pollution Control Engineering. Wiley Eastern Ltd. New Delhi (1995)
8. S. K. Agarwal. Industrial Environment Assessment and Strategy. APH Publishing Corporation. New Delhi (1996)
9. Sofer, Samir S. (ed.), Zaborsky, R. (ed.), “Biomass Conversion Processes for Energy and Fuels”, New York, Plenum Press, 1981
10. Hagerty, D. Joseph; Pavoni, Joseph L; Heer, John E., “Solid Waste Management”, New York, Van Nostrand, 1973
11. George Tchobanoglous, Hilary Theisen and Samuel Vigil Prsl: Tchobanoglous, George Theisen, Hillary Vigil, Samuel, “Integrated Solid Waste management: Engineering Principles and Management issues”, New York, McGraw Hill, 1993.

### **REFERENCES:**

1. C Parker and T Roberts (Ed), Energy from Waste - An Evaluation of Conversion Technologies, Elsevier Applied Science, London, 1985
2. KL Shah, Basics of Solid and Hazardous Waste Management Technology, Prentice Hall, 2000
3. M Datta, Waste Disposal in Engineered Landfills, Narosa Publishing House, 1997
4. G Rich et.al, Hazardous Waste Management Technology, Podvan Publishers, 1987
5. AD Bhide, BB Sundaresan, Solid Waste Management in Developing Countries, INSDOC, New Delhi, 1983 FUEL CELL AND

**ELECTRICAL AND ELECTRONICS ENGINEERING  
DISTRIBUTED GENERATION AND MICROGRID  
(Open Elective – II)**

**Course Objectives**

- To illustrate the concept of distributed generation
- To analyze the impact of grid integration.
- To study concept of Micro grid and its configuration
- To find optimal size, placement and control aspects of DGs

**Course Outcomes:** Upon the Completion of the course student will be able to

- Find the size and optimal placement DG
- Analyze the impact of grid integration and control aspects of DGs
- Model and analyze a micro grid taking into consideration the planning and operational issues of the DGs to be connected in the system.
- Describe the technical impacts of DGs in power systems

**UNIT – I**

Need for distributed generation - Renewable sources in distributed generation - Current scenario in distributed generation - Planning of DGs – Siting and sizing of DGs – Optimal placement of DG sources in distribution systems.

**UNIT – II**

Grid integration of DGs – Different types of interfaces - Inverter based DGs and rotating machine based interfaces - Aggregation of multiple DG units - Energy storage elements - Batteries, ultracapacitors, flywheels.

**UNIT – III**

Technical impacts of DGs – Transmission systems, Distribution systems, De-regulation – Impact of DGs upon protective relaying – Impact of DGs upon transient and dynamic stability of existing distribution systems.

**UNIT-IV**

Economic and control aspects of DGs – Market facts, issues and challenges - Limitations of DGs - Voltage control techniques, Reactive power control, Harmonics, Power quality issues - Reliability of DG based systems – Steady state and Dynamic analysis.

## **UNIT – V**

Introduction to micro-grids – Types of micro-grids – Autonomous and non-autonomous grids – Sizing of micro-grids - Modeling & analysis - Micro-grids with multiple DGs – Micro-grids with power electronic interfacing units - Transients in micro-grids - Protection of micro-grids – Case studies.

### **TEXT BOOKS:**

1. H. Lee Willis, Walter G. Scott , ‘Distributed Power Generation – Planning and Evaluation’, Marcel Decker Press, 2000.
2. M.Godoy Simoes, Felix A.Farret, ‘Renewable Energy Systems – Design and Analysis with Induction Generators’, CRC press.
3. Robert Lasseter, Paolo Piagi, ‘ Micro-grid: A Conceptual Solution’, PESC 2004, June 2004.
4. F. Katiraei, M.R. Iravani, ‘Transients of a Micro-Grid System with Multiple Distributed Energy Resources’, International Conference on Power Systems Transients (IPST’05) in Montreal, Canada on June 19-23, 2005.
5. Z. Ye, R. Walling, N. Miller, P. Du, K. Nelson, ‘Facility Microgrids’, General Electric Global Research Center, Niskayuna, New York, Subcontract report, May 2005.

**ELECTRICAL AND ELECTRONICS ENGINEERING**  
**RELIABILITY ENGINEERING**  
**(Open Elective – II)**

**Course Objectives:**

- To comprehend the concept of Reliability and Unreliability
- Derive the expressions for probability of failure, Expected value and standard deviation of Binominal distribution, Poisson distribution, normal distribution and weibull distributions.
- Formulating expressions for Reliability analysis of series-parallel and Non-series parallel systems
- Deriving expressions for Time dependent and Limiting State Probabilities using Markov models.

**Course Outcomes:** Upon the completion of this course, the student will be able to

- Apply fundamental knowledge of Reliability to modeling and analysis of seriesparallel and Non-series parallel systems.
- Solve some practical problems related with Generation, Transmission and Utilization of Electrical Energy.
- Understand or become aware of various failures, causes of failures and remedies for failures in practical systems.

**UNIT – I**

Rules for combining probabilities of events, Definition of Reliability. Significance of the terms appearing in the definition. Probability distributions: Random variables, probability density and distribution functions. Mathematical expectation, Binominal distribution, Poisson distribution, normal distribution, weibull distribution.

**UNIT – II**

Hazard rate, derivation of the reliability function in terms of the hazard rate. Failures: Causes of failures, types of failures (early failures, chance failures and wear-out failures). Bath tub curve. Preventive and corrective maintenance. Modes of failure. Measures of reliability: mean time to failure and mean time between failures.

**UNIT – III**

Classification of engineering systems: series, parallel and series-parallel systems- Expressions for the reliability of the basic configurations. Reliability evaluation of Non-series-parallel configurations: Decomposition, Path based and cutset based methods, Deduction of the Paths and cutsets from Event tree.

## **UNIT – IV**

Discrete Markov Chains: General modeling concepts, stochastic transitional probability matrix, time dependent probability evaluation and limiting state probability evaluation of one component repairable model. Absorbing states. Continuous Markov Processes: Modeling concepts, State space diagrams, Stochastic Transitional Probability Matrix, Evaluating time dependent and limiting state Probabilities of one component repairable model. Evaluation of Limiting state probabilities of two component repairable model.

## **UNIT – V**

Approximate system Reliability analysis of Series systems, parallel systems with two and more than two components, Network reduction techniques. Minimal cutset/failure mode approach.

### **TEXT BOOKS:**

1. “Reliability evaluation of Engineering systems”, Roy Billinton and Ronald N Allan, BS Publications.
2. “Reliability Engineering”, Elsayed A. Elsayed, Prentice Hall Publications.

### **REFERENCES:**

1. “Reliability Engineering: Theory and Practice”, By Alessandro Birolini, Springer Publications.
2. “An Introduction to Reliability and Maintainability Engineering”, Charles Ebeling, TMH Publications.
3. “Reliability Engineering”, E. Balaguruswamy, TMH Publications.

**MECHANICAL ENGINEERING  
ENGINEERING RESEARCH METHODOLOGY  
(Open Elective – II)**

**UNIT – I**

**Research Methodology:** Objectives and Motivation of Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Importance of Research Methodology, Research Process, Criteria of Good Research, Problems Encountered by Researchers in India, Benefits to the society in general.

**Defining the Research Problem:** Definition of Research Problem, Problem Formulation, Necessity of Defining the Problem, Technique involved in Defining a Problem.

**UNIT – II**

**Literature Survey:** Importance of Literature Survey, Sources of Information, Assessment of Quality of Journals and Articles, Information through Internet. **Literature Review:** Need of Review, Guidelines for Review, Record of Research Review.

**UNIT – III**

**Research Design:** Meaning of Research Design, Need of Research Design, Features of a Good Design Important Concepts Related to Research Design, Different Research Designs, Basic Principles of Experimental Design, Developing a Research Plan, Design of Experimental Set-up, Use of Standards and Codes.

**UNIT – IV**

**Data Collection:** Collection of primary data, Secondary data, Data organization, Methods of data grouping, Diagrammatic representation of data, Graphic representation of data. Sample Design, Need for sampling, some important sampling definitions, Estimation of population, Role of Statistics for Data Analysis, Parametric V/s Non Parametric methods, Descriptive Statistics, Measures of central tendency and Dispersion, Hypothesis testing, Use of Statistical software. **Data Analysis:** Deterministic and random data, Uncertainty analysis, Tests for significance: Chi-square, student's t-test, Regression modeling, Direct and Interaction effects, ANOVA, F-test, Time Series analysis, Autocorrelation and Autoregressive modeling.

**UNIT – V**

**Research Report Writing:** Format of the Research report, Synopsis, Dissertation, Thesis its Differentiation, References/Bibliography/Webliography, Technical paper writing/Journal report writing, making presentation, Use of visual aids. **Research Proposal Preparation:** Writing a Research Proposal and Research Report, Writing Research Grant Proposal.

**REFERENCES:**

1. C.R Kothari, Research Methodology, Methods & Technique; New Age International Publishers, 2004
2. R. Ganesan, Research Methodology for Engineers, MJP Publishers, 2011
3. Ratan Khananabis and Suvasis Saha, Research Methodology, Universities Press, Hyderabad, 2015.
4. Y. P. Agarwal, Statistical Methods: Concepts, Application and Computation, Sterling Publs.,Pvt., Ltd., New Delhi, 2004
5. Vijay Upagade and Aravind Shende, Research Methodology, S. Chand & Company Ltd.,New Delhi, 2009
6. G. Nageswara Rao, Research Methodology and Quantitative methods, BS Publications,Hyderabad, 2012.
7. Naval Bajjai “Business Research Methods” Pearson 2011.
8. Prahalad Mishra “ Business Research Methods “ Oxford 2016

**COMPUTER SCIENCE AND ENGINEERING**  
**MACHINE LEARNING**  
**(Open Elective - II)**

**Prerequisites:**

- Data Structures
- Knowledge on statistical methods

**Course Objectives:**

- This course explains machine learning techniques such as decision tree learning, Bayesian learning etc.
- To understand computational learning theory.
- To study the pattern comparison techniques.

**Course Outcomes:**

- Understand the concepts of computational intelligence like machine learning
- Ability to get the skill to apply machine learning techniques to address the real time problems in different areas
- Understand the Neural Networks and its usage in machine learning application.

**UNIT – I**

**Introduction** - Well-posed learning problems, designing a learning system Perspectives and issues in machine learning

**Concept learning and the general to specific ordering** – Introduction, A concept learning task, concept learning as search, Find-S: Finding a Maximally Specific Hypothesis, Version Spaces and the Candidate Elimination algorithm, Remarks on Version Spaces and Candidate Elimination, Inductive Bias.

**Decision Tree Learning** – Introduction, Decision Tree Representation, Appropriate Problems for Decision Tree Learning, The Basic Decision Tree Learning Algorithm Hypothesis Space Search in Decision Tree Learning, Inductive Bias in Decision Tree Learning, Issues in Decision Tree Learning.

**UNIT – II**

**Artificial Neural Networks** Introduction, Neural Network Representation, Appropriate Problems for Neural Network Learning, Perceptions, Multilayer Networks and the Back propagation Algorithm. Discussion on the Back Propagation Algorithm, An illustrative Example: Face Recognition **Evaluation Hypotheses** – Motivation, Estimation Hypothesis Accuracy, Basics of Sampling Theory, A General Approach for Deriving Confidence Intervals, Difference in Error of Two Hypotheses, Comparing Learning Algorithms.



## UNIT – III

**Bayesian learning** - Introduction, Bayes Theorem, Bayes Theorem and Concept Learning Maximum Likelihood and Least Squared Error Hypotheses, Maximum Likelihood Hypotheses for Predicting Probabilities, Minimum Description Length Principle , Bayes Optimal Classifier, Gibbs Algorithm, Naïve Bayes Classifier, An Example: Learning to Classify Text, Bayesian Belief Networks, EM Algorithm.

**Computational Learning Theory** – Introduction, Probably Learning an Approximately Correct Hypothesis, Sample Complexity for Finite Hypothesis Space, Sample Complexity for Infinite Hypothesis Spaces, The Mistake Bound Model of Learning.

**Instance-Based Learning** – Introduction, k-Nearest Neighbor Learning, Locally Weighted Regression, Radial Basis Functions, Case-Based Reasoning, Remarks on Lazy and Eager Learning.

## UNIT – IV

**Pattern Comparison Techniques**, Temporal patterns, Dynamic Time Warping Methods, Clustering, Codebook Generation, Vector Quantization

**Pattern Classification:** Introduction to HMMS, Training and Testing of Discrete Hidden Markov Models and Continuous Hidden Markov Models, Viterbi Algorithm, Different Case Studies in Speech recognition and Image Processing

## UNIT – V

**Analytical Learning** – Introduction, Learning with Perfect Domain Theories : PROLOG-EBG Remarks on Explanation-Based Learning, Explanation-Based Learning of Search Control Knowledge, Using Prior Knowledge to Alter the Search Objective, Using Prior Knowledge to Augment Search Operations.

**Combining Inductive and Analytical Learning** – Motivation, Inductive-Analytical Approaches to Learning, Using Prior Knowledge to Initialize the Hypothesis.

### TEXT BOOKS:

1. Machine Learning – Tom M. Mitchell,- MGH
2. Fundamentals of Speech Recognition By Lawrence Rabiner and Biing – Hwang Juang.

### REFERENCE BOOK:

1. Machine Learning : An Algorithmic Perspective, Stephen Marsland, Taylor & Francis