ACADEMIC REGULATIONS, COURSE STRUCTURE AND DETAILED SYLLABUS

M.Tech (PEED)

FOR
MASTER OF TECHNOLOGY TWO YEAR POST GRADUATE COURSE
(Applicable for the batches admitted from 2015-2016)

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

R 15 - ACADEMICREGULATIONS (CBCS) FOR M. Tech. (REGULAR) DEGREE PROGRAMMES

Applicable for the students of M. Tech. (Regular) programme from the Academic Year ***2015-16*** 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. 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.

AWARD OF M. Tech. DEGREE

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.

The student shall register for all **88** credits and secure all the 88 credits.

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 ommunication

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.

1. ATTENDANCE

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

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%.

Condonation of shortage of attendance in each subject up to 10% (65% and above and below75%)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.

Shortage of Attendance below65% in each subject shall not be condoned.

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.

A prescribed fees hall be payable towards condonation of shortage of attendance.

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.

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 practicals, on the basis of Internal Evaluation and End Semester Examination.

6.1 For the theory subjects 60 marks shall be awarded for the performance in the Semester End Examination and 40 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 10 marks. The details of the Question Paper pattern for End Examination (Theory) are given below:

- The Semester End Examination will be conducted for 60 marks. It consists of two parts. i).Part-A for 20 marks, ii). Part-B for 40 marks.
- Part-A is a compulsory question consisting of 5 questions, one from each unit and carries 4 marks each.
- Part-B to be answered 5 questions carrying 8 marks each. There will be two questions from each unit and only one should be answered.

6.2 For practical subjects, 60 marks shall be awarded for performance in the Semester End

Examinations and 40 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 50 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 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.

6.7 In case the candidate does not secure the minimum academic requirement in any subject (as specified in 6.6) he has to reappear for the Semester End Examination in that subject.

6.8 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.

6.9 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.

1. 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
80% and above ($\geq 80\%, \leq 100\%$)	O (Outstanding)	10
Below 80% but not less than 70% ($\geq 70\%, < 80\%$)	**A^+** (Excellent)	9
Below 70% but not less than 60% ($\geq 60\%, < 70\%$)	**A** (Very Good)	8
Below 60% but not less than 55% ($\geq 55\%, < 60\%$)	**B^+** (Good)	7
Below 55% but not less than 50% ($\geq 50\%, < 55\%$)	**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 (ΣCP) secured from ALL Subjects/ Courses registered in a Semester, by the Total Number of Credits registered during that Semester. SGPA is rounded off to TWO Decimal Places. SGPA is thus computed as

SGPA = $\left\{\sum_{i=1}^{N} C_i G_i\right\} / \left\{\sum_{i=1}^{N} C_i\right\}$ **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^{th} 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

CGPA = $\left\{\sum_{j=1}^{M} C_j G_j\right\} / \left\{\sum_{j=1}^{M} Cj\right\}$ **… for all S 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.

1. 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 50, the evaluation should be done by the PRC for 25 marks and Supervisor will evaluate for 25 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 PRC.

8.9 For Project work **Review II** in II Year II Sem. there is an internal marks of 50, the evaluation should be done by the PRC for 25 marks and Supervisor will evaluate for 25 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 PRC.

8.10 For Project Evaluation (Viva Voce) in II Year II Sem. there is an external marks of 150 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.

8.11 If he fails to fulfill as specified in 8.10, 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.

8.12 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.

8.13 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.

8.14 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.

8.15 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 **88** Credits (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:

Class Awarded	CGPA
First Class with Distinction	≥ 7.75
First Class	$6.75 \leq$ CGPA < 7.75
Second Class	$6.00 \leq$ 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 orequivalentsubjects 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 R15 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 candidates 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	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.

	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.	
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.	

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COURSE STRUCTURE

I Year - I Semester

Category	Course Title	Int. marks	Ext. marks	L	P	C
Core Course I	Machine Modeling and Analysis	40	60	4	--	4
Core Course II	Modern Control Theory	40	60	4	--	4
Core Course III	Power Electronic Control of DC Drives	40	60	4	--	4
Core Elective I	1. HVDC Transmission 2. Operations Research 3. Embedded Systems	40	60	4	--	4
Core Elective II	1. Microcontrollers and Applications 2. Programmable Logic Controllers and their Applications 3. Special Machines	40	60	4	--	4
Open Elective I	1. Power Electronic Converters-I 2. Reliability Engineering 3. Smart Grid Technologies	40	60	4	--	4
Laboratory I	Power Converters Lab	40	60	--	4	2
Seminar I	Seminar-I	50	--	--	4	2
Total Credits				24	8	**28**

I Year – II Semester

Category	Course Title	Int. marks	Ext. marks	L	P	C
Core Course IV	Power Electronic Converters – II	40	60	4	--	4
Core Course V	Power Electronic Control of AC Drives	40	60	4	--	4
Core Course VI	Neural Networks and Fuzzy Systems	40	60	4	--	4
Core Elective III	1. Digital Control Systems 2. Power Quality 3. Advanced Digital Signal Processing	40	60	4	--	4
Core Elective IV	1. Dynamics of Electrical Machines 2. High-Frequency Magnetic Components 3. Renewable energy systems	40	60	4	--	4
Open Elective II	1. Flexible AC Transmission Systems 2. Switched Mode Power Supplies (SMPS) 3. Intelligent Control	40	60	4	--	4
Laboratory II	Electrical Systems Simulation Lab	40	60	--	4	2
Seminar II	Seminar-II	50	--	--	4	2
Total Credits				**24**	**8**	**28**

II Year - I Semester

Course Title	Int. marks	Ext. marks	L	P	C
Comprehensive Viva-Voce	--	100	--	--	4
Project work Review I	50	--	--	24	12
Total Credits			--	24	**16**

II Year - II Semester

Course Title	Int. marks	Ext. marks	L	P	C
Project work Review II	50	--	--	8	4
Project Evaluation (Viva-Voce)	--	150	--	16	12
Total Credits			**--**	**24**	**16**

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	L	P	C
M. Tech (PEED) – I Year – I Sem.	**4**	**0**	**4**

MACHINE MODELLING AND ANALYSIS

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 α, β, o) – Active transformation (α .β, 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.

UNIT-IV:

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

UNIT-V:

Circuit model of a 3ph Synchronous motor – Two axis representation of Syn. Motor. Voltage and current Equations in state – space variable form – Torque equation.

TEXT BOOKS:

2. " Thyristor Control of Electric Drives" by Vedam Subranmanyam.
3. "Analysis of Electric Machinery and Drives Systems" by Paul C. Krause, Oleg wasynezuk, Scott D. Sudhoff.

REFERENCE BOOK:

1. **"** Generalized Theory of Electrical Machines" - PS Bimbra- Khanna Publishers-2002.

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	L	P	C
M. Tech (PEED) – I Year – I Sem.	**4**	**0**	**4**

MODERN CONTROL THEORY

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 Lypanov'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" - M. Gopal – New Age International – 1984.
2. " Modern Control Engineering" - Ogata. K – Prentice Hall – 1997.

REFERENCES:

1. Optimal Control Theory" - D. E. Kirk – Dover Publications.

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POWER ELECTRONIC CONTROL OF DC DRIVES

UNIT–I: SINGLE-PHASE CONTROLLED RECTIFIER FED DC MOTOR

Separately excited DC motors with rectified single –phase supply – single-phase semi converter and single phase full converter for continuous and discontinuous modes of operation – power and power factor.

UNIT–II: THREE-PHASE CONTROLLED RECTIFIER FED DC MOTOR

Three-phase semi converter and Three phase full converter for continuous and discontinuous modes of operation – power and power factor - Addition of Free wheeling diode – Three phase dual converter.
Three phase controlled bridge rectifier with passive load impedance, resistive load and ideal supply – Highly inductive load and ideal supply for load side and supply side quantities, shunt capacitor compensation, three phase controlled bridge rectifier inverter.

UNIT–III: PHASE, CURRENT & SPEED CONTROLLED DC DRIVE

Three-phase controlled converter, control circuit, control modeling of three phase converter – Steady state analysis of three phase converter controlled DC motor drive – Two quadrant, Three phase converter controlled DC motor drive – DC motor and load, converter.
Current and speed controllers - Current and speed feedback – Design of controllers – Current and speed controllers – Motor equations – filter in the speed feed back loop speed controller – current reference generator – current controller and flow chart for simulation – Harmonics and associated problems – sixth harmonics torque.

UNIT–IV: CHOPPER CONTROLLED DC MOTOR DRIVES

Principle of operation of the chopper – Four – quadrant chopper circuit – Chopper for inversion – Chopper with other power devices – model of the chopper – input to the chopper – steady state analysis of chopper controlled DC motor drives – rating of the devices – Pulsating torques.
Closed loop operation: Speed controlled drive system – current control loop – pulse width modulated current controller – hysteresis current controller – modeling of current controller – design of current controller.

UNIT–V: SIMULATION OF DC MOTOR DRIVES

Dynamic simulations of the speed controlled DC motor drives – Speed feedback speed controller – command current generator – current controller.

REFERENCES:

1. " Power Electronics and motor control" - Shepherd, Hulley, Liang – II Edition - Cambridge University Press.
2. "Electric motor drives: Modeling Analysis and control " - R. Krishnan – I Edition - Prentice Hall India.
3. "Power Electronics: Circuits, Devices and Applications" - MH Rashid – 3rd Edition - PHI - 1995.
4. " Fundamentals of Electric Drives" - GK Dubey - Narosa Publishers 1995.
5. " Power Semiconductor drives" - SB Dewan and A Straughen -1975.

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HVDC TRANSMISSION
(Core Elective-I)

UNIT-I: INTRODUCTION

General consideration, Power Handling Capabilities of HVDC Lines Basic Conversion principles, static converter configuration.

UNIT-II: STATIC POWER CONVERTERS

3-pulse, 6-pulse, and 12-pulse converters, converter station and Terminal equipment, commutation process, Rectifier and inverter operation, equivalent circuit for converter – special features of converter transformers. Harmonics in HVDC Systems, Harmonic elimination, AC and DC filters.

UNIT-III: CONTROL OF HVDC CONVERTERS AND SYSTEMS

Constant current, constant extinction angle and constant ignition angle control- Individual phase control and equidistant firing angle control - DC power flow control. Interaction between HV AC and DC systems – Voltage interaction - Harmonic instability problems and DC power modulation.

UNIT-IV: MTDC SYSTEMS & OVER VOLTAGES

Series, parallel and series-parallel systems - their operation and control.
Over voltages due to disturbances on DC side, over voltages due to DC and AC side line faults.

UNIT-V: CONVERTER FAULTS & PROTECTION

Converter faults -Over current protection - Valve group - DC line protection - Over voltage protection of converters -Surge arresters.

REFERENCE BOOKS:

1. "Direct current Transmission " - E.W. Kimbark - Wiely Inter Science – New York.
2. " HVDC Transmission" - J. Arillaga - Peter Peregrinus ltd.- London, UK – 1983.
3. " High Voltage Direct current Transmission" - KR Padiyar - Wiely Esatern Ltd - New Delhi – 1992.
4. " Power Transmission by Direct Current" - E. Uhlman - Springer Verlag, Berlin Helberg - 1985.

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OPERATIONS RESEARCH

(Elective – I)

UNIT-I:

Linear Programming Problem: Formulation – Graphical method - Simplex method – Artificial variable techniques – Big-M tune –phase methods

Duality theorem – Dual simplex method – Sensitivity analysis - effect of changes in cost coefficients, Constraint constants, Addition/Deletion of variables & constraints.

UNIT-II:

Transportation problem – formulation – Initial basic feasible solution methods – Northwest, Least cost & Vogels methods, MODI optimization - Unbalanced & degeneracy treatment - Assignment problem – Formulation – Hungarian method – Variants of assignment problems, Sequencing problems – Flow shop sequencing – n jobs 2 machines sequencing - n jobs 3 machines sequencing – Job-shop sequencing – 2 jobs m machines sequencing – Graphical methods.

UNIT-III:

Game Theory - Introduction - Terminology – Saddle point games - with out Saddle point games - 2 2 games, analytical method - 2 n and m 2 games – graphical method – dominance principle. Dynamic programming – Bellman's principle of optimality – short route – capital investment – inventory allocation.

UNIT-IV:

Non linear optimization – Single variable optimization problem – Unimodal function - Elimination methods – Fibinocci & Golden reaction methods - Interpolation methods - Quadratic & cubic interpotation method. Multi variable optimization problem – Direct research methods – Univariant method – Pattern search methods – Powell's , Hook-Jeaves & Rosen-brock's search method.

UNIT-V:

Geometric programming – Polynomial – Arithmetic – Seametric inequality – Unconstrained G.P – Constraint G.P with type constraint.

Simulation: Definition – Types- steps- Simulation of simple electrical systems – Advantages and Disadvantages

TEXT BOOKS:

1. " Optimization Theory & Applications" - S.S.Rao - New Age Internationals.
2. " Operations Research" by S.D.Sharma - Galgotia publishers.
3. " Operations Research" by Kausur & Kumar - Spinger Publishers.

REFERENCES:

1. "Optimization techniques: Theory & Practice" - M.C.Joshi & K.M. More Ugalya - Narosa Publications.
2. " Optimization : Theory & Practice" - Beweridze - Mc Graw Hill.
3. " Simulation Modelling & Analysis" - Law & Kelton – TMH.
4. " Optimization Concepts and Applications in Engineering" - A.D. Belegundu , J.R. Chandrupata - Pearson Education – Asia.

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EMBEDDED SYSTEMS

(Elective-I)

UNIT- I: OVERVIEW OF EMBEDDED SYSTEM

Embedded System, types of Embedded System, Requirements of Embedded System, and Issues in Embedded software development, Applications.

UNIT-II: PROCESSOR & MEMORY ORGANIZATION

Structural units in a processor, Processor selection, Memory devices, Memory selection, Memory Allocation & Map, Interfacing.

UNIT-III: DEVICES, DEVICE DRIVES & BUSES FOR DEVICE NETWORKS

I/O devices, Timer & Counter devices, Serial Communication, Communication between devices using different buses - Device drives, Parallel and serial port device drives in a system, Interrupt servicing mechanism, context and periods for context switching, Deadline and Interrupt Latency.

UNIT-IV: PROGRAMMING & PROGRAM MODELING CONCEPTS

Program elements, Modeling Processes for Software Analysis, Programming Models, Modeling of Multiprocessor Systems, Software algorithm Concepts, design, implementation, testing, validating, debugging, Management and maintenance, Necessity of RTOS.

UNIT-V: HARDWARE AND SOFTWARE CO-DESIGN

Embedded system design and co design issues in software development, design cycle in development phase for Embedded System, Use of ICE & Software tools for development of ES, Issues in embedded system design.

REFERENCE BOOKS:

1. " Embedded Systems: Architecture, Programming and Design" - Rajkamal - TMH 2003.
2. " Programming for Embedded System" - Dream-Tech Software Team - John Wiley - 2002.

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MICROCONTROLLERS AND APPLICATIONS

(Elective-II)

UNIT-I: OVERVIEW OF ARCHITECTURE & MICROCONTROLLER RESOURCES

Architecture of a microcontroller – Microcontroller resources – Resources in advanced and next generation microcontrollers – 8051 microcontroller – Internal and External memories – Counters and Timers – Synchronous serial-cum asynchronous serial communication - Interrupts.

UNIT-II: 8051- MICROCONTROLLERS INSTRUCTION SET

Basic assembly language programming – Data transfer instructions – Data and Bit-manipulation instructions – Arithmetic instructions – Instructions for Logical operations on the test among the Registers, Internal RAM, and SFRs – Program flow control instructions – Interrupt control flow.

UNIT-III: REAL TIME CONTROL

INTERRUPTS: Interrupt handling structure of an MCU – Interrupt Latency and Interrupt deadline
– Multiple sources of the interrupts – Non-maskable interrupt sources – Enabling or disabling of the sources – Polling to determine the interrupt source and assignment of the priorities among them – Interrupt structure in Intel 8051.

TIMERS: Programmable Timers in the MCU's – Free running counter and real time control – Interrupt interval and density constraints.

UNIT-IV: SYSTEMS DESIGN

DIGITAL AND ANALOG INTERFACING METHODS:

Switch, Keypad and Keyboard interfacings – LED and Array of LEDs – Keyboard-cum-Display controller (8279) – Alphanumeric Devices – Display Systems and its interfaces – Printer interfaces – Programmable instruments interface using IEEE 488 Bus – Interfacing with the Flash Memory – Interfaces – Interfacing to High Power Devices – Analog input interfacing – Analog output interfacing – Optical motor shaft encoders – Industrial control – Industrial process control system – Prototype MCU based Measuring instruments – Robotics and Embedded control – Digital Signal Processing and digital filters.

UNIT-V: REAL TIME OPERATING SYSTEM FOR MICROCONTROLLERS:

Real Time operating system – RTOS of Keil (RTX51) – Use of RTOS in Design – Software development tools for Microcontrollers.

16-BIT MICROCONTROLLERS: Hardware – Memory map in Intel 80196 family MCU system – IO ports – Programmable Timers and High-speed outputs and input captures – Interrupts – instructions.

ARM 32 Bit MCUs: Introduction to 16/32 Bit processors – ARM architecture and organization – ARM / Thumb programming model – ARM / Thumb instruction set – Development-tools.

TEXT BOOKS:

1. "Microcontrollers Architecture, Programming, Interfacing and System Design"– Raj Kamal - Pearson Education, 2005.
2. "The 8051 Microcontroller and Embedded Systems" - Mazidi and Mazidi – PHI, 2000.

REFERENCE BOOKS:

1. "Microcontrollers : Theory & Applications" - A.V. Deshmuk – WTMH, 2005.
2. "Design with PIC Microcontrollers" - John B. Peatman – Pearson Education - 2005.

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PROGRAMMABLE LOGIC CONTROLLERS AND THEIR APPLICATIONS
(Elective–II)

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 & sequence listings -Ladder diagram construction and flowchart for spray process system.

Unit III: PLC Registers
Characteristics of Registers- Module addressing -Holding registers - Input Registers - Output Registers.

PLC Functions
Timer functions & Industrial applications – Counters -Counter function-Industrial applications - Arithmetic functions - Number comparison functions - Number conversion functions

Unit IV: Data Handling Functions
SKIP - Master control Relay - Jump - Move - FIFO - FAL - ONS - CLR & Sweep functions and their applications -Bit Pattern and changing a bit shift register -Sequence functions and applications -Controlling of two-axis & three axis Robots with PLC - Matrix functions.

Unit V: Analog PLC Operation
Analog modules& 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" - John W Webb and Ronald A Reiss - Fifth Edition – PHI.
2. "Programmable Logic Controllers – Programming Method and Applications" - JR Hackworth and F.D Hackworth – Pearson Education - 2004.

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SPECIAL MACHINES
(Elective–II)

UNIT-I: SPECIAL TYPES OF D.C MACHINES-I

Series booster-Shunt booster-Non-reversible boost-Reversible booster

SPECIAL TYPES OF DC MACHINES –II: Armature excited machines—Rosenberg generator-The Amplidyne and Metadyne - Rototrol and Regulex-third brush generator-Three-wire generator-dynamometer.

UNIT–II: 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-III: 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 $L(\theta)$-θ 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–IV: PERMANENT MAGNET MATERIALS AND MOTORS

Introduction, Hysteresis loops and recoil line- stator frames (pole and yoke - part) of conventional PM dc Motors, Equivalent circuit of a PM-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-V: 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.

TEXT BOOKS:

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

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POWER ELECTRONIC CONVERTERS-I
(Open Elective - I)

UNIT-I: MODERN POWER SEMICONDUCTOR DEVICES
Modern power semiconductor devices – MOS turn Off Thyristor (MTO) – Emitter Turn off Thyristor (ETO) – Intergrated Gate-Commutated thyristor (IGCTs) – MOS-controlled thyristors (MCTs) – Static Induction circuit – comparison of their features.

UNIT-II: SINGLE PHASE AC VOLTAGE CONTROLLERS
Single phase AC voltage controllers with Resistive, Resistive –inductive and Resistive – inductive-induced EMF loads – AC voltage controllers with PWM Control – Effects of source and load inductances – Synchronous tap changers – Applications – numerical problems.

UNIT-III: THREE-PHASE AC VOLTAGE CONTROLLERS & CYCLO-CONVERTERS

Three Phase AC Voltage Controllers – Analysis of controllers with star and delta Connected Resistive, Resistive-inductive loads – Effects of source and load Inductances – applications – numerical problems.

Cyclo-converters : Single phase to single phase cyclo-converters – analysis of midpoint and bridge Configurations – Three phase to three phase cyclo-converters – analysis of Midpoint and bridge configurations – Limitations – Advantages – Applications – numerical problems.

UNIT-IV: SINGLE-PHASE & THREE-PHASE CONVERTERS
Single phase converters – Half controlled and fully controlled converters – Evaluation of input power factor and harmonic factor – continuous and Discontinuous load current – single phase dual converters – power factor Improvement – Extinction angle control – symmetrical angle control – PWM – single phase sinusoidal PWM – single phase series converters – Applications – Numerical problems.

Three Phase Converters – Half controlled and fully controlled converters – Evaluation of input power factor and harmonic factor – Continuous and Discontinuous load current – three phase dual converters – power factor Improvement – three-phase PWM converters – Twelve pulse converters – applications – Numerical problems.

UNIT-V: D.C. TO D.C. CONVERTERS
Choppers: 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 – Numerical problems.

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.
3. " Power Electronics: Devices, Circuits and Industrial applications" by V. R. Moorthi - Oxford University Press

REFERENCE BOOKS:

1. " Power Electronics" - Dr. P. S. Bimbhra - Khanna Publishers.
2. " Elements of Power Electronics" - Philip T. Krein - Oxford University Press.
3. " Power Electronics" - M. S. Jamil Asghar - PHI Private Limited.
4. " Principles of Power Electronics" - John G. Kassakian, Martin F. Schlect, Geroge C. Verghese - Pearson Education.

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RELIABILITY ENGINEERING
(Open Elective – I)

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 cutest 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 cutest/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.

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SMART GRID TECHNOLOGIES
(Open Elective – I)

Prerequisite: Electrical and Electronic Instrumentation

UNIT–I:

Introduction: Introduction to smart grid - Electricity network - Local energy networks- Electric transportation - Low carbon central generation - Attributes of the smart grid - Alternate views of a smart grid.

Smart Grid to Evolve A Perfect Power System: Introduction- Overview of the perfect power system configurations- Device level power system- Building integrated power systems- Distributed power systems- Fully integrated power system-Nodes of innovation.

UNIT–II:

Dc Distribution and Smart Grid:AC Vs DC sources-Benefits of and drives of DC power delivery systems - Powering equipment and appliances with DC-Data centers and information technology loads - Future neighborhood-Potential future work and research.

Intelligrid Architecture for the Smartgrid: Introduction- Launching intelligrid - Intelligrid today - Smart grid vision based on the intelligrid architecture-Barriers and enabling technologies.

UNIT–III:

Dynamic Energy Systems Concept: Smart energy efficient end use devices-Smart distributed energy resources - Advanced whole building control systems- Integrated communications architecture - Energy management-Role of technology in demand response- Current limitations to dynamic energy management-Distributed energy resources-Overview of a dynamic energy management-Key characteristics of smart devices- Key characteristics of advanced whole building control systems - Key characteristics of dynamic energy management system.

UNIT–IV:

Energy Port as Part of the Smart Grid: Concept of energy - Port, generic features of the energy port.

Policies and Programs to Encourage End – Use Energy Efficiency: Policies and programs in action - multinational - national-state-city and corporate levels.

Market Implementation: Framework-factors influencing customer acceptance and response - program planning - monitoring and evaluation.

UNIT–V:

Efficient Electric End – Use Technology Alternatives: Existing technologies – lighting – Space conditioning - Indoor air quality - Domestic water heating - hyper efficient appliances – Ductless residential heat pumps and air conditioners - Variable refrigerant flow air conditioning-Heat pump water heating - Hyper efficient residential appliances - Data center energy efficiency- LED street and area lighting - Industrial motors and drives

- Equipment retrofit and replacement - Process heating - Cogeneration, Thermal energy storage - Industrial energy management programs – Manufacturing process-Electro-technologies, Residential, Commercial and industrial sectors.

TEXT BOOKS:

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

REFERENCES:

1. JanakaEkanayake, KithsiriLiyanage, 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.

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M. Tech (PEED) – I Year – I Sem.

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POWER CONVERTERS LAB

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.

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POWER ELECTRONIC CONVERTERS-II

UNIT-I: PWM INVERTERS (SINGLE-PHASE & THREE-PHASE)

Principle of operation – Performance parameters – Single phase bridge inverter – Evaluation of output voltage and current with resistive, inductive and Capacitive loads – Voltage control of single phase inverters – 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 – Applications – Numerical problems.

Three phase inverters – Analysis of 180 degree condition for output voltage and current with Resistive, Inductive loads – Analysis of 120 degree Conduction – Voltage control of three phase inverters – Sinusoidal PWM – Third Harmonic PWM – 60 degree PWM – Space Vector Modulation – Comparison of PWM techniques – Harmonic reductions – Current Source Inverter – Variable DC link inverter – Buck and Boost inverter – Inverter circuit design – Advantages - Applications – Numerical problems.

UNIT-II: 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 and for series and parallel loaded inverters – Parallel resonant inverters – Voltage control of resonant inverters – Class E inverter and Class E rectifier – Numerical problems.

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 dc-link Inverters – Evaluation of L and C for a zero current switching inverter – Numerical problems.

UNIT-III: MULTILEVEL INVERTERS

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 – DC link capacitor voltage balancing – Features of Multilevel inverters – Comparisons of multilevel converters.

UNIT-IV: DC POWER SUPPLIES

DC power supplies – Classification – Switched mode dc power supplies – Fly back Converter – Forward converter – Push-Pull converter – Half bridge converter – Full bridge converter – Resonant dc power supplies – Bidirectional power supplies – Applications.

UNIT-V: AC POWER SUPPLIES

AC power supplies – Classification – Switched mode ac power supplies – Resonant AC power supplies – Bidirectional ac power supplies – Multistage conversions – Control circuits – Applications. Introduction – Power line disturbances – Power conditioners – Uninterruptible Power supplies – Applications.

TEXT BOOKS:

2. "Power Electronics" - Mohammed H. Rashid - Pearson Education - 3rd Edition.
3. " Power Electronics" - Ned Mohan, Tore M. Underland and William P. Robbins – John Wiley and Sons – Second Edition.

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POWER ELECTRONIC CONTROL OF AC DRIVES

UNIT-I: INTRODUCTION

Introduction to motor drives – Torque production – Equivalent circuit analysis – Speed – Torque Characteristics with variable voltage operation - Variable frequency operation constant v/f operation – Variable stator current operation – Induction motor characteristics in constant torque and field weakening regions.

UNIT-II: STATOR SIDE CONTROL OF INDUCTION MOTOR 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 – Efficiency optimization control by flux program.

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 Scherbius 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 – Adaptive control principles – Self tuning regulator Model referencing control.

UNIT–IV: CONTROL OF PMSM DRIVES

Synchronous motor and its characteristics –PMSM dynamic model – vector control - 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 – speed control scheme – Implementation strategy - speed controller design.

UNIT–V: VARIABLE RELUCTANCE MOTOR DRIVE

Variable Reluctance motor drives – 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. "Electric Motor Drives : Modeling, Analysis and control" - R. Krishnan – Pearson Publications – 1st edition – 2002.
2. " Modern Power Electronics and AC Drives" - B K Bose – Pearson Publications - 1st edition

3. " Power Electronics and Control of AC Motors" - MD Murthy and FG Turn Bull Pergman Press (For Chapters II, III, V) 1st edition
4. " Power Electronics and AC Drives" - BK Bose – Prentice Hall Eagle wood diffs - New Jersey (for chapters I, II, IV) - 1st edition
5. " Power Electronic circuits Deices and Applications" - M H Rashid – PHI – 1995.
6. " Fundamentals of Electrical Drives" - G. K. Dubey – Narosa publications – 1995 (for chapter II)
7. " Power Electronics and Variable frequency drives" - BK Bose – IEEE Press – Standard publications - 1st edition – 2002.
8. " Power Electronics and Motor Drives Advances and Trends" - Bimal Bose - Elesevier.

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NEURAL NETWORK AND FUZZY SYSTEMS

UNIT-I:

Biological neuron Vs artificial neuron, structure and activation functions – Neural network architectures –learning methods, stability and convergence .Single layer networks –Mcculloh–pitts neuron model, Perceptron training and algorithm, delta learning, widrow-Hoff learning rules, limitations, adaline and modification.

UNIT-II:

Multilayer networks, architectures and modeling, BP algorithm, radial basis functions. Unsupervised learning-Winner all learning, out star learning, Counter propagation networks, self organizing networks-Kohonen networks.

UNIT-III:

Grossberg, Hamming NET, MAXNET, Hopfield networks, recurrent and associative memory, BAM and ART architectures Fuzzy sets and systems – geometry of fuzzy sets – theorems – fuzzy and neural function estimators – FAM system architectures – Uncertainty and estimation – Types of uncertainty.

UNIT-IV:

Measures of Fuzziness – Classical measures of uncertainty – measures of Dissonance – confession specificity – knowledge base defuzzification.

UNIT-V:

Application to load forecasting, load flow, fault detection-unit commitments, LF control – economic dispatch, Neuro-Fuzzy controllers.

TEXTBOOK:

1. " Artificial Neural Networks" - B.Yegna Narayana –PHI -1st edition - 1999.
2. " Neural Networks" - Simon Haykin – Prentice Hall International - 1999.

REFERENCE BOOKS:

1. " Neural Networks and Fuzzy System" - Bart Kosko – 2nd edition - 2001.
2. " Neural Network Fundamentals with Graphs, Algorithms & Applications" by N.K.Bose and Liang – McGraw hill - 1996.
3. " Fuzzy Logic with Fuzzy Applications" - T.J.Rosee – Mcgraw hill - 1997.

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DIGITAL CONTROL SYSTEMS
(Elective-III)

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 invariant 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 stability.

UNIT- III: TIME DOMAIN ANALYSIS

Comparison of time response of continuous data and digital control systems-correlation between time response and root locus j 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 – Nyquist 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" - M.Gopal - TMH.

REFERENCE BOOKS:

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

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POWER QUALITY
(Elective – III)

UNIT-I: INTRODUCTION

Introduction of the Power Quality (PQ) problems, Terms used in PQ: Voltage Sag, Swell, Surges, Harmonics, over voltages, spikes, Voltage fluctuations, Transients, Interruption, overview of power quality phenomenon, Remedies to improve power quality, power quality monitoring.

UNIT-II: LONG & SHORT INTERRUPTIONS

Interruptions – Definition – Difference between failures, outage, Interruptions – causes of Long Interruptions – Origin of Interruptions – Limits for the Interruption frequency – Limits for the interruption duration – costs of Interruption – Overview of Reliability evaluation to power quality, comparison of observations and reliability evaluation.
Short interruptions: definition, origin of short interruptions, basic principle, fuse saving, voltage magnitude events due to re-closing, voltage during the interruption, monitoring of short interruptions, difference between medium and low voltage systems. Multiple events, single phase tripping – voltage and current during fault period, voltage and current at post fault period, stochastic prediction of short interruptions.

UNIT III: 1- PHASE & 3-PHASE VOLTAGE SAG CHARACTERIZATION

Voltage sag – definition, causes of voltage sag, voltage sag magnitude, and monitoring, theoretical calculation of voltage sag magnitude, voltage sag calculation in non-radial systems, meshed systems, and voltage sag duration.
Three phase faults, phase angle jumps, magnitude and phase angle jumps for three phase unbalanced sags, load influence on voltage sags.

UNIT-IV: POWER QUALITY CONSIDERATIONS IN INDUSTRIAL POWER SYSTEMS

Voltage sag – equipment behavior of Power electronic loads, induction motors, synchronous motors, computers, consumer electronics, adjustable speed AC drives and its operation. Mitigation of AC Drives, adjustable speed DC drives and its operation, mitigation methods of DC drives.

UNIT-V: MITIGATION OF INTERRUPTIONS & VOLTAGE SAGS

Overview of mitigation methods – from fault to trip, reducing the number of faults, reducing the fault clearing time changing the power system, installing mitigation equipment, improving equipment immunity, different events and mitigation methods.

System equipment interface – voltage source converter, series voltage controller, shunt controller, combined shunt and series controller.

Power Quality and EMC Standards:

Introduction to standardization, IEC Electromagnetic compatibility standards, European voltage characteristics standards, PQ surveys.

REFERENCE BOOK:

1. “Understanding Power Quality Problems” - Math H J Bollen - IEEE Press.

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ADVANCED DIGITAL SIGNAL PROCESSING
(Elective–III)

UNIT–I: DIGITAL FILTER STRUCTURES

Block diagram representation – Equivalent Structures – FIR and IIR digital filter Structures AII pass Filters-tunable IIR Digital filters - 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 ratio in Low –order IIR filters- Low –Sensitivity Digital filters – Reduction of Product round-off errors using error 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.

REFERENCE BOOKS:

2. " Digital Signal Processing" - Sanjit K. Mitra – TMH second edition
3. " Discrete Time Signal Processing" - Alan V. Oppenheim, Ronald W. Schafer – PHI 1996 1st Edition – 9th reprint
4. " Digital Signal Processing Principles – Algorithms and Applications" by John G. Proakis – PHI – 3rd edition 2002.
5. " Digital Signal Processing" - S Salivahanan. A. Vallavaraj C. Gnanapriya – TMH – 2nd reprint 2001.
6. " Theory and Applications of Digital Signal Processing" - Lourens R Rebinarand Bernold.
7. " Digital Filter Analysis and Design" - Auntoniou – TMH.

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DYNAMICS OF ELECTRICAL MACHINES
(Elective-IV)

UNIT-I: BASIC MACHINE THEORY
Electromechanical Analogy – Magnetic Saturation – Rotating field theory – Operation of Induction 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 – stead state analysis – transient analysis – Separately excited d. c. motors – stead 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:

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

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HIGH-FREQUENCY MAGNETIC COMPONENTS
(Elective-IV)

UNIT-I:

Fundamentals of Magnetic Devices: Introduction, Magnetic Relationships, Magnetic Circuits, Magnetic Laws, Eddy Currents, Core Saturation, Inductance, 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.

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 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 method, Inductor Design for Buck Converter in DCM method.

UNIT-V:

Self-Capacitance: Introduction, 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 BOOKS:

1. " Design of Magnetic Components for Switched Mode Power Converters" - Umanand L., Bhat. S.R., - Wiley Eastern Publication, 1992.

REFERENCES:

1. " High-Frequency Magnetic Components" - Marian K. Kazimierczuk - John Wiley & Sons, Inc.
2. " High frequency switching power supplies" - G.C. Chryssis - McGraw Hill, 1989 (2nd Edn.)
3. " Practical Transformer Design Handbook" - Eric Lowdon - Howard W. Sams & Co., Inc., 1980
4. " Electro-dynamic Magnetic Suspension" - Thompson
5. " Introduction to modeling of transformers and coupled inductors" - Witulski Beattie
6. "Effects of eddy currents in transformer windings" - P. L. Dowell
7. "Eddy current losses in transformer windings" - Dixon
8. "Design Considerations For A Sustainable Hybrid Energy System" - J J Ding, J S Buckkeridge, IPENZ Transactions, 2000.
9. "Windings" - Texas Instruments
10. "Magnetic core characteristics" - Ferroxcube Instruments

" 3f3 ferrite datasheet" - Ferroxcube Instruments

" Ferrite selection guide" - Ferroxcube Instruments

" Magnetics, Inc., Ferrite cores" from www. Mag-inc.com.

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RENEWABLE ENERGY SYSTEMS
(Open Elective - IV)

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_2-O_2 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" - Rakosh das Begamudre - New age International publishers, New Delhi - 2000.
2. "Renewable Energy Resources" - John Twidell and Tony Weir - 2nd Edition, Fspon & Co

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FLEXIBLE AC TRANSMISSION SYSTEMS (FACTS)
(Open Elective-II)

UNIT-I: FACTS CONCEPTS

Transmission interconnections -Power flow in an AC system -Loading capability limits - Dynamic stability considerations -Importance of controllable parameters - Basic types of FACTS controllers -Benefits from FACTS controllers.

UNIT-II: VOLTAGE SOURCE CONVERTERS

Single phase and three phase full wave bridge converters - Transformer connections for 12 pulse, 24 pulse and 48 pulse operation.
Three level Voltage Source Converter -Pulse Width Modulation converter - Basic concept of Current Source Converters - comparison of Current Source Converters with Voltage Source Converters.

UNIT-III: STATIC SHUNT COMPENSATION

Objectives of shunt compensation -Midpoint voltage regulation-Voltage instability prevention -Improvement of transient stability - Power oscillation damping -Methods of controllable VAR generation -Variable impedance type static VAR generators- Switching converter type VAR generators- Hybrid VAR generators.

UNIT-IV: SVC AND STATCOM

The regulation and slope transfer function - Dynamic performance -Transient stability enhancement and power oscillation damping -Operating point control -Summary of compensator control.

UNIT-V: STATIC SERIES COMPENSATORS

Concept of series capacitive compensation - Improvement of transient stability - Power oscillation damping -Functional requirements- GTO thyristor controlled Series Capacitor (GSC) -Thyristor Switched Series Capacitor(TSSC) - Thyristor Controlled Series Capacitor(TCSC) -Control schemes for GSC, TSSC,TCSC and SSSC.

TEXT BOOKS:

1. “Understanding FACTS Devices” - N.G. Hingorani and L. Guygi - IEEE Press Publications- 2000.

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SWITCHED MODE POWER SUPPLIES (SMPS)
(Open Elective II)

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

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INTELLIGENT CONTROL
(Open Elective-II)

Unit-I

Introduction and motivation. Approaches to intelligent control. Architecture for intelligent control.

Symbolic reasoning system, rule-based systems, the AI approach. Knowledge representation. Expert systems.

Unit-II

Concept of Artificial Neural Networks and its basic mathematical model, McCulloch-Pitts neuron model, simple perceptron, Adaline and Madaline, Feedforward Multilayer Perceptron. Learning and Training the neural network. Data Processing: Scaling, Fourier transformation, principal-component analysis.

Unit-III

Networks: Hopfield network, Self-organizing network and Recurrent network. Neural Network based controller Case studies: Identification and control of linear and nonlinear dynamic systems using Matlab-Neural Network toolbox. Stability analysis of Neural-Network interconnection systems.

Unit-IV

Genetic Algorithm: Basic concept of Genetic algorithm and detail algorithmic steps, adjustment of free parameters. Solution of typical control problems using genetic algorithm. Concept on some other search techniques like tabu search and ant-colony search techniques for solving optimization problems.

Unit-V

Introduction to crisp sets and fuzzy sets, basic fuzzy set operation and approximate reasoning.

Introduction to fuzzy logic modeling and control. Fuzzification, inferencing and defuzzification. Fuzzy knowledge and rule bases. Fuzzy modeling and control schemes for nonlinear systems. Fuzzy logic control for nonlinear time-delay system. Implementation of fuzzy logic controller using Matlab fuzzy logic toolbox. Stability analysis of fuzzy control systems.

TEXT BOOKS:

1. Simon Haykins, Neural Networks: A comprehensive Foundation, Pearson Edition, 2003.
2. T.J.Ross, Fuzzy logic with Fuzzy Applications, Mc Graw Hill Inc, 1997.
3. David E Goldberg, "Genetic Algorithms".
4. John Yen and Reza Langari, Fuzzy logic Intelligence, Control, and Information, Pearson Education, Indian Edition, 2003.

REFERENCES:

1. M.T.Hagan, H. B. Demuth and M. Beale, Neural Network Design, Indian reprint, 2008.
2. Fredric M.Ham and Ivica Kostanic, Principles of Neurocomputing for science and Engineering, McGraw Hill, 2001.
3. N.K. Bose and P.Liang, Neural Network Fundamentals with Graphs, Algorithms and

Applications, Mc - Graw Hill, Inc. 1996.
4. Yung C. Shin and Chengying Xu, Intelligent System - Modeling, Optimization and Control, CRC Press, 2009.
5. N.K.Sinha and Madan M Gupta, Soft computing & Intelligent Systems - Theory & Applications, Indian Edition, Elsevier, 2007.
6. Witold Pedrycz, Fuzzy Control and Fuzzy Systms, Overseas Press, Indian Edition, 2008.

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ELECTRICAL SYSTEMS SIMULATION LAB

1. Write program and simulate dynamical system of following models:
   a) I/O Model
   b) State variable model

   Also identify time domain specifications of each.
2. Obtain frequency response of a given system by using various methods:
   (a) General method of finding the frequency domain specifications.
   (b) Polar plot
   (c) Bode plot

   Also obtain the Gain margin and Phase margin.
3. Determine stability of a given dynamical system using following methods.
   a) Root locus
   b) Bode plot
   c) Nyquist plot
   d) Liapunov stability criteria
4. Transform a given dynamical system from I/O model to state variable model and vice versa.
5. Obtain model matrix of a given system, obtain it's diagonal form if exists or obtain Jordon Canonical form of system.
6. Write a program and implement linear quadratic regulator
7. Design a compensator for a given systems for required specifications.
8. Conduct a power flow study on a given power system using Newton- Raphson iterative method.
9. Design of PID controllers.
10. Conduct a power flow study on a given power system using Gauss-Seidel iterative method.
11. Develop a program to solve Swing Equation.
12. Develop a Simulink model for a single area load frequency problem and simulate the same.
13. Develop a Simulink model for a two-area load frequency problem and simulate the same.
14. Design a PID controller for two-area power system and simulate the same.
15. PSPICE Simulation of Single phase full converter using RL and E loads.
16. PSPICE Simulation of Three phase full converter using RL and E loads.
17. PSPICE Simulation of Single phase AC Voltage controller using RL load.
18. PSPICE Simulation of Three phase inverter with PWM controller.
19. PSPICE Simulation of resonant pulse commutation circuit.
20. PSPICE Simulation of impulse commutation circuit.

PART A:

1. Single phase full converter using RL and E loads.
2. Three phase full converter using RL and E loads.
3. Single phase AC Voltage controller using RL load.
4. Three-phase inverter with PWM controller.
5. DC-DC Converters.
6. Modeling of Separately Excited DC Motor.
7. Modeling of Three Phase Induction Motor.

PART B:

8. Write program and simulate dynamical system of following models:
   i. I/O Model ii . State variable model
   Also identify time domain specifications of each.

9. Obtain frequency response of a given system by using various methods:
   i. General method of finding the frequency domain specifications.
   ii. Polar plot
   iii. Bode plot
   iv. Also obtain the Gain margin and Phase margin.

10. Determine stability of a given dynamical system using following methods.
    i. Root locus
    ii. Bode plot
    iii. Nyquist plot
    iv. Liapunov stability criteria

11. Transform a given dynamical system from I/O model to state variable model and vice versa.
12. Design a compensator for a given systems for required specifications.
13. Design a PID controller based on Bode plot.
14. Develop a program to solve Swing Equation.

Notes: Use the suitable software for each simulation. Any ten experiments, Six from PART A and Four from PART B, can be selected from the above list.