ACADEMIC REGULATIONS
COURSE STRUCTURE
AND
DETAILED SYLLABUS

For
M.Tech: EEE

Common Specializations:

I.	**Power Electronics**
II.	**Power Industrial Drives**
III.	**Power and Industrial Drives**
IV.	**Power Electronics and Electrical Drives**
V.	**Power Electronics and Drives**
VI.	**Power Electronics and systems**
VII.	**Electrical Machines and Drives**

JAWAHARLAL NEHRU TECHNOLOGY UNIVERSITY KAKINADA
KAKINADA - 533 003, Andhra Pradesh, India

ACADEMIC REGULATIONS R13 FOR M. Tech (REGULAR) DEGREE COURSE

Applicable for the students of M. Tech (Regular) Course from the Academic Year 2013-14 onwards

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

1.0 ELIGIBILITY FOR ADMISSIONS

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

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

2.0 AWARD OF M. Tech DEGREE

2.1 A student shall be declared eligible for the award of the M. Tech Degree, if he pursues a course of study in not less than two and not more than four academic years.

2.2 The student shall register for all 80 credits and secure all the 80 credits.

2.3 The minimum instruction days in each semester are 90.

3.0 A. COURSES OF STUDY

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

1. M.Tech- Structural Engineering
2. M.Tech- Transportation Engineering
3. M.Tech- Infrastructure Engineering & Management
4. ME- Soil Mechanics and Foundation Engineering
5. M.Tech- Environmental Engineering
6. M.Tech-Geo-Informatics
7. M.Tech-Spatial Information Technology

8. M.Tech- Civil Engineering
9. M.Tech -Geo-Technical Engineering
10. M.Tech- Remote Sensing
11. M.Tech- Power Electronics
12. M.Tech- Power & Industrial Drives
13. M.Tech- Power Electronics & Electrical Drives
14. M.Tech- Power System Control & Automation
15. M.Tech- Power Electronics & Drives
16. M.Tech- Power Systems
17. M.Tech- Power Systems Engineering
18. M.Tech- High Voltage Engineering
19. M.Tech- Power Electronics and Power Systems
20. M.Tech- Power System and Control
21. M.Tech- Power Electronics & Systems
22. M.Tech- Electrical Machines and Drives
23. M.Tech- Advanced Power Systems
24. M.Tech- Power Systems with Emphasis on High Voltage Engineering
25. M.Tech- Control Engineering
26. M.Tech- Control Systems
27. M.Tech- Electrical Power Engineering
28. M.Tech- Power Engineering & Energy System
29. M.Tech- Thermal Engineering
30. M.Tech- CAD/CAM
31. M.Tech- Machine Design
32. M.Tech- Computer Aided Design and Manufacture
33. M.Tech- Advanced Manufacturing Systems
34. M.Tech-Computer Aided Analysis & Design
35. M.Tech- Mechanical Engineering Design
36. M.Tech- Systems and Signal Processing
37. M.Tech- Digital Electronics and Communication Systems
38. M.Tech- Electronics & Communications Engineering
39. M.Tech- Communication Systems
40. M.Tech- Communication Engineering & Signal Processing
41. M.Tech- Microwave and Communication Engineering
42. M.Tech- Telematics

43. M.Tech- Digital Systems & Computer Electronics
44. M.Tech- Embedded System
45. M.Tech- VLSI
46. M.Tech- VLSI Design
47. M.Tech- VLSI System Design
48. M.Tech- Embedded System & VLSI Design
49. M.Tech- VLSI & Embedded System
50. M.Tech- VLSI Design & Embedded Systems
51. M.Tech- Image Processing
52. M.Tech- Digital Image Processing
53. M.Tech- Computers & Communication
54. M.Tech- Computers & Communication Engineering
55. M.Tech- Instrumentation & Control Systems
56. M.Tech – VLSI & Micro Electronics
57. M.Tech – Digital Electronics & Communication Engineering
58. M.Tech- Embedded System & VLSI
59. M.Tech- Computer Science & Engineering
60. M.Tech- Computer Science
61. M.Tech- Computer Science & Technology
62. M.Tech- Computer Networks
63. M.Tech- Computer Networks & Information Security
64. M.Tech- Information Technology
65. M.Tech- Software Engineering
66. M.Tech- Neural Networks
67. M.Tech- Chemical Engineering
68. M.Tech- Biotechnology
69. M.Tech- Nano Technology
70. M.Tech- Food Processing
71. M.Tech- Avionics

and any other course as approved by AICTE/ University from time to time.

3.0 B. Departments offering M. Tech Programmes with specializations are noted below:

Civil Engg.	1. M.Tech- Structural Engineering 2. M.Tech- Transportation Engineering 3. M.Tech- Infrastructure Engineering & Management 4. ME- Soil Mechanics and Foundation Engineering 5. M.Tech- Environmental Engineering 6. M.Tech-Geo-Informatics 7. M.Tech-Spatial Information Technology 8. M.Tech- Civil Engineering 9. M.Tech -Geo-Technical Engineering 10. M.Tech- Remote Sensing
EEE	1. M.Tech- Power Electronics 2. M.Tech- Power & Industrial Drives 3. M.Tech- Power Electronics & Electrical Drives 4. M.Tech- Power System Control & Automation 5. M.Tech- Power Electronics & Drives 6. M.Tech- Power Systems 7. M.Tech- Power Systems Engineering 8. M.Tech- High Voltage Engineering 9. M.Tech- Power Electronics and Power Systems 10. M.Tech- Power System and Control 11. M.Tech- Power Electronics & Systems 12. M.Tech- Electrical Machines and Drives 13. M.Tech- Advanced Power Systems 14. M.Tech- Power Systems with Emphasis on High Voltage Engineering 15. M.Tech- Control Engineering 16. M.Tech- Control Systems 17. M.Tech- Electrical Power Engineering 18. M.Tech- Power Engineering & Energy System
ME	1. M.Tech- Thermal Engineering 2. M.Tech- CAD/CAM 3. M.Tech- Machine Design 4. M.Tech- Computer Aided Design and Manufacture 5. M.Tech- Advanced Manufacturing Systems 6. M.Tech-Computer Aided Analysis & Design 7. M.Tech- Mechanical Engineering Design

ECE	1.	M.Tech- Systems and Signal Processing
	2.	M.Tech- Digital Electronics and Communication Systems
	3.	M.Tech- Electronics & Communications Engineering
	4.	M.Tech- Communication Systems
	5.	M.Tech- Communication Engineering & Signal Processing
	6.	M.Tech- Microwave and Communication Engineering
	7.	M.Tech- Telematics
	8.	M.Tech- Digital Systems & Computer Electronics
	9.	M.Tech- Embedded System
	10.	M.Tech- VLSI
	11.	M.Tech- VLSI Design
	12.	M.Tech- VLSI System Design
	13.	M.Tech- Embedded System & VLSI Design
	14.	M.Tech- VLSI & Embedded System
	15.	M.Tech- VLSI Design & Embedded Systems
	16.	M.Tech- Image Processing
	17.	M.Tech- Digital Image Processing
	18.	M.Tech- Computers & Communication
	19.	M.Tech- Computers & Communication Engineering
	20.	M.Tech- Instrumentation & Control Systems
	21.	M.Tech – VLSI & Micro Electronics
	22.	M.Tech – Digital Electronics & Communication Engineering
	23.	M.Tech- Embedded System & VLSI
CSE	1.	M.Tech- Computer Science & Engineering
	2.	M.Tech- Computer Science
	3.	M.Tech- Computer Science & Technology
	4.	M.Tech- Computer Networks
	5.	M.Tech- Computer Networks & Information Security
	6.	M.Tech- Information Technology
	7.	M.Tech- Software Engineering
	8.	M.Tech- Neural Networks
Others	1.	M.Tech- Chemical Engineering
	2.	M.Tech- Biotechnology
	3.	M.Tech- Nano Technology
	4.	M.Tech- Food Processing
	5.	M.Tech- Avionics

4.0 ATTENDANCE

4.1 A student shall be eligible to write University examinations if he acquires a minimum of 75% of attendance in aggregate of all the subjects.

4.2 Condonation of shortage of attendance in aggregate up to 10% (65% and above and below 75%) in each semester shall be granted by the College Academic Committee.

4.3 Shortage of Attendance below 65% in aggregate shall not be condoned.

4.4 Students whose shortage of attendance is not condoned in any semester are not eligible to write their end semester examination of that class.

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

4.6 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 into the same class.

5.0 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.

5.1 For the theory subjects 60 marks shall be awarded based on the performance in the End Semester Examination and 40 marks shall be awarded based on the Internal Evaluation. The 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 instruction. Each mid term examination shall be conducted for a total duration of 120 minutes with 4 questions (without choice) each question for 10 marks. End semester examination is conducted for 60 marks for 5 questions to be answered out of 8 questions.

5.2 For practical subjects, 60 marks shall be awarded based on the performance in the End Semester Examinations and 40 marks shall be awarded based on the day-to-day performance as Internal Marks.

5.3 There shall be two seminar presentations during III semester and IV 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 Project Review 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.

5.4 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 End semester Examination and a minimum aggregate of 50% of the total marks in the End Semester Examination and Internal Evaluation taken together.

5.5 In case the candidate does not secure the minimum academic requirement in any subject (as specified in 5.4) he has to reappear for the End semester Examination in that subject. A candidate shall be given one chance to re-register for each subject provided the internal marks secured by a candidate are less than 50% and has failed in the end examination. In such a case, the candidate must re-register for the subject(s) 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 end examination in those subject(s). In the event of the student taking another chance, his internal marks and end examination marks obtained in the previous attempt stand cancelled. For re-registration the candidates have to apply to the University through the college by paying the requisite fees and get approval from the University before the start of the semester in which re-registration is required.

5.6 In case the candidate secures less than the required attendance in any re registered subject (s), he shall not be permitted to write the End Examination in that subject. He shall again re-register the subject when next offered.

5.7 Laboratory examination for M. Tech. courses must be conducted with two Examiners, one of them being the Laboratory Class Teacher or teacher of the respective college and the second examiner shall be appointed by the university from the panel of examiners submitted by the respective college.

6.0 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.

6.1 A Project Review Committee (PRC) shall be constituted with Head of the Department and two other senior faculty members.

6.2 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.

6.3 After satisfying 6.2, a candidate has to submit, in consultation with his project supervisor, the title, objective and plan of action of his project work for approval. The student can initiate the Project work, only after obtaining the approval from the Project Review Committee (PRC).

6.4 If a candidate wishes to change his supervisor or topic of the project, he can do so with the approval of the Project Review Committee (PRC). However, the Project Review Committee (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.

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

6.6 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 theory and practical course with the approval of PRC not earlier than 40 weeks from the date of registration of the project work. The candidate has to pass all the theory and practical subjects before submission of the Thesis.

6.7 Three copies of the Project Thesis certified by the supervisor shall be submitted to the College/School/Institute.

6.8 The thesis shall be adjudicated by one examiner selected by the University. For this, the Principal of the College shall submit a panel of 5 examiners, eminent in that field, with the help of the guide concerned and head of the department.

6.9 If the report of the examiner is not favourable, the candidate shall revise and resubmit the Thesis, in the time frame as decided by the PRC. If the report of the examiner is unfavorable again, the thesis shall be summarily rejected. The candidate has to re-register for the project and complete the project within the stipulated time after taking the approval from the University.

6.10 If the report of the examiner is favourable, Viva-Voce examination shall be conducted by a board consisting of the Supervisor, Head of the Department and the examiner who adjudicated the Thesis. The Board shall jointly report the candidate's work as one of the following:

A. Excellent
B. Good
C. Satisfactory
D. Unsatisfactory

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

6.11 If the report of the Viva-Voce is unsatisfactory, the candidate shall retake the Viva-Voce examination only after three months. If he fails to get a satisfactory report at the second Viva-Voce examination, the candidate has to re-register for the project and complete the project within the stipulated time after taking the approval from the University.

7.0 AWARD OF DEGREE AND CLASS

After a student has satisfied the requirements prescribed for the completion of the program and is eligible for the award of M. Tech. Degree he shall be placed in one of the following four classes:

Class Awarded	**% of marks to be secured**
First Class with Distinction	70% and above (Without any Supplementary Appearance)
First Class	Below 70% but not less than 60% 70% and above (With any Supplementary Appearance)
Second Class	Below 60% but not less than 50%

The marks in internal evaluation and end examination shall be shown separately in the memorandum of marks.

8.0 WITHHOLDING OF RESULTS

If the student has not paid the dues, if any, to the university or if any case of indiscipline is pending against him, the result of the student will be withheld. His degree will be withheld in such cases.

4.0 TRANSITORY REGULATIONS (for R09)

9.1 Discontinued or detained candidates are eligible for re-admission into same or equivalent subjects at a time as and when offered.

9.2 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 R13 academic regulations.

10. GENERAL

10.1 Wherever the words “he”, “him”, “his”, occur in the regulations, they include “she”, “her”, “hers”.

10.2 The academic regulation should be read as a whole for the purpose of any interpretation.

10.3 In the case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Vice-Chancellor is final.

10.4 The University 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 University.

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	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project

	(theory or practical) in which the candidate is appearing.	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 University.
3.	Impersonates any other candidate in connection with the examination.	The candidate who has impersonated shall be expelled from examination hall. The candidate is also debarred and forfeits the seat. The performance of the original candidate who has been impersonated, shall be cancelled in all the subjects of the examination (including practicals and project work) already appeared and shall not be allowed to appear for examinations of the remaining subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all University 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	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and

	the examination.	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 University 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 of his 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	In case of students of the college, they shall be expelled from examination halls and cancellation of their performance in that subject and all other subjects the candidate(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the subjects of that semester/year. The candidates also are debarred and forfeit their seats. In case of outsiders, they will be handed over to the police and a police case is registered against them.

	outside the examination hall or any of his relations, or indulges in any other act of misconduct or mischief which result in damage to or destruction of property in the examination hall or any part of the College campus or engages in any other act which in the opinion of the officer on duty amounts to use of unfair means or misconduct or has the tendency to disrupt the orderly conduct of the examination.	
7.	Leaves the exam hall taking away answer script or intentionally tears of the script or any part thereof inside or outside the examination hall.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
8.	Possess any lethal weapon or firearm in the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining

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

Malpractices identified by squad or special invigilators

1. Punishments to the candidates as per the above guidelines.
2. Punishment for institutions : (if the squad reports that the college is also involved in encouraging malpractices)
   - (i) A show cause notice shall be issued to the college.
   - (ii) Impose a suitable fine on the college.
   - (iii) Shifting the examination centre from the college to another college for a specific period of not less than one year.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA

KAKINADA-533003, Andhra Pradesh (India)
For Constituent Colleges and Affiliated Colleges of JNTUK

Ragging

Prohibition of ragging in educational institutions Act 26 of 1997

Salient Features

- ⇨ Ragging within or outside any educational institution is prohibited.
- ⇨ Ragging means doing an act which causes or is likely to cause Insult or Annoyance of Fear or Apprehension or Threat or Intimidation or outrage of modesty or Injury to a student

	Imprisonment upto		Fine Upto
Teasing, Embarrassing and Humiliation	6 Months	+	Rs. 1,000/-
Assaulting or Using Criminal force or Criminal intimidation	1 Year	+	Rs. 2,000/-
Wrongfully restraining or confining or causing hurt	2 Years	+	Rs. 5,000/-
Causing grievous hurt, kidnapping or Abducts or rape or committing unnatural offence	5 Years	+	Rs.10,000/-
Causing death or abetting suicide	10 Months	+	Rs. 50,000/-

In Case of Emergency CALL TOLL FREE NO. : 1800 - 425 - 1288

LET US MAKE JNTUK A RAGGING FREE UNIVERSITY

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA

KAKINADA-533003, Andhra Pradesh (India)
For Constituent Colleges and Affiliated Colleges of JNTUK

Ragging

ABSOLUTELY NO TO RAGGING

1. Ragging is prohibited as per Act 26 of A.P. Legislative Assembly, 1997.
2. Ragging entails heavy fines and/or imprisonment.
3. Ragging invokes suspension and dismissal from the College.
4. Outsiders are prohibited from entering the College and Hostel without permission.
5. Girl students must be in their hostel rooms by 7.00 p.m.
6. All the students must carry their Identity Card and show them when demanded
7. The Principal and the Wardens may visit the Hostels and inspect the rooms any time.

Jawaharlal Nehru Technological University Kakinada
For Constituent Colleges and Affiliated Colleges of JNTUK

In Case of Emergency CALL TOLL FREE NO. : 1800 - 425 - 1288

LET US MAKE JNTUK A RAGGING FREE UNIVERSITY

COURSE STRUCTURE

I SEMESTER

S.No	Name of the Subject	L	P	C
1	Electrical Machine Modeling & Analysis	4	—	3
2	Analysis of Power Electronic Converters	4	—	3
3	Electric Drives - I	4	—	3
4	Flexible AC Transmission Systems	4	—	3
5	Elective – I Modern Control Theory Power Quality Optimization Techniques	4	—	3
6	Elective – II Energy Auditing, Conservation and Management Artificial Intelligence Techniques HVDC Transmission	4	—	3
7	Systems Simulation Lab	—	4	2
	Total			**20**

II SEMESTER

1	Switched Mode Power Conversion	4	—	3
2	Electric Drives- II	4	—	3
3	Digital Controllers	4	—	3
4	Custom Power devices	4	—	3
5	Elective – III Renewable Energy Systems Reactive Power Compensation & Management Electrical Distribution Systems	4	—	3
6	Elective – IV Smart Grid Special Machines Programmable Logic Controllers & Applications	4	—	3
7	Power Converters & Drives Lab	—	4	2
	Total			**20**

III SEMESTER

1	Seminar – I	—	—	2
2	Project Work - I	—	—	18
	Total			**20**

IV SEMESTER

1	Seminar – II	—	—	2
2	Project Work - II	—	—	18
	Total			**20**

SYLLABUS

I – I	L	P	Credits
	4	-	3
ELECTRICAL MACHINE MODELING & ANALYSIS			

UNIT – I

Basic concepts of Modeling Basic Two-pole Machine representation of Commutator machines, 3-phase synchronous machine with and without damper bars and 3-phase induction machine, Kron's primitive Machine-voltage, current and Torque equations.

UNIT – II

DC Machine Modeling Mathematical model of separately excited D.C motor – Steady State analysis-Transient State analysis-Sudden application of Inertia Load-Transfer function of Separately excited D.C Motor- Mathematical model of D.C Series motor, Shunt motor-Linearization Techniques for small perturbations.

UNIT-III

Reference frame theory & Modeling of single phase Induction Machines Linear transformation-Phase transformation - three phase to two phase transformation (abc to áâ0) and two phase to three phase transformation áâ0 to abc - -Power equivalence- Mathematical modeling of single phase induction machines.

UNIT – IV

Modeling of three phase Induction Machine Generalized model in arbitrary reference frame-Electromagnetic torque-Derivation of commonly used Induction machine models- Stator reference frame model-Rotor reference frame model-Synchronously rotating reference frame model-state space model with flux linkages as variables.

UNIT – V

Modeling of Synchronous Machine Synchronous machine inductances –voltage equations in the rotor's dq0 reference frame-electromagnetic torque-current in terms of flux linkages-three synchronous machine model- modeling of PM Synchronous motor, modeling of BLDC motor, modeling of Switched Reluctance motor.

REFERENCE BOOKS

1. Electric Motor Drives - Modeling, Analysis& control -R.Krishnan-Pearson Publications-1st edition -2002.
2. Analysis of Electrical Machinery and Drive systems – P.C.Krause, Oleg Wasynczuk, Scott D.Sudhoff – Second Edition-IEEE Press.
3. Dynamic simulation of Electric machinery using Matlab / Simulink – Chee Mun Ong-Prentice Hall.

I – I	L	P	Credits
	4	-	3

ANALYSIS OF POWER ELECTRONIC CONVERTERS

UNIT-I

AC voltage Controllers Single Phase AC Voltage Controllers with PWM control only –synchronous tap changers - Three Phase AC Voltage controllers-Analysis of Controllers with star and delta connected resistive, resistive –inductive loads-Effects of source and load inductances–Application- numerical problems.

UNIT –II

AC-DC converters Single phase full and half Converters with inductive load– Power factor improvements: Extinction angle control-symmetrical angle control - single phase sinusoidal PWM-Single phase series converters- numerical problems - Three Phase full and half Converter with inductive load– harmonic analysis -Power factor improvements-three phase PWM-twelve pulse converters- numerical problems.

UNIT-III

Power Factor Correction Converters Single-phase single stage boost power factor corrected rectifier, power circuit principle of operation, and steady state- analysis, three phase boost PFC converter.

UNIT –IV

PWM Inverters single phase full bridge inverters - sinusoidal PWM – modified PWM – phase displacement Control – Trapezoidal, staircase, stepped, harmonic injection and delta modulation – numerical problems - Three-Phase Inverters- Sinusoidal PWM- 60^0 PWM- Third Harmonic PWM- Space Vector Modulation- Comparison of PWM Techniques-current source inverters-Variable dc link inverter - numerical problems.

UNIT -V

Multi level inverters Multilevel Concept, Types of Multilevel Inverters-Diode-Clamped Multilevel Inverter, Features of Diode-Clamped Inverter, Improved Diode-Clamped Inverter- Flying-Capacitors Multilevel Inverter-Features of Flying-Capacitors Inverter- Cascaded Multilevel

Inverter- Principle of Operation- Features of Cascaded Inverter- Switching Device Currents-DC-Link Capacitor Voltage Balancing- Features of Multilevel Inverters- Comparisons of Multilevel Converters.

TEXTBOOKS

1. Power Electronics-Md.H.Rashid –Pearson Education Third Edition- First IndianReprint- 2008.
2. Power Electronics- Ned Mohan, Tore M.Undelan and William P.Robbins –John Wiley& Sons -2nd Edition.
3. Power Electronics – Lander –Ed.2009.
4. Modern power Electronics and AC Drives – B.K.Bose.
5. Power Converter Circuits – William Shepherd & Li Zhang-Yes Dee Publishing Pvt Ltd.

I – I	L	P	Credits
	4	-	3

ELECTRIC DRIVES – I

UNIT-I

Introduction and single phase convertor fed DC motor drive: Basic power electronic drive system, components, stability of power electronic drive, single phase full-convertor and half-convertor fed dc drives for continuous and discontinuous mode of operation. Four quadrant operation of drive using dual convertor.

UNIT-II

Three phase AC-DC convertor fed DC motor drive: Three phase full-convertor and half-convertor fed dc drives for continuous and discontinuous mode of operation. Four quadrant operation of drive using three phase dual convertor. Pulsating torque.

UNIT-III

Modeling of AC-DC convertor fed DC drive components & design of controller: Transfer function of Dc motor and load, convertor, current and speed controllers, current and speed feedback elements. Design of current controller and speed controller. Closed loop two quadrant DC motor drive, closed loop four quadrant DC motor drive, introduction to simulation of DC motor drive.

UNIT-IV

DC-DC convertor drive fed DC motor drive: Four quadrant DC-DC convertor fed dc motor drive, steady state analysis of DC-DC convertor dc motor drive, pulsating torques.

UNIT-V

Closed loop operation of DC-DC convertor fed dc motor drive: Design of current controller, design of speed controller, modeling of current and speed controller, introduction to simulation of speed controlled dc motor drive.

REFERENCE BOOKS:

1. Electrical Motor Drives Modeling, Analysis and Control – R. Krishna, Prentice Hall India.

2. Power Semiconductor Drives – G.K. Dubey.

3. Power Electronics and Motor control – Shepherd, Hulley, Liang-II Edition, Cambridge University Press.

4. Power electronic circuits, devices and applications – M.H.Rashid – PHI.

I – I	L	P	Credits
	4	-	3

FLEXIBLE AC TRANSMISSION SYSTEMS

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, three phase, full wave bridge converters, transformer connections for 12 pulse, 24 and 48 pulse operation. Three level voltage source converter, pulse width modulation converter, basic concept of current source converters, and 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 and dynamic performance, transient stability enhancement and power oscillation damping, operating point control and summary of compensation control.

UNIT-IV

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), and thyristor controlled series capacitor (TCSC), control schemes for GSC, TSSC and TCSC.

TEXT BOOK :

1. "Understanding FACTS Devices" N.G.Hingorani and L.Guygi, IEEE Press. Indian Edition is available:—Standard Publications
2. Sang.Y.H and John.A.T, "Flexible AC Transmission systems" IEEE Press (2006).
3. HVDC & FACTS Controllers: applications of static converters in power systems- Vijay K.Sood- Springer publishers

I – I	L	P	Credits
	4	-	3

(ELECTIVE-I)
MODERN CONTROL THEORY

UNIT – I

State Variable Analysis The concept of state – State Equations for Dynamic systems – State diagram--- - Linear Continuous time model for physical systems – Existence and Uniqueness of Solutions to Continuous – Time State Equations – Solutions – Linear Time Invariant Continuous – Time State Equations – State transition matrix and it's properties

UNIT – II

State Variable Techniques 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 – State feedback controller design through pole assignment.

UNIT – III

Non Linear Systems – 1 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.

UNIT – IV

Non Linear Systems – 11 Introduction to phase – plane analysis, Method of Isoclines for Constructing Trajectories, singular points, phase – plane analysis of nonlinear control systems.

UNIT – V

Stability Analysis Stability in the sense of Lyapunov, Lyapunov's stability and Lyapunov's instability theorems – Stability Analysis of the Linear Continuous time invariant systems by Lyapunov second

method – Generation of Lyapunov functions – Variable gradient method – Krasooviski's method.

TEXTS BOOKS:

1. Modern Control System Theory by M. Gopal – New Age International – 1984
2. Modern Control Engineering by Ogata. K – Prentice Hall – 1997
3. Nonlinear systems, Hassan K. Klalil, Prentice Hall, 1996
4. Modern control systems, Richard C. Dorf and Robert H. Bishop, 11th Edition, Pearson Edu, India, 2009

I – I	L	P	Credits
	4	-	3
(ELECTIVE I) **POWER QUALITY**			

UNIT-I

Introduction Overview of Power Quality - Concern about the Power Quality - General Classes of Power Quality Problems – Transients - Long-Duration Voltage Variations - Short-Duration Voltage Variations - Voltage Unbalance - Waveform Distortion - Voltage fluctuation - Power Frequency Variations - Power Quality Terms - Voltage Sags and Interruptions - Sources of Sags and Interruptions – Nonlinear loads.

UNIT-II

Transient Over Voltages Source of Transient Over Voltages - Principles of Over Voltage Protection - Devices for Over Voltage Protection - Utility Capacitor Switching Transients - Utility Lightning Protection - Load Switching Transient Problems - Computer Tools for Transient Analysis

UNIT-III

Harmonic Distortion and solutions Voltage vs. Current Distortion - Harmonics vs. Transients - Power System Quantities under Nonsinusoidal Conditions - Harmonic Indices – Sources of harmonics - Locating Sources of Harmonics – System Response Characteristics - Effects of Harmonic Distortion – Interharmonics - Harmonic Solutions Harmonic Distortion Evaluation - Devices for Controlling Harmonic Distortion - Harmonic Filter Design - Standards on Harmonics

UNIT-IV

Long Duration Voltage Variations Principles of Regulating the Voltage - Device for Voltage Regulation - Utility Voltage Regulator Application - Capacitor for Voltage Regulation - End-user Capacitor Application - Regulating Utility Voltage with Distributed Resources – Flicker

UNIT-V

Distributed Generation and Power Quality Resurgence of Distributed Generation - DG Technologies - Interface to the Utility System - Power Quality Issues - Operating Conflicts - DG on Low Voltage Distribution Networks - Interconnection standards - Wiring and Grounding - Typical Wiring and Grounding Problems - Solution to Wiring and grounding Problems

TEXTBOOKS

1. Electrical Power Systems Quality, Dugan R C, McGranaghan M F, Santoso S, and Beaty H W, Second Edition, McGraw-Hill, 2002.
2. Power Quality Primer, Kennedy B W, First Edition, McGraw-Hill, 2000.

REFERENCES

1. Understanding Power Quality Problems: Voltage Sags and Interruptions, Bollen M H J, First Edition, IEEE Press; 2000.
2. Power System Harmonics, Arrillaga J and Watson N R, Second Edition, John Wiley & Sons, 2003.
3. Electric Power Quality control Techniques, W. E. Kazibwe and M. H. Sendaula, Van Nostrad Reinhold, New York.
4. Power Quality by C.Shankaran, CRC Press,2001
5. Harmonics and Power Systems –Franciso C.DE LA Rosa-CRC Press (Taylor & Francis)
6. Power Quality in Power systems and Electrical Machines-Ewald F.fuchs, Mohammad A.S. Masoum-Elsevier

I – I	L	P	Credits
	4	-	3

(ELECTIVE I)
OPTIMIZATION TECHNIQUES

UNIT – I

Introduction and Classical Optimization Techniques: Statement of an Optimization problem – design vector – design constraints – constraint surface – objective function – objective function surfaces – classification of Optimization problems. Single variable Optimization – multi variable Optimization without constraints – necessary and sufficient conditions for minimum/maximum – multivariable Optimization with equality constraints. Solution by method of Lagrange multipliers – multivariable Optimization with inequality constraints – Kuhn – Tucker conditions.

UNIT – II

Linear Programming Standard form of a linear programming problem – geometry of linear programming problems – definitions and theorems – solution of a system of linear simultaneous equations – pivotal reduction of a general system of equations – motivation to the simplex method – simplex algorithm.

UNIT – III

Unconstrained Nonlinear Programming: One – dimensional minimization methods: Classification, Fibonacci method and Quadratic interpolation method. Univariate method, Powell's method and steepest descent method.

UNIT – IV

Constrained Nonlinear Programming: Characteristics of a constrained problem, Classification, Basic approach of Penalty Function method; Basic approaches of Interior and Exterior penalty function methods. Introduction to convex Programming Problem.

UNIT – V

Dynamic Programming: Dynamic programming multistage decision processes – types – concept of sub optimization and the principle of

optimality – computational procedure in dynamic programming – examples illustrating the calculus method of solution - examples illustrating the tabular method of solution.

TEXT BOOKS:

1. "Engineering optimization: Theory and practice"-by S. S.Rao, New Age International (P) Limited, 3rd edition, 1998.
2. "Introductory Operations Research" by H.S. Kasene & K.D. Kumar, Springer (India), Pvt .LTd.

REFERENCE BOOKS:

1. "Optimization Methods in Operations Research and systems Analysis" – by K.V. Mital and C. Mohan, New Age International (P) Limited, Publishers, 3rd edition, 1996.
2. Operations Research – by Dr. S.D.Sharma.
3. "Operations Research: An Introduction" – by H.A. Taha, PHI Pvt. Ltd., 6th edition
4. Linear Programming–by G.Hadley.

I – I	L	P	Credits
	4	-	3

(ELECTIVE II)
ENERGY AUDITING , CONSERVATION & MANAGEMENT

UNIT-I

Basic Principles of Energy Audit Energy audit- definitions, concept , types of audit, energy index, cost index ,pie charts, Sankey diagrams, load profiles, Energy conservation schemes- Energy audit of industries- energy saving potential, energy audit of process industry, thermal power station, building energy audit

UNIT-II

Energy Management –I Principles of energy management, organizing energy management program, initiating, planning, controlling, promoting, monitoring, reporting. Energy manger, Qualities and functions, language, Questionnaire - check list for top management

UNIT-III

Energy Efficient Motors and Lighting Energy efficient motors , factors affecting efficiency, loss distribution , constructional details , characteristics - variable speed , variable duty cycle systems, RMS hp- voltage variation-voltage unbalance- over motoring- motor energy audit, good lighting system design and practice, lighting control, lighting energy audit

UNIT-IV

Power Factor Improvement and energy instruments Power factor – methods of improvement , location of capacitors , Power factor with non-linear loads, effect of harmonics on p.f. , p.f motor controllers - Energy Instruments- watt meter, data loggers, thermocouples, pyrometers, lux meters, tongue testers ,application of PLC's

UNIT-V

Economic Aspects and their computation Economics Analysis- Depreciation Methods, time value of money, rate of return, present

worth method, replacement analysis, lifecycle costing analysis - Energy efficient motors. Calculation of simple payback method, net present worth method- Power factor correction, lighting - Applications of life cycle costing analysis, return on investment.

REFERENCE BOOKS

1. Energy management by W.R. Murphy & G. Mckay Butter worth, Heinemann publications.
2. Energy efficient electric motors by John .C. Andreas, Marcel Dekker Inc Ltd-2nd edition, 1995-
3. Energy management by Paul o' Callaghan, Mc-graw Hill Book company-1st edition, 1998
4. Energy management hand book by W.C.Turner, John wiley and sons
5. Energy management and good lighting practice : fuel efficiency-booklet12-EEO

I – I	L	P	Credits
	4	-	3

(ELECTIVE II)
ARTIFICIAL INTELLIGENCE TECHNIQUES

UNIT-I

Introduction to artificial Intelligence systems ,concept of Artificial Neural Networks and its basic mathematical model, McCulloch-Pitts neuron model, simple perceptron, Adaline and Madaline, Multilayer Perceptron. Learning and Training the neural network.

UNIT-II

Data Pre-Processing: Scaling, Fourier transformation, principal-component analysis and wavelet transformations. Networks: Hopfield network, Self-organizing network and Recurrent network,Back propagation neural network: Architecture, algorithm and applications.

UNIT-III

Genetic Algorithm: Basic concept of Genetic algorithm and detail algorithmic steps, adjustment of free parameters,solution of typical control problems using genetic algorithm, Particle swarm optimization.

UNIT-IV

Introduction to crisp sets and fuzzy sets, basic fuzzy set operation, Fuzzy relations, membership function, defuzzication methods, fuzzy rule base, inference system, mamdani model and Takagi –sugeno fuzzy model, construction of an fuzzy logic control, fuzzy PD controller. Fuzzy modeling and control schemes for nonlinear systems. Self-organizing fuzzy logic control. Implementation of fuzzy logic controller using Matlab fuzzy-logic toolbox.

UNIT-V

Fuzzy logic applications: Design of Fuzzy PI controller for speed control of DC motor- Flux programming efficiency improvement of three phase induction motor.

Neural network applications:-PWM Controller-Selected harmonic elimination PWM-Space vector PWM-Vector controlled drive-feedback signal estimation-speed estimation and flux estimation of induction motor

TEXT BOOKS

1. Neural Networks: A comprehensive Foundation – Simon Haykins, Pearson Edition, 2003.
2. Fuzzy logic with Fuzzy Applications – T.J.Ross – Mc Graw Hill Inc, 1997.
3. Genetic Algorithms- David E Goldberg.
4. Modern Power Electronics and AC Drives –B.K.Bose-Pearson Publications
5. Artificial Intelligent based Electrical Machines and Drives- Peter Vas, Oxford University Press

REFERENCES

1. Neural Network Design-M.T.Hagan, H. B. Demuth and M. Beale, Indian reprint, 2008.
2. Fundamental of neural networks architectures, algorithms and applications- Laurene Fausett-pearson publications
3. Principles of Neurocomputing for science and Engineering,- Fredric M.Ham and Ivica Kostanic, McGraw Hill, 2001.
4. Principles of Neurocomputing for science and Engineering,- Fredric M.Ham and Ivica Kostanic, McGraw Hill, 2001.
5. Neural Network Fundamentals with Graphs, Algorithms and Applications, N.K. Bose and P.Liang, Mc-Graw Hill, Inc. 1996.
6. Intelligent System- Modeling, Optimization and Control- Yung C. Shin and Chengying Xu,CRC Press, 2009.
7. Soft computing & Intelligent Systems- Theory & Applications – N.K.Sinha and Modan M Gupta. Indian Edition, Elsevier, 2007.
8. Fuzzy logic Intelligence, Control, and Information- John Yen and Reza Langari, Pearson Education, Indian Edition, 2003.
9. Fuzzy Control and Fuzzy Systms, Witold Pedrycz, Overseas Press, Indian Edition, 2008.

I – I	L	P	Credits
	4	-	3

(ELECTIVE II)
H.V.D.C. TRANSMISSION

UNIT –I

Limitation of EHV AC Transmission .Advantages of HVDC Technical economical reliability aspects. H.V.D.C. Transmission: General considerations, Power Handling Capabilities of HVDC Lines, Basic Conversion principles, static converter configuration. Types of HVDC links-Apparatus and its purpose.

UNIT-II

Static Power Converters : 6-pulse bridge circuit and 12-pulse converters, converter station and Terminal equipment, commutation process, Rectifier and inverter operation, equivalent circuit for converter – special features of converter transformers. Comparison of the perform of diametrical connection with 6-pulse bridge circuit.

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. Factors responsible for generation of Harmonics voltage and current harmonics effect of variation of á and µ. Filters Harmonic elimination.

UNIT-IV

Interaction between HV AC and DC systems – Voltage interaction, Harmonic instability problems and DC power modulation. Development of DC circuit Breakers, Multi-terminal DC links and systems; series, parallel and series parallel systems, their operation and control.

UNIT-V

Transient over voltages in HV DC systems : Over voltages due to disturbances on DC side, over voltages due to DC and AC side line faults. Converter faults and protection in HVDC Systems: Converter faults, over current protection - valve group, and DC line protection, circuit breakers. Over voltage PROTECTION OF CONVERTERS, SURGE ARRESTERS.

REFERENCE BOOKS :

1. K.R.Padiyar : High Voltage Direct current Transmission, Wiley Eastern Ltd., New Delhi – 1992.
2. E.W. Kimbark : Direct current Transmission, Wiley Inter Science – New York.
3. J.Arillaga : H.V.D.C.Transmission Peter Peregrinus ltd., London UK 1983
4. E.Uhlman : Power Transmission by Direct Current, Springer Verlag, Berlin Helberg – 1985.
5. HVDC Transmission-S Kamakshaih and V Kamaraju MG hill.

I – I	L	P	Credits
	-	4	2
SYTEMS SIMULATION LAB			

Any 10 of the following experiments are to be conducted.

List of experiments:

1. Switching characteristics of Thyristor, MOSFET,IGBT using PSPICE Simulation
2. PSPICE Simulation of Single phase full converter using R-L load, R-L-E load with and without LC Filter.
3. PSPICE Simulation of Three phase full converter using R-L-E Load.
4. PSPICE Simulation of single phase AC Voltage controller with PWM control for RL load.
5. PSPICE Simulation of three phase AC Voltage controller using RL load.
6. PSPICE Simulation of single phase inverter with sinusoidal PWM control for R- load
7. PSPICE Simulation of Three phase inverter with Sinusoidal PWM control for R-Load.
8. PSPICE Simulation of dc-dc Boost converter.
9. Three phase converter fed DC motor using Matlab/Simulink
10. Development and Simulation of 3-phase PWM Inverter with sinusoidal pulse-width modulation using Matlab/Simulink
11. Characteristics of induction machines under balanced and symmetrical conditions for the following using Matlab/Simulink

    a. dq model in synchronous reference frame

    b. dq model in stator reference frame

    c. dq model in rotor reference frame

12. Volts/Hz closed-loop speed control of an induction motor drive using Matlab/Simulink.

13. Open-loop Volts/Hz control of a synchronous motor drive using Matlab/Simulink.

14. Speed control of a permanent magnet synchronous motor using Matlab/ Simulink.

15. Capacitor-start capacitor-run single-phase induction motor using Matlab/Simulink.

16. Single phase IGBT based fully controlled rectifier with PWM control using Matlab-Simpower blockset.

17. Three phase IGBT based ac voltage controller with PWM control using Matlab-Simpower blockset

I – II	L	P	Credits
	4	-	3

SWITCHED MODE POWER CONVERSION

UNIT-I

Non-isolated switch mode converters: Control of DC-DC converters, Buck converters, Boost converters, Buck-Boost converter, CUK Converter, Converter realization with nonideal components.

UNIT-II

Resonant converters: Basic resonant circuit concepts, series resonant circuits, parallel resonant circuits, zero current switching Quasi-resonant buck converter, zero current switching Quasi-resonant boost converter, zero voltage switching Quasi-resonant buck converter, zero voltage switching Quasi-resonant boost converter

UNIT-III

Isolated switch-mode converters: Forwarded converter, flyback converter, Push-pull converter, half-bridge converter, full bridge converter

UNIT-IV

Control schemes of switching converters: Voltage-mode control, Current-mode control, control scheme for resonant converters, proportional integral controller.

Magnetic design consideration: Transformers design, DC inductor and capacitor design.

UNIT-V

Modeling & Control design based on linearization: Formulation of averaged models for buck and boost converters average circuits models, small –signal analysis and linearization.

Control design based on linearization: Transfer function of converters, control design, large signal issues in voltage-mode & current-mode control.

REFERENCE BOOKS:

1. Power Electronics – Issa Bataresh, Jhon willey publications,2004
2. Power switching converters-simon ang, alejandro olive, CRC Press (Taylor & franics group).
3. Elements of Power Electronics – Philip T. Krein, oxford university press.
4. Power Electronics: converters Applications & Design – Mohan, Undeland, Robbins- Wiley publications

I – II	L	P	Credits
	4	-	3

ELECTRIC DRIVES – II

UNIT-I

3-phase induction motor drives – Part 1 Analysis of IM fed from non-sinusoidal supply, harmonic equivalent circuit, transient analysis – starting and plugging; variable frequency control, torque-slip relation, starting torque and braking torque, closed-loop VSI fed IM drive. Slip-ring IM control, closed-loop speed control with static rotor resistance, closed-loop speed control by using slip power recovery scheme.

UNIT-II

3-phase induction motor drives – Part 2 Concept of space vector, vector control of IM: direct or feed-back vector control, flux vector estimation, indirect or feed forward vector control, vector control of line side PWM converter, stator flux oriented vector control, vector control of converter fed inverter drive.

UNIT-III

Synchronous motor and BLDC motor drives Variable frequency control of synchronous motor, closed-loop control of inverter fed synchronous motor drive. Permanent magnet synchronous motor drive. BLDC motor drives, VSI fed BLDC motor drives, back emf, phase current and torque waveforms, control of BLDC motors with sensors, sensor-less control of BLDC motors

UNIT-IV

Traction drives Motors employed in railway traction and road-vehicles, control of railway traction dc motors using ac-dc converters, control of railway traction ac motors using ac-dc and dc-ac converters, power electronic control circuits of electric vehicles and hybrid electric vehicles

UNIT-V

Switched reluctance and stepper motor drives Switched reluctance motor operation and control: modes of operation, converter circuits closed-loop speed control. Stepper motor characteristics, drive circuits for uni-polar and bipolar stepper motors.

REFERENCES:

1. "Electric motor drives, modeling, analysis and control", R. Krishnan, PHI Publishers
2. "Control of electric drives", W. Leonhard, Springer Verilog
3. "Vector control of AC machines", Arindam Ghosh, Gerard Ledwich
4. "Power Electronics: Converters,Application and design" ,Mohan,Undeland and Robbins, Wiley Publications.
5. "Urban transport and hybrid electric vehicles", Edited by Seref Soylu, Published online, 18 Aug 2010. Available:http://www.intechopen.com/books/urban-transport-and-……..
6. "Power control of AC motors", J.M.D. Murphy and F. G. Turnbul
7. "Power semiconductor drives", G. K. Dubey, Printice Hall International
8. "Fundamentals of electric drives", G. K. Dubey, Narosi Publishing House

I – II	L	P	Credits
	4	-	3

DIGITAL CONTROLLERS

UNIT-I

PIC MICROCONTROLLERS PIC Microcontrollers: Overview and Features, PIC 16C6X/7X, FSR(File Selection Register) [Indirect Data Memory Address Pointer], PIC Reset Actions, PIC Oscillator Connections, PIC Memory Organizations, PIC PIC 16C6X/7X Instructions, Addressing Modes, I/O Ports, Interrupts in PIC 16C61/71, PIC 16C61/71 Timers, PIC 16C71 Analog-to-Digital Converter (ADC).

UNIT - II

INTRODUCTION TO DSP Introduction to the C2xx DSP core and code generation, The components of the C2xx DSP core, Mapping external devices to the C2xx core , peripherals and Peripheral Interface, System configuration registers , Memory , Types of Physical Memory, memory Addressing Modes , Assembly Programming using C2xx DSP, Instruction Set, Software Tools.

UNIT - III

I/O & CONTROL REGISTERS Pin Multiplexing (MUX) and General Purpose I/O Overview, Multiplexing and General Purpose I/O Control Registers .Introduction to Interrupts, Interrupt Hierarchy, Interrupt Control Registers, Initializing and Servicing Interrupts in Software.

UNIT - IV

ADC & EVENT MANAGER ADC Overview , Operation of the ADC in the DSP , Overview of the Event manager (EV) , Event Manager Interrupts , General Purpose (GP) Timers , Compare UNITs, Capture UNITs And Quadrature Enclosed Pulse (QEP) Circuitry , General Event Manager Information.

UNIT - V

FPGA Introduction to Field Programmable Gate Arrays – CPLD Vs FPGA – Types of FPGA , Xilinx XC3000 series , Configurable logic Blocks (CLB), Input/Output Block (IOB) – Programmable Interconnect Point (PIP) – Xilinx 4000 series – HDL programming – overview of Spartan 3E and Virtex II pro FPGA boards- case study.

REFERENCES

1. Microcontrollers-Theory and Applications by Ajay V Deshmukh, McGraw Hills.
2. Microcontrollers by Kennith J ayala, Thomson publishers.
3. Microprocessor and Microcontrollers by Prof C.R.Sarma.
4. Hamid.A.Toliyat and Steven G.Campbell " DSP Based Electro Mechanical Motion Control " CRC Press New York , 2004.
5. XC 3000 series datasheets (version 3.1). Xilinx,Inc.,USA, 1998.
6. Wayne Wolf," FPGA based system design ", Prentice hall, 2004.

I – II	L	P	Credits
	4	-	3

CUSTOM POWER DEVICES

UNIT-I

Introduction Custom Power and Custom Power Devices - power quality variations in distribution circuits –Voltage Sags, Swells, and Interruptions - System Faults – Over voltages and Under voltages - Voltage Flicker - Harmonic Distortion - Voltage Notching - Transient Disturbances - Characteristics of Voltage Sags.

UNIT-II

Overview of Custom Power Devices Reactive Power and Harmonic Compensation Devices - Compensation Devices for Voltage Sags and Momentary Interruptions - Backup Energy Supply Devices - Battery UPS – Super Conducting Magnetic Energy Storage systems - Flywheel – Voltage Source Converter - Multi-level converters.

UNIT-III

Reactive Power and Harmonic Compensation Devices Var control devices - Static Var Compensator – Topologies - Direct Connected Static Var Compensation for Distribution Systems – Static Series Compensator - Static Shunt Compensator (DSTATCOM) - Interaction with Distribution Equipment and System - Installation Considerations.

UNIT-IV

High-Speed Source Transfer Switches, Solid State Limiting, And Breaking Devices: Source Transfer Switch - Static Source Transfer Switch (SSTS),- Hybrid source transfer switch – High-speed mechanical source transfer switch - Solid state current limiter - Solid state breaker.

UNIT-V

Application of Custom Power Devices in Power Systems P-Q theory – Control of P and Q – Dynamic Voltage Restorer (DVR) – Operation and control – Interline Power Flow Controller (IPFC) – Operation and control – Unified Power Quality Conditioner (UPQC) – Operation and control. Recent custom power devices.

TEXT BOOKS

1. Guidebook on Custom Power Devices, Technical Report, Published by EPRI, Nov 2000
2. Power Quality Enhancement Using Custom Power Devices – Power Electronics and Power Systems, Gerard Ledwich, Arindam Ghosh, Kluwer Academic Publishers, 2002.

REFERENCES

1. Power Quality, C. Shankaran, CRC Press, 2001.
2. Instantaneous power theory and application to power conditioning, H. Akagi et.al., IEEE Press, 2007.
3. Custom Power Devices - An Introduction, Arindam Ghosh and Gerard Ledwich, Springer, 2002.
4. A Review of Compensating Type Custom Power Devices for Power Quality Improvement, Yash Pal et.al., Joint International Conference on Power System Technology and IEEE Power India Conference, 2008. POWERCON 2008.

I – II	L	P	Credits
	4	-	3

(ELECTIVE-III)
RENEWABLE ENERGY SYSTEMS

UNIT-I

Solar Energy - Availability - Solar radiation data and measurement - Estimation of average solar radiation - Solar water heater types - Heat balance – Flat plate collector efficiency – Efficiency of heat removal - Thermo siphon flow calculation - Forced circulation calculation - Evacuated collectors - Basics of solar concentrators Solar Energy Applications - Solar air heaters – Solar Chimney - Crop driers - Passive solar system - Active solar systems - Water desalination - Output from solar still – Principle of solar ponds.

UNIT-II

Wind Energy – Nature of wind – Characteristics – Variation with height and time – Power in wind –Aerodynamics of Wind turbine – Momentum theory – Basics of aerodynamics – Aero foils and their characteristics – HAWT – Blade element theory – Prandtl's lifting line theory (prescribed wake analysis) VAWT aerodynamics – Wind turbine loads – Aerodynamic loads in steady operation – Yawed operation and tower shadow. Wind Energy Conversion System – Sitting – Rotor selection – Annual energy output – Horizontal axis wind turbine (HAWT) – Vertical axis wind turbine (VAWT) – Rotor design considerations – Number of blades – Solidity - Blade profile – Upwind/Downwind – Yaw system – Tower – Braking system - Synchronous and asynchronous generators and loads – Integration of wind energy converters to electrical networks – Inverters – Control system – Requirement and strategies – Noise Applications of wind energy

UNIT-III

Biomass energy - Bio fuel classification – Examples of thermo chemical, Pyrolysis, biochemical and agrochemical systems – Energy farming – Direct combustion for heat – Process heat and electricity – Ethanol production and use – Anaerobic digestion for biogas – Different

digesters – Digester sizing – Applications of Biogas - Operation with I.C.Engine

UNIT-IV

Ocean Energy - OTEC Principle - Lambert's law of absorption - Open cycle and closed cycle - heat exchanger calculations – Major problems and operational experience. Tidal Power - Principles of power generation - components of power plant – Single and two basin systems – Turbines for tidal power - Estimation of energy – Maximum and minimum power ranges - tidal powerhouse.

Wave Energy – Concept of energy and power from waves – Wave characteristics – period and wave velocities - Different wave energy conservation devices (Saltor duck, oscillating water column and dolphin types) – operational experience.

UNIT-V

Geothermal Energy - Classification- Fundamentals of geophysics - Dry rock and hot aquifier energy analysis - Estimation of thermal power - Extraction techniques - Prime movers.

REFERENCES:

1. Renewable Energy Resources / John Twidell and Tony Weir / E & F.N.Spon
2. Renewable Energy Resources Basic Principles and Applications / G.N.Tiwari and M.K.Ghosal / Narosa
3. Solar Energy - Principles of thermal collection and storage/ S.P. Sukhatme / TMH
4. Solar Energy Thermal Processes,/Duffie & Beckman
5. Solar Heating and Cooling / Kreith & Kreider
6. Wind Energy Handbook / Tony Burton, David Sharpe, Nick Jenkins and Ervin Bossanyi / WileyWind Electrical Systems / S.N.Bhadra, D.Kastha and S.Banerjee / Oxford
7. Biogas Technology - A Practical Hand Book / K.Khendelwal & S.S. Mahdi / McGraw-Hill

I – II	L	P	Credits
	4	-	3

(ELECTIVE III)
REACTIVE POWER COMPENSATION & MANAGEMENT

UNIT-I

Load Compensation Objectives and specifications – reactive power characteristics – inductive and capacitive approximate biasing – Load compensator as a voltage regulator – phase balancing and power factor correction of unsymmetrical loads- examples.

UNIT-II

Reactive power compensation in transmission system: Steady state - Uncompensated line – types of compensation – Passive shunt and series and dynamic shunt compensation – examples

Transient state - Characteristic time periods – passive shunt compensation – static compensations- series capacitor compensation –compensation using synchronous condensers – examples

UNIT-III

Reactive power coordination: Objective – Mathematical modeling – Operation planning – transmission benefits – Basic concepts of quality of power supply – disturbances- steady –state variations – effects of under voltages – frequency – Harmonics, radio frequency and electromagnetic interferences

UNIT-IV

Distribution side Reactive power Management: System losses –loss reduction methods – examples – Reactive power planning – objectives – Economics Planning capacitor placement – retrofitting of capacitor banks

User side reactive power management: KVAR requirements for domestic appliances – Purpose of using capacitors – selection of capacitors – deciding factors – types of available capacitor, characteristics and Limitations

UNIT-V

Reactive power management in electric traction systems and are furnaces: Typical layout of traction systems – reactive power control requirements – distribution transformers- Electric arc furnaces – basic operations- furnaces transformer –filter requirements – remedial measures –power factor of an arc furnace

REFERENCE BOOKS:

1. Reactive power control in Electric power systems by T.J.E.Miller, John Wiley and sons, 1982
2. Reactive power Management by D.M.Tagare,Tata McGraw Hill,2004

I – II	L	P	Credits
	4	-	3

(ELECTIVE-III)
ELECTRICAL DISTRIBUTION SYSTEMS

UNIT-I

General : Introduction to Distribution systems, an overview of the role of computers in distribution system planning-Load modeling and characteristics: definition of basic terms like demand factor, utilization factor, load factor, plant factor, diversity factor, coincidence factor, contribution factor and loss factor-Relationship between the load factor and loss factor - Classification of loads (Residential, Commercial, Agricultural and Industrial) and their characteristics.

UNIT-II

Distribution Feeders and Substations : Design consideration of Distribution feeders: Radial and loop types of primary feeders, voltage levels, feeder-loading. Design practice of the secondary distribution system. Location of Substations : Rating of a Distribution Substation, service area with primary feeders. Benefits derived through optimal location of substations.

UNIT-III

System analysis : Voltage drop and power loss calculations : Derivation for volt-drop and power loss in lines, manual methods of solution for radial networks, three-phase balanced primary lines, non-three-phase primary lines.

UNIT-IV

Protective devices and coordination : Objectives of distribution system protection, types of common faults and procedure for fault calculation. Protective Devices: Principle of operation of fuses, circuit reclosers, line sectionalizer and circuit breakers. Coordination of protective devices: General coordination procedure.

UNIT-V

Capacitive compensation for power factor control: Different types of power capacitors, shunt and series capacitors, effect of shunt capacitors (Fixed and switched) power factor correction, capacitor location. Economic justification. Procedure to determine the best capacitor location. Voltage control : Equipment for voltage control, effect of series capacitors, effect of AVB/AVR, line drop compensation.

REFERENCE BOOKS :

1. "Electric Power Distribution System Engineering " by Turan Gonen, Mc.Graw-Hill Book Company,1986.

2. Electric Power Distribution-by A.S.Pabla, Tata Mc Graw-Hill Publishing Company, 4th edition, 1997.

3. Electrical Distribution V.Kamaraju-Mc Graw Hill

I – II	L	P	Credits
	4	-	3

(ELECTIVE – IV)
SMART GRID

UNIT-I

Introduction to Smart Grid: Evolution of Electric Grid, Concept of Smart Grid, Definitions, Need of Smart Grid, Functions of Smart Grid, Opportunities & Barriers of Smart Grid, Difference between conventional & smart grid, Concept of Resilient & Self Healing Grid, Present development & International policies on Smart Grid. Case study of Smart Grid.

UNIT-II

Smart Grid Technologies: Part 1: Introduction to Smart Meters, Real Time Prizing, Smart Appliances, Automatic Meter Reading(AMR), Outage Management System(OMS), Plug in Hybrid Electric Vehicles(PHEV), Vehicle to Grid, Smart Sensors, Home & Building Automation, Phase Shifting Transformers.

UNIT-III

Smart Grid Technologies: Part 2: Smart Substations, Substation Automation, Feeder Automation. Geographic Information System(GIS), Intelligent Electronic Devices(IED) & their application for monitoring & protection, Smart storage like Battery, SMES, Pumped Hydro, Compressed Air Energy Storage, Wide Area Measurement System(WAMS), Phase Measurement Unit(PMU).

UNIT-IV

Microgrids and Distributed Energy Resources: Concept of microgrid, need & applications of microgrid, formation of microgrid, Issues of interconnection, protection & control of microgrid. Plastic & Organic solar cells, Thin film solar cells, Variable speed wind generators, fuelcells, microturbines, Captive power plants, Integration of renewable energy sources.

UNIT-V

Power Quality Management in Smart Grid: Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy

Sources, Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring, Power Quality Audit.

Information and Communication Technology for Smart Grid: Advanced Metering Infrastructure (AMI), Home Area Network (HAN), Neighborhood Area Network (NAN), Wide Area Network (WAN).

TEXT BOOKS:

1. Ali Keyhani, Mohammad N. Marwali, Min Dai "Integration of Green and Renewable Energy in Electric Power Systems", Wiley
2. Clark W. Gellings, "The Smart Grid: Enabling Energy Efficiency and Demand Response",CRC Press
3. Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama,"Smart Grid: Technology and Applications", Wiley
4. Jean Claude Sabonnadière, Nouredine Hadjsaïd, "Smart Grids", Wiley Blackwell 19
5. Peter S. Fox Penner, "Smart Power: Climate Changes, the Smart Grid, and the Future of Electric Utilities", Island Press; 1 edition 8 Jun 2010
6. S. Chowdhury, S. P. Chowdhury, P. Crossley, "Microgrids and Active Distribution Networks." Institution of Engineering and Technology, 30 Jun 2009
7. Stuart Borlase, "Smart Grids (Power Engineering)", CRC Press

REFERENCE BOOKS:

1. Andres Carvallo, John Cooper, "The Advanced Smart Grid: Edge Power Driving Sustainability: 1", Artech House Publishers July 2011
2. James Northcote, Green, Robert G. Wilson "Control and Automation of Electric Power Distribution Systems (Power Engineering)", CRC Press
3. Mladen Kezunovic, Mark G. Adamiak, Alexander P. Apostolov, Jeffrey George Gilbert "Substation Automation (Power Electronics and Power Systems)", Springer
4. R. C. Dugan, Mark F. McGranghan, Surya Santoso, H. Wayne Beaty, "Electrical Power System Quality", 2nd Edition, McGraw Hill Publication
5. Yang Xiao, "Communication and Networking in Smart Grids", CRC Press

I – II	L	P	Credits
	4	-	3

(ELECTIVE IV)
SPECIAL MACHINES

UNIT-I

Stepper Motors Constructional features, Principle of operation, Modes of excitation torque production in Variable Reluctance (VR) stepping motor, Dynamic characteristics, Drive systems and circuit for open loop control, closed loop control of stepping motor.

UNIT-II

Permanent Magnet Synchronous Motors (PMSM) and Switched Reluctance Motors (SRM)

PMSM: Power electronic controllers, Torque speed characteristics, Self control, Vector control, Current control.

SRM: Constructional features, Principle of operation. Torque equation, Characteristics, Control Techniques, Drive concept.

UNIT-III

Permanent Magnet Brushless DC Motors Concept of electronic commutation, Hall sensors, Optical sensors, back emf detection, Multiphase Brushless motor, Square wave permanent magnet brushless motor drives, Torque and emf equation, Torque-speed characteristics, Speed control by microcontroller.

UNIT-IV

Servomotors and AC Tachometers Servomotor – Types – Constructional features – Principle of Operation – Characteristics - Control – Microprocessor based applications.

AC Tachometers: Permanent magnet ac tachometer, AC induction tachometer, Schematic diagrams, Operating principle.

UNIT-V

Linear Motors Linear Motors: Linear Induction Motor (LIM) Classification – Construction – Principle of operation – Concept of Current sheet –Goodness factor – DC Linear Motor (DCLM) types – Circuit equation – DCLM control-applications.

REFERENCES

1. Miller, T.J.E. "Brushless Permanent Magnet and Reluctance Motor Drives", Clarendon Press, Oxford, 1989.
2. Kenjo, T, "Stepping Motors and their Microprocessor control", Clarendon Press, Oxford, 1989.
3. Naser A and Boldea I, "Linear Electric Motors: Theory, Design and Practical Application", Prentice Hall Inc., New Jersey,1987.
4. Special Electrical Machines-K.Venkataratnam- University press.
5. Floyd E Saner,"Servo Motor Applications", Pittman USA, 1993.
6. Kenjo, T and Naganori, S "Permanent Magnet and brushless DC motors", Clarendon Press, Oxford, 1989.
7. Generalized Theory of Electrical Machines – P.S.Bimbra-Khanna publications-5th edition- 1995.

I – II	L	P	Credits
	4	-	3

(ELECTIVE IV)
PROGAMMABLE LOGIC CONTROLLERS & APPLICATIONS

UNIT-I

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

UNIT-II

PLC Programming: Input instructions, outputs, operational procedures, programming examples using contacts and coils. Drill press operation. Digital logic gates, programming in the Boolean algebra system, conversion examples. Ladder diagrams for process control: Ladder diagrams and sequence listings, ladder diagram construction and flow chart for spray process system.

UNIT-III

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

UNIT-IV

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

UNIT-V

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

REFERENCE BOOKS:

1. Programmable Logic Controllers – Principle and Applications by John W. Webb and Ronald A. Reiss, Fifth Edition, PHI

2. Programmable Logic Controllers – Programming Method and Applications by JR. Hackworth and F.D Hackworth Jr. – Pearson, 2004.

3. Introduction to Programmable Logic Controllers- Gary Dunning-Cengage Learning.

4. Programmable Logic Controllers –W.Bolton-Elsevier publisher

I – II	L	P	Credits
	-	4	2
POWER CONVERTERS AND DRIVES LAB			

List of experiments

1. Operation of 3- phase Full-Converter on R & R-L load.
2. Performance & speed control of D.C. drive using 3-phase full Converter.
3. Performance & Operation of a four quadrant Chopper on D.C. Drive
4. Performance & Operation of a 3-phase A.C. Voltage controller on motor load.
5. Single Phase IGBT based PWM Inverter on R & R-L load
6. Operation of 3-phase IGBT based PWM Inverter on R & R-L load.
7. Performance & speed control of 3 phase slip ring Induction motor by Static Rotor Resistance controller.
8. Three phase PWM Pulse generation using PIC Micro controller
9. PIC Microcontroller based speed control of three phase Induction Motor
10. DSP based V/F Control of 3 phase Induction motor.