AVANTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

(Autonomous)

(Approved by A.I.C.T.E., New Delhi &Permanently Affiliated to JNTU-GV, Vizianagaram)
NAAC Accredited with A+ grade
Tamaram (V), Makavarapalem,Narsipatnam (RD), Anakapalle Dist,Pin-531113

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

ACADEMIC REGULATIONS

COURSE STRUCTURE AND SYLLABUS

For PG-R24

M.Tech – POWER ELECTRONICS

(Applicable for batches admitted from 2024-2025)

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Academic Regulations (R24) for M.Tech (Regular) Degree Course

(Applicable for the students of M.Tech from the Academic Year 2024-2025 onwards)

1. ELIGIBILITY FOR ADMISSIONS

Admission to the above program shall be made subject to eligibility, qualification and specialization as prescribed by the Institute 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 Institute or on the basis of any other order of merit as approved by the Institute, subject to reservations as laid down by the Govt. from time to time.

2. AWARD OF M. Tech DEGREE

a) 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.

b) The student shall register for all 68 credits and secure all the 68 credits.

c) The minimum instruction days in each semester are 90.

3. PROGRAMME OF STUDY

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

M.Tech

1. M.Tech- Computer Science & Engineering
2. M.Tech- Power Systems
3. M.Tech- Power Electronics
4. M.Tech- Digital Electronics and Communication Systems
5. M.Tech- VLSI Design

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

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

Department	Programme Code	Title
EEE	56	M.Tech- Power Systems

EEE	43	M.Tech- Power Electronics
ECE	38	M.Tech- Digital Electronics and Communication Systems
ECE	72	M.Tech - VLSI Design
CSE	58	M.Tech - Computer Science & Engineering

5. ATTENDANCE

a) A student shall be eligible to write the examinations of the institute if he acquires a minimum of 75% of attendance in aggregate of all the subjects / courses, and with minimum 50% in each and every course including practicals.

b) 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.

c) Shortage of Attendance **below** 65% in aggregate shall not be condoned and not eligible to write their end semester examination of that class.

d) Students whose shortage of attendance is not condoned in any semester are not eligibleto write their end semester examination of that class.

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

f) 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 re-admission into that semester when offered next. If any candidate fulfills the attendance requirement in the present semester, he shall not be eligible for re-admission into the same class.

6. EVALUATION

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

a) For the theory subjects 75 marks shall be awarded based on the performance in the End Semester Examination and 25 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 midterm examination shall be conducted for a total duration of 120 minutes with 4 questions (without choice) each question for 10 marks, and it will be reduced to 25 marks. End semester examination is conducted for 75 marks for all FIVE (5) questions (one question from one unit) to be answered (either or).

b) For practical subjects, 75 marks shall be awarded based on the performance in the End Semester Examinations and 25 marks shall be awarded based on the day-to-day performance as Internal Marks. The internal evaluation based on the day to day work-5 marks, record- 5 marks and the remaining 15 marks to be awarded by conducting an internal laboratory test. The end examination shall be conducted by the examiners, with a breakup mark of Procedure-20, Experimentation-30, Results-10, and Viva-voce-15.

c) For Mini Project with 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 / mentor and two other senior faculty members of the department. For Mini Project with Seminar, there will be only internal evaluation of 100 marks. A candidate has to secure a minimum of 50% of marks to be declared successful.

d) 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.

e) In case the candidate does not secure the minimum academic requirement in any subject (as specified in 5.4) he has to re-appear 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 shall stand cancelled. For re-registration, the candidates have to apply to the college by paying the requisite fees and get approval from the institute before the start of the semester in which re-registration is required.

f) 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.

g) 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 institute from the panel of examiners submitted by the respective departments.

7. 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.

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

b) Registration of Dissertation/ 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.

c) 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).

d) 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 PRC shall examine whether or not to change the topic/supervisor leads to a major change in 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.

e) Continuous assessment of Dissertation-I and Dissertation-II during the Semester(s) will be monitored by the PRC.

f) A candidate shall submit his status report in two stages to the PRC, at least with a gap of 3 months between them.

g) 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.

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

i) The thesis shall be adjudicated by one examiner selected by the institute. 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.

j) If the report of the examiner is not favorable, 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 candidates have to re-registered for the project and complete the project within the stipulated time after taking the approval from the Institute.

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

l) If the report of the examiner is favorable, 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 for a maximum of 100 marks as one of the following:

I. Excellent
II. Good
III. Satisfactory
IV. Unsatisfactory

m) If the report of the Viva-Voce is unsatisfactory (ie, < 50 marks), 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 college.

8. Cumulative Grade Point Average (CGPA)

As measure of the student's performance, a 10-point Absolute Grading System using the following Letter Grades and corresponding percentage of marks shall be followed: **A**fter each course is evaluated for 100 marks, the marks obtained in each course will be converted to a corresponding letter grade as given below, depending on the range in which the marks obtained by the student fall.

Structure of Grading of Academic Performance

Marks Range Theory/ Laboratory (Max – 100)	Marks Range Mini Project/ Project Work or Dissertation (Max – 100)	Letter Grade	Level	Grade Point
≥ 90	≥ 90	S	Superior	10
≥80 to <90	≥80 to <90	A	Excellent	9
≥70 to <80	≥70 to <80	B	Very Good	8
≥60 to <70	≥60 to <70	C	Good	7
≥50 to <60	≥50 to <60	D	Average	6
<50	<50	F	Fail	0
		AB	Absent	0

i) A student obtaining Grade "F" or Grade "Ab" in a subject shall be considered failed and will be required to reappear for that subject when it is offered the next supplementary examination.

ii) For non-credit audit courses, "Satisfactory" or "Unsatisfactory" shall be indicated instead of the letter grade and this will not be counted for the computation of SGPA/ CGPA / Percentage.

Computation of Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA):

SGPA: The Semester Grade Point Average (SGPA) is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses under gone by a student, i.e.,

$$\mathbf{SGPA=\Sigma (C_i \times G_i) / \Sigma C_i}$$

Where, C_i is the number of credits of the i^{th} subject and G_i is the grade point scored by the student in the i^{th} course.

CGPA: The Cumulative Grade Point Average (CGPA) will be computed in the same manner considering all the courses under gone by a student over all the semesters of a program, i.e.

$$\mathbf{CGPA=\Sigma (C_i \times S_i) / \Sigma C_i}$$

Where "S_i" is the SGPA of the i^{th} semester and C_i is the total number of credits up to that semester.

Both SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts. While computing the SGPA the subjects in whom the student is awarded Zero grade points will also be included.

Equivalent Percentage = (CGPA-0.75)*10

Grade Point: It is a numerical weight allotted to each letter grade on a 10-point scale. Letter Grade: It is an index of the performance of students in a said course. Grades are denoted by the letters S, A, B, C, D and F.

9. 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	CGPA to be secured	
First Class with Distinction	**≥ 7.75 (Without any supplementary appearance)**	**From the CGPA secured from 68 Credits.**
First Class	**≥ 7.75 (With any supplementary appearance)** **≥ 6.75 and < 7.75 (Without any**	

	supplementary appearance)	
Second Class	**≥ 6.75 and < 7.75 (With any supplementary appearance)** **≥ 6.0 to < 6.75 (Without any supplementary appearance)**	
Pass Class	**≥ 6.0 to < 6.75 (With any supplementary appearance)**	

The Grades secured, Grade points and Credits obtained will be shown separately in the memorandum of marks.

10. WITH HOLDING OF RESULTS

If the student is involved in indiscipline/malpractices/court cases, the result of the student will be withheld.

11. TRANSITORY REGULATIONS (For R24)

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

b) 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 R19 (JNTUK) academic regulations.

12. GENERAL

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

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

c) In the case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Principal / Dean-Academics of the institution is final.

d) The Institute 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 Institute.

MALPRACTICES RULES

DISCIPLINARY ACTION FOR / IMPROPER CONDUCT IN EXAMINATIONS

S.No	Nature of Malpractices / Improper conduct	Punishment
	If the candidate:	
1	(a) Possesses or keeps accessible in examination hall, any paper, note book, programmable calculators, Cell phones, pager, palm computers or any other form	Expulsion from the examination hall and cancellation of the performance in that subject only of all the candidates involved. In case of anoutsider, he will be handed over

	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) (b) Gives assistance or guidance or receivesit 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.	to the police anda case is registered against him.
2	Has copied in the examination hall from any paper, book, programmable calculators, palm computers or any other form of material relevant to the subject of the examination (theory or practical) in which the candidate is appearing.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the subjects of that Semester/year. The Hall Ticket of the candidate is to be cancelled and sent to the 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 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 External 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	Expulsion from the examination hall and

	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.	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 External 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 lettersto 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 outside the examination hall or any of his relations, or indulges in any other act of misconduct or mischief which result in damage to or destruction of property in the examination hall or any part of the College campus or engages in any other act which in the opinion of the officer on duty amounts to use of unfair means or misconduct or has the tendency to disrupt the orderly conduct of the examination.	In case of students of the college, they shall be expelled from examination halls and cancellation of their performance in that subject and all other subjects the candidate(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the subjects of that semester/year. The candidates also are debarred and forfeit their seats. In case of outsiders, they will be handed over to the police and a police case is registered against them.
7	Leaves the exam hall taking away answer script or intentionally tears 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 External 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 Institute 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.

Seminar/ comprehensive vivo evaluation

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.

(a) For Ist & IInd semesters Seminar 100 marks are allotted for each, which shall be awarded based on the performance of the student on the selected advanced topic which is subdivided as follows.

Marks for assignment	-	20
Marks for Power Point Presentation	-	60
Marks for viva voce (Orals)	-	20
Total marks	-	100

(b) 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 (PRC) 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.

(Dr. R Prasad Rao)
Dean(Academics) &
Member Secretary (AC)

(Dr.C P V N J Mohan Rao)
Chairman
Academic Council

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Program: M.Tech- PE **Regulation R24**

I Year I Semester- Course Structure

S.No	Category	Course Code	Course Name	Hours per Week			
				L	T	P	C
1	PC	2443PC01	Electrical Machine Modeling and Analysis	3	0	0	3
2	PC	2443PC02	Advanced Power Electronic Converters - I	3	0	0	3
3	PE I		**Program Elective-I**	3	0	0	3
		2443PE01.1	1. Modern Control Theory				
		2443PE01.2	2. Power Quality Improvement Techniques				
		2443PE01.3	3. Programmable Logic Controllers & Applications				
4	PE II		**Program Elective-II**	3	0	0	3
		2443PE02.1	1. Artificial Intelligence Techniques				
		2443PE02.2	2. Renewable Energy Technologies				
		2443PE02.3	3. Reactive Power Compensation and Management				
5	PC	2443PC03	Power Electronics Simulation Laboratory	0	0	4	2
6	PC	2443PC04	Power Converters Laboratory	0	0	4	2
7	MC	24MTMC01	Research Methodology andIPR	2	0	0	2
8	AC		**Audit Course – 1**	2	0	0	0
		24MTAC01.1	1.English for Research paper writing				
		24MTAC01.2	2.Disaster Management				
			Total	**16**	**0**	**8**	**18**

Category	Courses	Credits
PC-Program Core Courses	4	10
PE-Program Elective Courses	2	6
MC-Mandatory Courses	1	2
AC- Audit Courses	1	0
Total	**8**	**18**

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Program: M.Tech-PE **Regulation R24**

I Year II Semester- Course Structure

S.No	Category	Course Code	Course Name	Hours per Week			
				L	T	P	C
1	PC	2443PC05	Advanced Power Electronic Converters - II	3	0	0	3
2	PC	2443PC06	Power Electronic Control of Electrical Drives	3	0	0	3
3	PE-III		**Program Elective-III**	3	0	0	3
		2443PE03.1	1. Power Electronics for Renewable Energy Systems				
		2443PE03.2	2. Electric Vehicles and Design				
		2443PE03.3	3. Digital Control Systems				
4	PE-IV		**Program Elective-IV**	3	0	0	3
		2443PE04.1	1. Advanced Digital Signal Processing				
		2443PE04.2	2. Applications of Power Converters				
		2443PE04.3	3. Microcontroller applications to power electronics				
5	PC	2443PC07	Electric Drives Simulation Laboratory	0	0	4	2
6	PC	2443PC08	Electric Drives Laboratory	0	0	4	2
7	PR	2443PR01	Mini Project with Seminar	0	0	4	2
8	AC		Audit Course – 2	2	0	0	0
		24MTAC02.1	1.Constitution of India				
		24MTAC02.2	2.Value of Education				
			Total	**14**	**0**	**12**	**18**

Category	Courses	Credits
PC-Program Core Courses	4	10
PE-Program Elective Courses	2	6
PR-Mini Project	1	2
AC- Audit Course	1	0
Total	**8**	**18**

ELECTRICAL MACHINE MODELING AND ANALYSIS
I M.TECH- I SEMESTER

Course Title: Electrical Machine Modeling And Analysis	Course Code: 2443PC01
Teaching Scheme (L:T:P): 3:0:0	Credits: 3
Type of Course: Lecture	
Continuous Internal Evaluation: 25 Marks	Semester End Exam: 75 Marks
Pre requisites: Electrical Machines	

Course objectives:

The objectives of this course are to

1. To know the concepts of generalized theory of electrical machines.
2. To represent the DC and AC machines as Basic Two Pole machine.
3. To model the electrical machines with voltage, current, torque and speed equations
4. To investigate the steady state and transient behavior of the electrical machines.
5. To understand the dynamic behavior of the AC machines

Course Outcomes:

CO#	Course Outcomes
CO1	Analyze the characteristics of different types of DC motors to design suitable controllers for different applications.
CO2	Apply the knowledge of reference frame theory for AC machines to model the induction and Synchronous machines
CO3	Evaluate the steady state and transient behaviour of induction and synchronous machines to propose the suitability of drives for different industrial applications
CO4	Analyze the behaviour of induction machines using voltage and torque equations.
CO5	Analyze the behaviour of synchronous machines using voltage and torque equations.

COURSE CONTENT (SYLLABUS)

UNIT- I: Basic Concepts Of Modelling

Basic two-pole machine representation of Commutator machines, representations of 3-phase synchronous Machine with and without damper bars and 3-phase induction machine, Kron‟s primitive Machine Voltage, current and torque equations.

Self-Learning Topics: Basics of DC & AC Machines

UNIT-II: Dc Machine Modelling

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

Self-Learning Topics: DC Motors

UNIT- III: Reference Frame Theory & Modelling Of Single Phase Induction Machines

Linear transformation-Phase transformation - three phase to two phase transformation (abc to αβ0) and Vice-versa, transformation to rotating reference frame, (αβ0 to dqo) and vice versa -Power equivalence- Mathematical modelling of single phase induction machines

Self-Learning Topics: Single Phase induction Motors

UNIT– IV: Modelling Of Three Phase Induction Machine

Generalized model in arbitrary reference frame-Derivation of commonly used induction machine models- Synchronously rotating reference frame model, Stator reference frame model-Rotor reference frame Model--power equation, electromagnetic torque equation, and state space model in induction motor with flux Linkages as variables

Self-Learning Topics: Three Phase Induction motors

UNIT– V: Modelling Of Synchronous Machine

Synchronous machine inductances –derivation of voltage equations in the rotor‟s dq0 reference frame Electromagnetic torque-current in terms of flux linkages-three phase synchronous motor. State space Models with flux linkages as variables.

Self-Learning Topics: Special Machines

Text Books:

1. Analysis of Electric Machinery and Drive Systems, 3rd Edition-Wiley-IEEE Press- Paul Krause, Oleg Wasynczuk, Scott D. Sudhoff, Steven Pekarek, Junr 2013.
2. Electric Motor Drives - Modeling, Analysis& control -R.Krishnan- Pearson Publications

Reference Books:

1. Generalized theory of Electrical Machines -Fifth edition, Khanna Publishers P. S. Bimbhra, 1985.
2. Dynamic simulation of Electric machinery using MATLAB / Simulink – CheeMunOng- Prentice Hall, 2003.
3. Magneto electric devices transducers, transformers and machines-G. R. Slemon- Wiley in New York, London, 1966.

Web References:

1. **https://onlinecourses.nptel.ac.in/noc21_ee20/preview**
2. **https://onlinecourses.nptel.ac.in/noc24_ee76/preview**

ADVANCED POWER ELECTRONIC CONVERTERS – I

I M.TECH- I SEMESTER

Course Title: Advanced power Electronic converters-I	Course Code: 2443PC02
Teaching Scheme (L:T:P): 3:0:0	Credits: 3
Type of Course: Lecture	
Continuous Internal Evaluation: 25 Marks	Semester End Exam: 75 Marks
Pre requisites: Power electronics	

COURSE OBJECTIVES:

The objectives of this course are to

1. To understand various advanced power electronic devices.
2. To comprehend the design of rectifiers and inverters.
3. To understand the operation of multi-level inverters with switching strategies for high power applications.

COURSE OUTCOMES:

CO#	Course Outcomes
CO1	Capability in designing isolated converters
CO2	Ability to dynamic analysis of power Converters.
CO3	Competency in operation of resonant converter.
CO4	Know-how of multilevel converter

COURSE CONTENT (SYLLABUS)

UNIT -I: **Modern Power Semiconductor Devices**

Modern power semiconductor devices: Symbol, Structure and equivalent circuit ofInsulated Gate Bipolar Transistor (IGBT), MOSFET, MOS Turn off Thyristor (MTO), Emitter Turn off Thyristor (ETO), Integrated Gate-Commutated Thyristor (IGCTs), MOS-controlled thyristors (MCTs), Power Integrated Circuits (PICs). Comparison of their features.

Self-Learning Topics: Power Electronics

UNIT-II: **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 Improvements Techniques, Extinction angle control, Symmetrical angle control, Single phase sinusoidal PWM, Single phase series converters, Overlap analysis, Applications & 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 Improvements Techniques, Three phase PWM, Twelve pulse converters, Applications &Problems.

Self-Learning Topics: Power Electronics

UNIT-III: **Pulse Width Modulated Inverters**

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 modulation, Advantages, Applications & Problems.
Self-Learning Topics: Single Phase Inverters

UNIT-IV: **Three Phase Inverters**
Generalized model in arbitrary reference frame-Derivation of commonly used induction machine models- Synchronously rotating reference frame model, Stator reference frame model-Rotor reference frame Model--power equation, electromagnetic torque equation, and state space model in induction motor with flux Linkages as variables
Self-Learning Topics: Inverters

UNIT-V: Multilevel Inverters
Multilevel concept, Classification of multilevel inverters, Principle of operation, main features and comparison of Diode clamped, Improved diode Clamped, Flying capacitors, Cascaded multilevel inverters, Multilevel inverter applications, Reactive power compensation, Back to back intertie system, Adjustable drives, Switching device currents, DC link capacitor voltage balancing.
Self-Learning Topics: Basics of Multi Level Inverters

TEXT BOOKS:

1. Mohammed H. Rashid, "Power Electronics", Pearson Education, 3rd Edition, 1st Indian reprint 2004.
2. Ned Mohan Tore M. Undeland and William P. Robbins, "Power Electronics", John Wiley & Sons, 2nd Edition.

REFERENCE BOOKS:

1. Milliman Shepherd and Lizang, "Power converters circuits", Chapter 14 (Matrix converter) PP- 415-444,
2. M.H.Rashid, "Power Electronics hand book".
3. Marian P. Kaźmierkowski, Ramu Krishnan, Frede Blabjerg Edition, "Control in Power electronics", Published by Academic Press, 2002.

ONLINE RESOURCES:

https://onlinecourses.nptel.ac.in/noc21_ee20/preview
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MODERN CONTROL THEORY
I M.TECH- I SEMESTER

Course Title: Modern Control Theory	Course Code: 2443PE01.1
Teaching Scheme (L:T:P): 3:0:0	Credits: 3
Type of Course: Lecture	
Continuous Internal Evaluation: 25Marks	Semester End Exam: 75 Marks
Pre requisites: Digital control systems, control systems	

COURSE OBJECTIVES:

The objectives of this course are to

1. To facilitate the evolution of state variable approach for the analysis of control systems.
2. To examine the importance of controllability and observability in modern control engineering.
3. To enable students to analyze various types of nonlinearities & construction of trajectories using describing functions and phase plane analysis.
4. To study the analysis of stability and instability of continuous time invariant system

COURSE OUTCOMES:

CO#	Course Outcomes
CO1	Formulate and solve the state equations of dynamic systems, analyze controllability and observability
CO2	Design state feedback controller; design an observer
CO3	Linearize a nonlinearsystem model; analyze non-linear systems through describing functions
CO4	Determine the stability of a given system; generate a Lyapunov function
CO5	Minimize a given functional, design an optimal feedback gain matrix

COURSE CONTENT (SYLLABUS)

UNIT -I: **State Variable Analysis**

The concept of state –State Equations for Dynamic systems– Solution of Linear Time Invariant ContinuousTime State Equations, State transition matrix and it‟s properties. Controllability and Observability of state model in Jordan Canonical form - Controllability and Observability Canonical Forms of State model.

Self-Learning Topics: Basics of Control Systems

UNIT-II: **Design Using State Variable Technique**

Design of state feedback controller through pole placement technique-Necessary and sufficient conditionAckermann‟s formula. Concept of observer-Design of full order state observer-reduced order observer

Self-Learning Topics: Control Systems

UNIT-III: **Non Linear Systems**

Classification of Nonlinearities- common physical nonlinearities– Characteristics of nonlinear

systems - Singular Points –Linearization of nonlinear systems– Describing function – describing function analysis of nonlinear systems- Stability analysis of Nonlinear systems through describing functions.

Self-Learning Topics: Stability

UNIT-IV: **Stability Analysis**

Generalized model in arbitrary reference frame-Derivation of commonly used induction machine modelsSynchronously rotating reference frame model, Stator reference frame model-Rotor reference frame Model-- power equation, electromagnetic torque equation, and state space model in induction motor with flux Linkages as variables

Self-Learning Topics: Stability Analysis

UNIT-V: **Introduction To Optimal Control**

Minimization of functional of single function – Constrained minimization – Minimum principle – Control Variable inequality constraints – Control and state variable inequality constraints – Euler Lagrangine Equation. Typical optimal control performance measures-optimal control based on Quadratic performance MeasuresQuadratic optimal regulator systems- State regulator problems – Output regulator problems, Tracking problems; Riccati equation-Infinite time regulator problem-Reduce matrix Riccati equation determination of optimal feedback gain matrix.

Self-Learning Topics: Control Techniques

TEXT BOOKS:

1. Modern Control Engineering – by K. Ogata, Prentice Hall of India, 3rd edition, 1998.
2. Automatic Control Systems by B.C. Kuo, Prentice Hall Publication

REFERENCE BOOKS:

1. Modern Control System Theory – by M. Gopal, New Age International Publishers, 2 nd edition,1996
2. Control Systems Engineering by I.J. Nagarath and M.Gopal, New Age International (P) Ltd.
3. Digital Control and State Variable Methods – by M. Gopal, Tata McGraw–Hill Companies, 1997.
4. Systems and Control by Stainslaw H. Zak , Oxford Press, 2003.
5. Optimal control theory: an Introduction by Donald E.Kirk by Dover publications.
6. Modern control systems, Richard C. Dorf and Robert H. Bishop, 11th Edition, Pearson Edu, India,2009

ONLINE RESOURCES:

1. **https://onlinecourses.nptel.ac.in/noc21_ee20/preview**
2. **https://onlinecourses.nptel.ac.in/noc24_ee76/preview**

POWER QUALITY IMPROVEMENT TECHNIQUES
I M.TECH- I SEMESTER

Course Title: power Quality improvement techniques	Course Code: 2443PE01.2
Teaching Scheme (L:T:P): 3:0:0	Credits: 3
Type of Course: Lecture	
Continuous Internal Evaluation: 25 Marks	Semester End Exam: 75 Marks
Pre requisites: Power systems,Facts	

COURSE OBJECTIVES:

The objectives of this course are to

1. To know different terms of power quality.
2. To illustrate power quality issues for short and long interruptions.
3. To study of characterization of voltage sag magnitude and three-phase unbalanced voltage sag.
4. To know the behavior of power electronics loads, induction motors, synchronous motor etc. by the power quality issues.
5. To know mitigation of power quality problems by using VSI converters.

COURSE OUTCOMES:

CO#	Course Outcomes
CO1	Know the severity of power quality problemsin distribution system
CO2	Understand the concept of voltage sag transformation from up-stream (higher voltages) to downstream (lower voltage)
CO3	Compute the power quality improvement by using various mitigating custom power devices
CO4	Understand power quality monitoring and Classification techniques.
CO5	Understand power quality monitoring and Classification techniques

COURSE CONTENT (SYLLABUS)

UNIT -I: **Introduction And Power Quality Standards**

Introduction, Classification of Power Quality Problems, Causes, Effects and Mitigation Techniques of Power Quality Problems, Power Quality Terminology, Standards, Definitions, Monitoring and Numerical Problems.

Self-Learning Topics: Basics of Power Systems

UNIT-II: **Causes Of Power Quality Problems**

Introduction to Non-Linear Loads, Power Quality Problems caused by Non-Linear Loads, Analysis of NonLinear Loads, Numerical Problems.

Self-Learning Topics: Power Quality

UNIT-III: **Passive Shunt And Series Compensation**

Introduction, Classification and Principle of operation of Passive Shunt and Series Compensators, Analysis and Design of Passive Shunt Compensators for Single-Phase System, Three-Phase Three

Wire System and Three-Phase Four Wire System.
Self-Learning Topics: FACTS Devices

UNIT-IV: **Active Shunt And Series Compensation**
Introduction to Shunt compensators: Classification of DSTATCOM‟s, Principle of Operation of DSTATCOM. Different Control Algorithms of DSTATCOM: PI Controller, I-Cosφ Control Algorithm, Synchronous Reference Frame Theory, Single-Phase PQ theory and DQ Theory Based Control Algorithms, Analysis and Design of Shunt Compensators, Numerical Problems. Introduction to Series Compensators: Classification of Series Compensators, Principle of Operation of DVR. Different Control Algorithms of DVR: Synchronous Reference Frame Theory-Based Control of DVR, Analysis and Design of Active Series Compensators, Numerical Problems
Self-Learning Topics: Control Algorithms

UNIT-V: **Unified Power Quality Compensators**
Introduction to Unified Power Quality Compensators (UPQC), Classification of UPQCs, Principle of Operation of UPQC. Control of UPQCs: Synchronous Reference Frame Theory-Based UPQC, Analysis and Design of UPQCs, Numerical Problems..
Self-Learning Topics: Facts Devices

TEXT BOOKS:
1. Bhim Singh, Ambrish Chandra, Kamal Al-Haddad, “Power Quality Problems and Mitigation Techniques”, Wiley Publications, 2015.
2. Math H J Bollen, “Understanding Power Quality Problems”, IEEE Press, 2000

REFERENCE BOOKS:
1. R.C. Dugan, M.F. McGranaghan and H.W. Beaty, “Electric Power Systems Quality”, New York, McGrawHill, 1996.
2. G.T. Heydt, “Electric power quality”, McGraw-Hill Professional, 2007.
3. J. Arrillaga, “Power System Quality Assessment”, John wiley, 2000.
4. G.T. Heydt,” Electric Power Quality”, 2ndEdition, West Lafayette, IN, Stars in Circle Publications, 1994.
5. R. SastryVedamMulukutlaS.Sarma, “Power Quality VAR Compensation in Power Systems”, CRC Press.
6. A Ghosh, G. Ledwich,” Power Quality Enhancement Using Custom Power Devices”, Kluwer Academic, 2002

ONLINE RESOURCES:
1. **https://onlinecourses.nptel.ac.in/noc21_ee20/preview**
2. **https://onlinecourses.nptel.ac.in/noc24_ee76/preview**

PROGRAMMABLE LOGIC CONTROLLERS & APPLICATIONS

I M.TECH- I SEMESTER

Course Title: Programmable logic controllers & Applications	Course Code: 2443PE01.3
Teaching Scheme (L:T:P): 3:0:0	Credits: 3
Type of Course: Lecture	
Continuous Internal Evaluation: 25 Marks	Semester End Exam: 75 Marks
Pre requisites: Basis of MPMC ,Switching theory and Logic design	

COURSE OBJECTIVES:

The objectives of this course are to

1. To have knowledge on PLC.
2. To acquire the knowledge on programming of PLC.
3. To understand different PLC registers and their description.
4. To have knowledge on data handling functions of PLC.
5. To know how to handle analog signal and converting of A/D in PLC.

COURSE OUTCOMES:

CO#	Course Outcomes
CO1	Understand the PLCs and their I/O modules.
CO2	Develop control algorithms to PLC using ladder logic etc.
CO3	Manage PLC registers for effective utilization in different applications
CO4	Handle data functions and control of two axis and their axis robots with PLC
CO5	Design PID controller with PLC.

COURSE CONTENT (SYLLABUS)

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.

Self-Learning Topics: Basics in PLC

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

Self-Learning Topics: Programming

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

Self-Learning Topics: Registers In PLC

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

Self-Learning Topics: 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.

Self-Learning Topics: Analog Operations

TEXT 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.

REFERENCE BOOKS:

1. Introduction to Programmable Logic Controllers- Gary Dunning-Cengage Learning. Programmable Logic Controllers –W.Bolton-Elsevier publisher.

ONLINE RESOURCES:

1. **https://onlinecourses.nptel.ac.in/noc21_ee20/preview**
2. **https://onlinecourses.nptel.ac.in/noc24_ee76/preview**

ARTIFICIAL INTELLIGENCE TECHNIQUES

I M.TECH- I SEMESTER

Course Title:Artificial Intelligence Techniques	Course Code: 2443PE02.1
Teaching Scheme (L:T:P): 3:0:0	Credits: 3
Type of Course: Lecture	
Continuous Internal Evaluation: 25 Marks	Semester End Exam: 75 Marks
Pre requisites: Neural Networks	

COURSE OBJECTIVES:

The objectives of this course are to

1. To have knowledge on concept of neural network.
2. To know different types of neural networks and training algorithms.
3. To understand the concept of genetic algorithm and its application in optimization.
4. To have the knowledge on fuzzy logic and design of fuzzy logic controllers.
5. To know the applications of AI Techniques in electrical engineering.

COURSE OUTCOMES:

CO#	Course Outcomes
CO1	Understand the PLCs and their I/O modules.
CO2	Develop control algorithms to PLC using ladder logic etc.
CO3	Manage PLC registers for effective utilization in different applications
CO4	Handle data functions and control of two axis and their axis robots with PLC
CO5	Design PID controller with PLC.

COURSE CONTENT (SYLLABUS)

UNIT -I: **Introduction**

Artificial Neural Networks (ANN) – definition and fundamental concepts – Biological neural networks – Artificial neuron – activation functions – setting of weights – typical architectures – biases and thresholds – learning/training laws and algorithms. Perceptron – architectures, ADALINE and MADLINE – linear separability- XOR function

Self-Learning Topics: Fuzzy Basics

UNIT-II: ANN Paradigms

ADALINE – feed forward networks – Back Propagation algorithm- number of hidden layers – gradient decent algorithm – Radial Basis Function (RBF) network. Kohonen‟sself organizing map (SOM), Learning Vector Quantization (LVQ) and its types – Functional Link Networks (FLN) – Bidirectional Associative Memory (BAM) – Hopfield Neural Network.

Self-Learning Topics: ANN Techniques

UNIT-III: Classical and Fuzzy Sets

Introduction to classical sets- properties, Operations and relations; Fuzzy sets, Membership, Operations, Properties, Fuzzy relations, Cardinalities, Membership functions.

Self-Learning Topics: Properties of Fuzzy

UNIT-IV: Fuzzy Logic Controller (FLC)

Generalized model in arbitrary reference frame-Derivation of commonly used induction machine models- Synchronously rotating reference frame model, Stator reference frame model-Rotor reference frame Model--power equation, electromagnetic torque equation, and state space model in induction motor with flux Linkages as variables

Self-Learning Topics: FLC

UNIT -V: Application of AI Techniques

Speed control of DC motors using fuzzy logic –load flow studies using back propagation algorithm, single area and two area load frequency control using fuzzy logic.

Self-Learning Topics: AI Applications

TEXT BOOKS:

1. Introduction to Artificial Neural Systems - Jacek M. Zuarda, Jaico Publishing House, 1997.
2. Fuzzy logic with Fuzzy Applications – T.J Ross – McGraw Hill Inc, 1997.

REFERENCE BOOKS:

1. Milliman Shepherd and Lizang, "Power converters circuits", Chapter 14 (Matrix converter) PP- 415-444,
2. M.H.Rashid, "Power Electronics hand book".
3. Marian P. Kaźmierkowski, Ramu Krishnan, Frede Blabjerg Edition, "Control in Power electronics", Published by Academic Press, 2002.

ONLINE RESOURCES:

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RENEWABLE ENERGY TECHNOLOGIES
I M.TECH- I SEMESTER

Course Title: Renewable Energy Technologies	Course Code: 2443PE02.2
Teaching Scheme (L:T:P): 3:0:0	Credits: 3
Type of Course: Lecture	
Continuous Internal Evaluation: 25 Marks	Semester End Exam: 75 Marks
Pre requisites: Renewable Energy Source	

COURSE OBJECTIVES:

1. To learn technical challenges in renewable energy.
2. To learn basics of wind energy conversion & PV power generation.
3. To analyze the of fuel cell system.

COURSE OUTCOMES:

CO#	Course Outcomes
CO1	Understand various general aspects of renewable energy Systems.
CO2	Analyze and design induction generator for power generation from wind.
CO3	Design MPPT controller for solar power utilization.
CO4	Utilize fuel cell systems for power generation.

COURSE CONTENT (SYLLABUS)

UNIT -I: **Introduction**
Renewable Sources of Energy; Distributed Generation; Renewable Energy Economics - Calculation of Electricity Generation Costs; Demand-Side Management Options; Supply-Side Management Options; Control of renewable energy based power Systems
Self-Learning Topics: Basics of RES

UNIT-II: **Induction Generators**
Principles of Operation; Representation of Steady-State Operation; Power and Losses Generated - Self-Excited Induction Generator; Magnetizing Curves and Self-Excitation - Mathematical Description of the Self-Excitation Process; Interconnected and Stand-alone operation - Speed and Voltage Control.
Self-Learning Topics: Power and Losses in Induction Generator

UNIT-III: **Wind Power Plants**
Site Selection; Evaluation of Wind Intensity; Topography; Purpose of the Energy Generation-General Classification of Wind Turbines; Rotor Turbines; Multiple-Blade Turbines; Drag Turbines; Lifting Turbines - Generators and Speed Control Used in Wind Power Energy; Analysis of Small wind energy conversion system.
Self-Learning Topics: Energy Generation

UNIT-IV: **Photovoltaic Power Plants**
Solar Energy; Generation of Electricity by Photovoltaic Effect; Dependence of a PV Cell on Temperature and irradiance input-output Characteristics - Equivalent Models and Parameters for

Photovoltaic Panels; MPPT schemes: P&O,INC, effect of partial shaded condition. Applications of Photovoltaic Solar Energy-Economical Analysis of Solar Energy

Self-Learning Topics: Photovoltaic Effect

UNIT-V: **Induction Generators**

The Fuel Cell; Low- and High-Temperature Fuel Cells; Commercial and Manufacturing Issues - Constructional Features of Proton Exchange-Membrane Fuel Cells; Reformers; Electrolyzer Systems; Advantages and Disadvantages of Fuel Cells - Fuel Cell Equivalent Circuit; Practical Determination of the Equivalent Model Parameters; Aspects of Hydrogen for storage

Self-Learning Topics: Fuel Cells

TEXT BOOKS:

1. Felix A. Farret, M. Godoy Simo` es, Integration of Alternative Sources of Energy, John Wiley & Sons, 2006.
2. Remus Teodorescu, Marco Liserre, Pedro Rodríguez, Grid Converters for Photovoltaic and Wind Power Systems, John Wiley & Sons, 2011.

REFERENCE BOOKS:

1. Gilbert M. Masters, Renewable and Efficient Electric Power Systems, John Wiley & Sons, 2004

ONLINE RESOURCES:

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REACTIVE POWER COMPENSATION AND MANAGEMENT
I M.TECH- I SEMESTER

Course Title: Reactive Power Compensation And Management	Course Code: 2443PE02.3
Teaching Scheme (L:T:P): 3:0:0	Credits: 3
Type of Course: Lecture	
Continuous Internal Evaluation: 25Marks	Semester End Exam: 75 Marks
Pre requisites: Powersystems	

COURSE OBJECTIVES:

1. To identify the necessity of reactive power compensation
2. To describe load compensation
3. To select various types of reactive power compensation in transmission systems
4. To illustrate reactive power coordination system
5. To characterize distribution side and utility side reactive power management

COURSE OUTCOMES:

CO#	Course Outcomes
CO1	Distinguish the importance of load compensation in symmetrical as well as unsymmetrical loads
CO2	Work out on various compensation methods in transmission lines
CO3	Construct models for reactive power coordination
CO4	Distinguish demand side reactive power management & user side reactive power management

COURSE CONTENT (SYLLABUS)

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

Self-Learning Topics: Fuzzy Basics

UNIT-II: STEADY–STATE REACTIVE POWER COMPENSATION IN TRANSMISSION SYSTEMS

Uncompensated line, Types of compensation, Passive shunt and series and dynamic shunt compensation, Examples.

TRANSIENT STATE REACTIVE POWER COMPENSATION IN TRANSMISSION SYSTEMS

Characteristic time periods, Passive shunt compensation, Static compensation, Series capacitor compensation, Compensation using synchronous condenser, Examples.

Self-Learning Topics: ANN Techniques

UNIT- III: REACTIVE POWER COORDINATION

Objective, Mathematical modeling, Operation planning, Transmission benefits, Basic concepts of quality of power supply, Disturbances, Steady–state variations, Effect of under-voltages, Frequency, Harmonics, Radio frequency and electromagnetic interference..

Self-Learning Topics: Properties of Fuzzy

UNIT– IV: DEMAND SIDE MANAGEMENT

Load patterns, Basic methods load shaping, Power tariffs, KVAR based tariffs penalties for voltage flickers and Harmonic voltage levels

DISTRIBUTION SIDE REACTIVE POWER MANAGEMENT

System losses, Loss reduction methods, Examples, Reactive power planning, Objectives, Economics Planning capacitor placement, Retrofitting of capacitor banks.

Self-Learning Topics: FLC

UNIT– V: 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.

REACTIVE POWER MANAGEMENT IN ELECTRIC TRACTION SYSTEMS AND ARC FURNACES

Typical layout of traction systems, Reactive power control requirements,Distribution transformers, Electric arc furnaces, Basic operation, Furnaces transformer, Filter requirements, Remedial measures, Power factor of an arc furnace.

Self-Learning Topics: AI Applications

TEXT BOOKS:

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

REFERENCE BOOKS:

1. Wolfgang Hofmann, Jurgen Schlabbach, Wolfgang Just, "Reactive Power Compensation: A Practical Guide", Wiley Publication, April2012.

ONLINE RESOURCES:

https://onlinecourses.nptel.ac.in/noc21_ee20/preview
https://onlinecourses.nptel.ac.in/noc24_ee76/preview

POWER ELECTRONICS SIMULATION LABORATORY
I M.TECH- I SEMESTER

Course Title: Power Electronics Simulation Laboratory	Course Code: 2443PC03
Teaching Scheme (L:T:P): 0:0:4	Credits: 2
Type of Course: Practical	
Continuous Internal Evaluation: 25 Marks	Semester End Exam: 75 Marks
Pre requisites: power electronics	

Course Objectives:

1. To analyze the operation of DC-DC converters, AC-DC converters and DC-AC converters by simulation.
2. Use power electronic simulation packages& hardware to develop the power converters
3. Analyze and choose the appropriate converters for various applications.

COURSE OUTCOMES:

CO#	Course Outcomes
CO1	Describe the operation of power electronic devices and its applications.
CO2	Analyze the I-V characteristics of SCR, DIAC and TRIAC.

List of Experiments

1. Simulation of Buck converter using small signal model.
2. Simulation of Boost converter using small signal model.
3. Simulation of single phase half bridge inverter.
4. Simulation of single-phase full bridge inverter using Uni-polar & Bi-polar PWM techniques
5. Simulation of three phase inverter using sine-triangle PWM.
6. Simulation of three phase inverter using space vector PWM
7. Simulation of three level three phase NPC inverter.
8. Study of neutral point voltage floating in NPC three level inverter
9. Simulation of 3-level flying capacitor inverter & evaluation of capacitor Voltage balanced Methods
10. Simulation of single phase AC voltage regulator
11. Simulation of three phase AC voltage regulator.
12. Comparison of harmonic profile of two level& three level inverter
13. Simulation of 5-level inverter using carrier based PWM methods.
14. Simulation of three phase full converter with RL & RLE loads.
15. Simulation of three-phase dual converter.

Exercise Problems

1. Analysis of Buck Converter
2. Analysis of Boost Converter
3. I-Phase Bridge inverter
4. PWM Techniques.
5. 3-Phase Inverter using single triangle PWM
6. 5-Level Inverter using Carrier based PWM

POWER CONVERTERS LABORATORY
I M.TECH- I SEMESTER

Course Title: Power Converters Laboratory	Course Code: 2443PC04
Teaching Scheme (L:T:P): 0:0:4	Credits: 2
Type of Course: Practical	
Continuous Internal Evaluation: 25 Marks	Semester End Exam: 75 Marks
Pre requisites: Power electronics	

Course Objectives:

1. To expose students to operation and characteristics of power semiconductor devices and passive components, their practical application in power electronics.
2. To provide a practical exposure to operating principles, design and synthesis of different power electronic converters.
3. To introduce students to industrial control of power electronic circuits as well as safe electrical connection and measurement practices.

COURSE OUTCOMES:

CO#	Course Outcomes
CO1	Analyze and test the power semiconductor devices and their applications.
CO2	Compare and contrast various power semiconductor devices according to their applications.

List of Experiments

1. Study of DC-DC non-isolated converters such as Buck & Boost converter
2. Study of DC-DC Buck-Boost and Cuk converters.
3. Study of 1-ϕ dual converter.
4. Determination of input p.f. and harmonic factor for 1-ϕsemi- converter and 1-ϕ fullconverter (Inductive load)
5. Study of p.f. improvement in 1-ϕ full-converter with symmetric and extinction angle control..
6. Study of 1-ϕ square wave and sinusoidal PWM inverter
7. Study of 3-ϕ inverter with 120o and 180o mode of operation. 8 Study of 3-ϕ sinusoidal PWM inverter.
9. Study of 3-level NPC inverter
10. Study of 5-level cascaded H-bridge inverter.
11. Determination of input p.f. and harmonic factor for 3-ϕ full converter .
12. Determination of input p.f. and harmonic factor for 3-ϕ semi converter
13. Study the characteristics of IGBT, MOSFET & GTO‟s.
14. Design of gate drive circuits for IGBT & MOSFET‟s.

Exercise Problems

1. Study of DC – DC Converters
2. Study of 1-phase Dual converter
3. Study of 3-level NPC Inverter
4. Study of 5-level cascaded H-bridge Inverter

RESEARCH METHODOLOGY AND IPR
I M.TECH- I SEMESTER

Course Title: Research Methodology And IPR	Course Code: 24MTMC01
Teaching Scheme (L:T:P): 2:0:0	Credits: 2
Type of Course: Lecture	
Continuous Internal Evaluation: 25 Marks	Semester End Exam: 75 Marks
Pre requisites:	

SYLLABUS

UNIT– I

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

UNIT– II

Effective literature studies approaches, analysis Plagiarism, Research ethics, Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

UNIT – III:

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT- IV:

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

UNIT-V:

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

REFERENCE BOOKS:

1.Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'"

2.Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"

3. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners

4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd,2007.

5. .Mayall, "Industrial Design", McGraw Hill, 1992.

ENGLISH FOR RESEARCH PAPER WRITING
I M.TECH- I SEMESTER

Course Title: English For Research Paper Writing	Course Code: 24MTAC01.1
Teaching Scheme (L:T:P): 2:0:0	Credits: 0
Type of Course: Lecture	
Continuous Internal Evaluation: 0	Semester End Exam:0
Pre requisites:	

Course objectives:

1. Understand that how to improve your writing skills and level of readability
2. Learn about what to write in each section
3. Understand the skills needed when writing a Title Ensure the good quality of paper at very first time submission

COURSE CONTENT (SYLLABUS)

Unit-1

Planning and Preparation, Word Order, breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

Unit-2

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction

Unit-3

Review of the Literature, Methods, Results, Discussion,Conclusions, The Final Check.

Unit-4

key skills are needed when writing a Title, key skills are neededwhen writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature.

Unit -5

skills are needed when writing the Methods, skills needed whenwriting the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions, useful phrases, how to ensure paper is as good as it could possibly be the first- time submission

Suggested Studies:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on GoogleBooks)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM.Highman‟sbook .
4. Adrian Wallwork , English for Writing Research Papers, Springer New York DordrechtHeidelberg London, 2011

DISASTER MANAGEMENT
I M.TECH- I SEMESTER

Course Title: Disaster Management	Course Code: 24MTAC01.2
Teaching Scheme (L:T:P): 2:0:0	Credits: 0
Type of Course: Lecture	
Continuous Internal Evaluation: 0	Semester End Exam: 0
Pre requisites:	

Course Objectives: -

Students will be able to:

- learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in.

COURSE CONTENT (SYLLABUS)

Unit-1: Introduction, Disaster:

Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude.

Unit-2: Repercussions Of Disasters and Hazards:

Economic Damage, Loss of Human and Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man- made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

Unit-3: Disaster Prone Areas In India Study Of Seismic Zones:

Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics .

Unit-4: Disaster Preparedness and Management Preparedness:

Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.

Unit-5 : Risk Assessment & Disaster Mitigation

Disaster Risk: Concept And Elements, Disaster Risk Reduction, Global And National Disaster Risk Situation. Techniques Of Risk Assessment, Global Co-Operation In Risk Assessment And Warning, People‟s Participation In Risk Assessment. Strategies for Survival. Meaning,

Concept and Strategies of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation In India.

References:

1.R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies ""New Royal book Company.
2.Sahni, PardeepEt.Al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi.
3.Goel S. L. , Disaster Administration And Management Text And Case Studies" ,Deep &Deep Publication Pvt. Ltd., New Delhi.

Advanced Power Electronic Converters – II
I M.TECH- II SEMESTER

Course Title: Advanced Power Electronic Converters-II	Course Code: 2443PC05
Teaching Scheme (L:T:P): 3:0:0	Credits: 3
Type of Course: Lecture	
Continuous Internal Evaluation: 25 Marks	Semester End Exam: 75 Marks
Pre requisites: Power electronics	

COURSE OBJECTIVES:

1. To comprehend the concepts of different power converters and their applications
2. To analyze and design switched mode regulators for various industrial applications.
3. To develop resonant power converters with better performance.

COURSE OUTCOMES:

CO#	Course Outcomes
CO1	Select an appropriate power semiconductor device and design a power converter for the required application
CO2	Model existing and modified power converters based on real time applications
CO3	Analyze and design power Converters and feedback loops
CO4	analyze, apply and optimize the modulation schemes for single-phase and three phases switch-mode DC/DC and DC/AC power electronic converters.
CO5	Model and simulate the electrical, thermal and electromagnetic performance of power electronic systems Using advanced software tools

COURSE CONTENT (SYLLABUS)

UNIT -I: **Non-Isolated D.C. To D.C. Converters**

Analysis of step-down and step-up dc to dc converters with Resistive and Resistive-Inductive loads, Switched mode regulators, Analysis of Buck Regulators, Boost regulators, Buck and boost regulators, Cuk regulators, Condition for continuous inductor current and capacitor voltage, Comparison of regulators, Multi output boost converters, Advantages, Applications, Problems, State space analysis of regulators.

Self-Learning Topics: Choppers

UNIT-II: **Isolated D.C. To D.C. Converters**

Classification, switched mode dc power supplies, Fly back Converter, Forward converter, Push-pull converter, Half bridge converter, Full bridge converter, Control circuits, Magnetic design considerations, Applications.

Self-Learning Topics: converters

UNIT-III: **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, Parallel resonant, Series loaded, Parallel loaded, Series and Parallel loaded inverters,

Voltage control of resonant inverters, Class-E resonant inverter, Class-E resonant rectifier, Evaluation of values of 'C' and 'L' for Class-E inverter and Class-E rectifier, Numerical problems..

Self-Learning Topics: Inverters

UNIT-IV: **Zcs &Zvs Resonant Converters**

Resonant converters, zero current switching resonant converters, L-type and 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 currents witching inverter ,Numerical problems.

Self-Learning Topics: Resonance

UNIT-V: **Powerconditioners**

Power line disturbances, Power conditioners ,Uninterruptible Power supplies ,Applications

Advancedconverters

Principle of operation of SEPIC converter, Matrix Converter, Luo Converter ,Interleaved Converter.

Self-Learning Topics: Converters

TEXT BOOKS:

1. MohammedH.Rashid,"PowerElectronics",PearsonEducation,3rdEdition,1stIndianrepri nt,2004.
2. Ned Mohan Tore M. Undeland and William P. Robbins, "Power Electronics", John Wiley &Sons,2nd Edition.

REFERENCE BOOKS:

1. Milliman Shepherdand Lizang, "Power converters circuits", Chapter14(Matrix converter)pp.415-444.
2. M. H .Rashid," Power Electronics Hand Book".
3. Marian P .Kaźmierkowski, RamuKrishnan,FredeBlabjergEdition,"ControlinPowerElectronics",PublishedbyAcademicPress,20 02.

ONLINE RESOURCES:

1. **https://archive.nptel.ac.in/courses/108/107/108107128/**

POWER ELECTRONIC CONTROL OF ELECTRICAL DRIVES
I M.TECH- II SEMESTER

Course Title: Power Electronic Control Of Electrical Drives	Course Code: 2443PC06
Teaching Scheme (L:T:P): 3:0:0	Credits: 3
Type of Course: Lecture	
Continuous Internal Evaluation: 25 Marks	Semester End Exam: 75 Marks
Pre requisites: power electronic, power semiconductor drives, electric motors	

COURSE OBJECTIVES:

- To familiarize with advanced control schemes for induction motor drives and control techniquesfor PMSM, BLDC and SRM drives

COURSE OUTCOMES:

CO#	Course Outcomes
CO1	Understand the concepts of scalarand vector control methods for drivesystems
CO2	Analyze and designcontrollers and converters for induction motor, PMSM and BLDC drives.
CO3	Select and implement proper control techniques for induction motorand PMSM for specific applications
CO4	Analyze and designcontrol techniques and converters for SRM drives.

COURSE CONTENT (SYLLABUS)

UNIT -I:
Vector Control of Induction Motor Drive: Principle of scalar and vector control, direct vector control, indirect vector control, rotor flux oriented control, stator flux oriented control, air gap flux oriented control,decoupling circuits.
Self-Learning Topics: ac machines,power electronics

UNIT-II:
Sensor less Control of induction Motor Drive: Advantages of speed sensor less control, voltage current based speed sensor less control, MRAS-model reference adaptive systems, Extended Kalman filter observers.
Self-Learning Topics: power electronics

UNIT-III:
Direct Torque Control of Induction Motor Drive: Principle of Direct torque control (DTC), concept of space vectors, DTC control strategy of induction motor, comparison between vector control and DTC, applications, space vector modulation based DTC of induction motors.
Self-Learning Topics: induction motors

UNIT-IV:
Control of Permanent Magnet Synchronous Machines (PMSM) and Brushless DC (BLDC) Motor Drives: Advantages and limitations of Permanent magnet machines, operating principle of PMSM,

modeling of PMSM, operating principle of BLDC, modeling of BLDC, similarities and difference between PMSM and BLDC, need for position sensing in BLDC motors, control strategies for PMSM and BLDC, methods of reducing torque ripples of BLDC motor.

Self-Learning Topics: synchronous machines

UNIT-V:

Control of Switched Reluctance Motor (SRM) Drive: SRM structure, Merits and limitations, stator excitation, converter topologies, SRM waveforms, Torque control schemes, speed control of SRM, torque ripple minimization, instantaneous-torque control using current controllers and flux controllers

Self-Learning Topics: reluctance motor

TEXT BOOKS:

- Bose B. K., "Power Electronics and Variable Frequency Drives",IEEE Press, Standard PublisherDistributors. 2001.
- Krishnan R., "Electric Motor Drives – Modeling, Analysis and Control", Prentice Hall of IndiaPrivate Limited.

REFERENCE BOOKS:

- Switched Reluctance Motors and Their Control-T. J. E. Miller, Magna Physics, 1993.
- Power electronic converters applications and design-Mohan, Undeland, Robbins-Wiley publication

POWER ELECTRONICS FOR RENEWABLE ENERGY SYSTEMS

I M.TECH- II SEMESTER

Course Title: power electronics for renewable energy systems	Course Code: 2443PE03.1
Teaching Scheme (L:T:P): 3:0:0	Credits: 3
Type of Course: Lecture	
Continuous Internal Evaluation: 25 Marks	Semester End Exam: 75 Marks
Pre requisites: power electronics	

COURSE OBJECTIVES:

The objectives of this course are to

1. To impart knowledge on different types of renewable energy systems.
2. To analyze the operation of electrical generators used for the wind energy conversion Systems.
3. To know the operation of AC-DC, DC-DC and AC-AC power converters used in renewable Energy systems.
4. To know the principles of standalone, grid connected and hybrid operation in renewable energy systems.

COURSE OUTCOMES:

CO#	Course Outcomes
CO1	Demonstrate the various types of renewable energy technologies that are used to harness electrical power.
CO2	Demonstrate the operating principle and analysis of various types of Wind generators
CO3	Identify a suitable converter such as AC-DC, DC-DC and AC-AC converters for renewable energy systems
CO4	Demonstrate and analyze the various types of wind and PV systems
CO5	Interpret the stand alone, grid connected and hybrid renewable energy systems

COURSE CONTENT (SYLLABUS)

UNIT -I:

Solar cell characteristics and their measurement, PV Module, PV array, Partial shading of a solar cell and a module, The diode, Power conditioning unit, maximum power point tracker, Implementation of Perturb and Observe Method, Incremental Conductance Method, Battery charger/discharge controller.

Self-Learning Topics: Batteries and Cells

UNIT-II:

Centralized Inverters, String Inverters, Multi-string Inverters, Module Integrated Inverter/Micro inverters, Inverter Topology, Model of Inverter, Sizing Batteries and Inverters for a Solar PV System.Types of PV Systems: Grid-Connected Solar PV System, Stand-Alone Solar PV System.

Self-Learning Topics: Solor System

UNIT-III:
Introduction to wind: Characteristics, Wind Turbine, Fixed and Variable-Speed Wind Turbines, Components of WECS, Description of Components, Types of Wind Turbine Generators, Economics of Wind Energy Conversion Systems, Linking Wind Turbines onto the Grid, Power Converter Topologies for Wind Turbine Generators.
Self-Learning Topics: Turbines

UNIT-IV:
Introduction to wind: Characteristics, Wind Turbine, Fixed and Variable-Speed Wind Turbines, Components of WECS, Description of Components, Types of Wind Turbine Generators, Economics of Wind Energy Conversion Systems, Linking Wind Turbines onto the Grid, Power Converter Topologies for Wind Turbine Generators.
Self-Learning Topics: Turbines

UNIT-V:
Hybrid Energy Systems, Need for Hybrid Energy Systems, Range and types of Hybrid systems, Hybrid Solar PV/Wind Energy System, Architecture of Solar-Wind Hybrid System and Grid connected issues.
Self-Learning Topics: Hybrid Systems

TEXT BOOKS:
1. S. N. Bhadra, D.Kastha, S.Banerjee, "Wind Electrical Systems", Oxford University Press, 2005.

REFERENCE BOOKS:
1. S.N.Bhadra, D. Kastha, & S. Banerjee "Wind Electrical Systems", Oxford University Press, 2009. 2. Rashid .M. H, "Power Electronics Hand book", Academic Press, 2001.
3. Rai. G.D, "Non-conventional energy sources", Khanna Publishers, 1993.
4. Rai. G.D," Solar energy utilization", Khanna Publishes, 1993.
5. Gray, L. Johnson, "Wind energy system", Prentice Hall of India, 1995.
6. B.H.Khan "Non-conventional Energy sources", Mc Graw-hill, 2nd Edition, 2009.

ONLINE RESOURCES:
1. https://archive.nptel.ac.in/courses/108/107/108107128/

ELECTRIC VEHICLES AND DESIGN

I M.TECH- II SEMESTER

Course Title: electric vehicles and design	Course Code: 2443PE03.2
Teaching Scheme (L:T:P): 3:0:0	Credits: 3
Type of Course: Lecture	
Continuous Internal Evaluation: 25 Marks	Semester End Exam: 75 Marks
Pre requisites: Electric drives, power electronics and power generation	

COURSE OBJECTIVES:

The objectives of this course are to

1. To understand the fundamental concepts, principles, analysis and design of hybrid and electric vehicles.
2. To know the various aspects of hybrid and electric drive train such as their configuration, types of electric machines that can be used energy storage devices, etc.

COURSE OUTCOMES:

CO#	Course Outcomes
CO1	Understand the models to describe hybrid vehicles and their performance
CO2	Understand the different possible ways of energy storage
CO3	Understand the different strategies related to energy storage systems
CO4	Know different batteries and other energy storage systems
CO5	Understand the Energy management strategies

COURSE CONTENT (SYLLABUS)

UNIT -I: **Conventional Vehicles**

Basics of vehicle performance, Vehicle power source characterization, Transmission characteristics, Mathematical models to describe vehicle performance.

Self-Learning Topics: Vehicle Performance

UNIT-II: **Introduction To Hybrid Electric Vehicles**

History of hybrid and electric vehicles, Social and environmental importance of hybrid and electric vehicles, Impact of modern drive-trains on energy supplies. Hybrid Electric Drive-Trains: Basic concept of hybrid traction, Introduction to various hybrid drive-train topologies, Power flow control in hybrid drive-train topologies, Fuel efficiency analysis .

Self-Learning Topics: Electric Vehicles

UNIT-III: **Electric Trains**

Electric Drive-Trains: Basic concept of electric traction, introduction to various electric drive train topologies, Power flow control in electric drive-train topologies, Fuel efficiency analysis. Electric Propulsion Unit: Introduction to electric components used in hybrid and electric vehicles,Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives,Configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, Drive system efficiency.

Self-Learning Topics: Power Grid

UNIT-IV: **Energy Storage**

Energy Storage: Introduction to Energy Storage, Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices. Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, Sizing the power electronics, selecting the energy storage technology, Communications, Supporting subsystems

Self-Learning Topics: power electronics

UNIT-V: **Energy Management Strategies**

Energy Management Strategies: Introduction to energy management strategies used in hybrid and Electric vehicles, Classification of different energy management strategies, Comparison of different energy Management strategies ,Implementation issues of energy management strategies. Case Studies: Design of a Hybrid Electric Vehicle (HEV), Design of a Battery Electric Vehicle (BEV).

Self-Learning Topics: power generation

TEXT BOOKS:

1. C. Mi, M. A. Masrur and D. W. Gao, "Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives", John Wiley & Sons, 2011.
2. S. Onori, L. Serrao and G. Rizzoni, "Hybrid Electric Vehicles: Energy Management Strategies", Springer, 2015.

REFERENCE BOOKS:

1. M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design", CRC Press, 2004
2.T. Denton, "Electric and Hybrid Vehicles", Routledge, 2016.

ONLINE RESOURCES:

(PDF) Control of Renewable Energy Systems (researchgate.net)

DIGITAL CONTROL SYSTEMS
I M.TECH- II SEMESTER

Course Title: Digital Control System	Course Code: 2443PE03.3
Teaching Scheme (L:T:P): 3:0:0	Credits: 3
Type of Course: Lecture	
Continuous Internal Evaluation: 25 Marks	Semester End Exam: 75 Marks
Pre requisites: Fourier analysis, Laplace transformers	

COURSE OBJECTIVES:

The objectives of this course are to

1. To understand fundamentals of digital circuits and devices using Z-transforms and Inverse Z Transforms
2. To understand the controllability and observability in digital domain
3. To understand the stability and controller design in digital domain
4. To understand the design an observer
5. To understand the solving of a given optimal control problem

COURSE OUTCOMES:

CO#	Course Outcomes
CO1	Analyze digital control systems using Z- transforms and Inverse Z-Transforms
CO2	Evaluate the state transition matrix and solve state equation for discrete model for continuous time systems,investigate the controllability andobservability
CO3	Determine the stability;design state feedback controller.
CO4	Design an observer
CO5	Solve a given optimal control problem

COURSE CONTENT (SYLLABUS)

UNIT -I: **Introduction :**

Introduction to analog and digital control systems – Advantages of digital systems – Typical examples– Sample and hold devices – Sampling theorem and data reconstruction-Transfer functions and frequency domain characteristics of zero order hold and first order hold. Review of Z–transforms and Inverse Z– transforms- solving differential equations. Mapping between the S–Plane and the Z–Plane – Primary strips and Complementary Strips

Self-Learning Topics: Z Transforms

UNIT-II: **State space analysis and the concepts of Controllability and observability :**

State space analysis and the concepts of Controllability and observability :

State Space Representation of discrete time systems – State transition matrix properties and evaluation – Solution of state equations- Discretization of continuous-time state equations – controllability and observability – concepts, conditions and tests, Principle of duality.

Self-Learning Topics: Matrix

UNIT-III:**Stability Analysis and Controller Design** :

Stability criterion – Modified Routh‟s stability criterion and Jury‟s stability test, Lyapunov‟s stability analysis. Design of state feedback controller through pole placement techniques, Necessary and sufficient conditions, Ackermann‟s formula, controller for deadbeat response, control system with reference input, Design of full order observer-reduced order observer.

Self-Learning Topics: Control Systems

UNIT-IV:**State Observer:**

Necessary and sufficient condition for state observation-Full order state observer- error dynamics – design of prediction observers- Ackermann‟s formula-effect of the addition of observer on closed loop system-Current observer- minimum order observer observed – state feedback control system with minimum order observer -control system with reference input.

Self-Learning Topics: Control Systems

UNIT-V:**Quadratic Optimal Control Systems :**

Quadratic optimal control problems-Solution by minimization method using Lagrange multipliersEvolution of the minimum performance index – discretize quadratic optimal control – Steady state Riccati equations-Lyapunov approaches to the solution of the Steady state quadratic optimal regulator problem and optimal control problem - Quadratic optimal control of a servo system

Self-Learning Topics: Control Systems

TEXT BOOKS:

1. Discrete–Time Control systems – K. Ogata, Pearson Education/PHI, 2nd Edition.
2. B. C. Kuo, “Digital control systems”- Holt Saunder‟s International Edition, 1991.

REFERENCE BOOKS:

1. M. Gopal: Digital control engineering, New Age Int. Ltd., India, 1998.
2. K. Ogata, “Modern control engineering”- PHI, 1991.

ONLINE RESOURCES:

1. **NPTELECE4540/5540: Digital Control Systems (uccs.edu)**

ADVANCED DIGITAL SIGNAL PROCESSING
I M.TECH- IISEMESTER

Course Title: Advanced Digital Signal Processing	Course Code: 2443PE04.1
Teaching Scheme (L:T:P): 3:0:0	Credits: 3
Type of Course: Lecture	
Continuous Internal Evaluation: 25 Marks	Semester End Exam: 75 Marks
Pre requisites: Fourier transforms and filters	

COURSE OBJECTIVES:

The objectives of this course are to

1. To understand the various digital filter structures
2. To design the FIR and IIR Filters
3. To know the importance of FFT algorithm for computation of Discrete Fourier Transform
4. To analyze the finite word length effects on various filters
5. To learn the concepts of power spectrum estimation of periodic and non-periodic signals

COURSE OUTCOMES:

CO#	Course Outcomes
CO1	Describe structure of digital filters
CO2	To design the FIR and IIR Filters
CO3	To know the importance ofFFT algorithm for computation of Discrete Fourier Transform.
CO4	To analyze the finite word length effects onvarious filters
CO5	To learn the conceptsof power spectrum estimation of periodic and non-periodic signals

COURSE CONTENT (SYLLABUS)

UNIT -I: **Digital Filter Structure**

Block diagram representation-Equivalent Structures-FIR and IIR digital filter Structures All pass Filters- tunable IIR Digital Filters-IIR tapped cascaded Lattice Structures-FIR cascaded Lattice structures-Parallel- Digital Sine-cosine generator-Computational complexity of digital filter structures.

Self-Learning Topics: Filters

UNIT-II: **Digital filter design**

Preliminary considerations-Bilinear transformation method of IIR filter design design of lowpass, 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 – meansquare-error-constrainedleast-square design of FIR digital filters

Self-Learning Topics: Filters

UNIT-III: **DSP algorithm implementation**

Computation of the discrete Fourier transform- number representation arithmetic operations handling ofoverflow-tunable digital filters-function approximation.

Self-Learning Topics: Fourier transforms

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 filters, Round-off errors in FFT Algorithms.

Self-Learning Topics: Filters

UNIT-V: **Power Spectrum Estimation**

Estimation of spectra from finite duration observations signals – Nonparametric 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 & torchy method.

Self-Learning Topics: Fundamentals of Signals and Systems

TEXT BOOKS:

1. Digital signal processing-Sanjit K. Mitra-TMH second edition, 2002.
2. Discrete Time Signal Processing – Alan V.Oppenheim, Ronald W.Shafer - PHI-1996 1st edition9threprint

REFERENCE BOOKS:

1. Digital Signal Processing and principles, algorithms and Applications – John G.Proakis -PHI –3rdedition-2002.
2. Digital Signal Processing – S.Salivahanan, A.Vallavaraj, C. Gnanapriya – TMH - 2 nd reprint-2001
3. Theory and Applications of Digital Signal Proceesing-LourensR. Rebinar&Bernold.
4. Digital Filter Analysis and Design- Auntonian-TMH..

ONLINE RESOURCES:

1.**https://onlinecourses.nptel.ac.in/noc2_ee20/preview**

2. https://onlinecourses.nptel.ac.in/noc24_ee76/preview

APPLICATIONS OF POWER CONVERTERS
I M.TECH- IISEMESTER

Course Title: **Applications Of Power Converters**	Course Code: 2443PE04.2
Teaching Scheme (L:T:P): 3:0:0	Credits: 3
Type of Course: Lecture	
Continuous Internal Evaluation: 25 Marks	Semester End Exam: 75 Marks
Pre requisites: power electronics and micro processor	

COURSE OBJECTIVES:

1. To understand the inverters for induction heating applications
2. To understand the power converters for different industrial applications
3. To understand modeling of high voltage power supplies using the power converters for radar and spaceapplications
4. To understand modeling of low voltage and high current power supplies using the power converters formicroprocessors and computer loads
5. To understand the applications of DC-DC converters

COURSE OUTCOMES:

CO#	Course Outcomes
CO1	Analyze power electronic application requirements
CO2	Identify suitable powerconverter from the available configurations
CO3	Develop improved power converters for any stringent application requirements
CO4	Improvise the existingcontrol techniques to suit the application
CO5	Design of Bi-directionalconverter for charge/discharge applications

COURSE CONTENT (SYLLABUS)

UNIT– I: Inverters for Induction Heating:
For induction cooking, induction hardening, melting, and welding applications.
Self-Learning Topics: Inverters

UNIT– I: Power Converters for Lighting, pumping and refrigeration Systems
Electronic ballast, LED power drivers for indoor and outdoor applications. PFC based grid fed LED drivers,PV / battery fed LED drivers. PV fed power supplies for pumping/refrigeration applications
Self-Learning Topics: Power Converters

UNIT– III: High Voltage Power Supplies
Power supplies for X-ray applications - power supplies for radar applications - power supplies for spaceapplications.
Self-Learning Topics: High Voltage Power Supplies

UNIT-IV: Low voltage high current power supplies:
Power converters for modern microprocessor and computer loads
Self-Learning Topics: microprocessor

UNIT– V: Bi-directional DC-DC (BDC) converters:
Electric traction, automotive Electronics and charge/discharge applications, Line Conditioners and SolarCharge Controllers.
Self-Learning Topics: Different types of converters

Text Books

1. Ali Emadi, A. Nasiri, and S. B. Bekiarov: Uninterruptible Power Supplies and Active Filters, CRCPress, 2005.
2. M. Ehsani, Y. Gao, E. G. Sebastien and A. Emadi: Modern Electric, Hybrid Electric and Fuel CellVehicles, 1st Edition,CRC Press, 2004.

Reference Books:

1. William Ribbens: Understanding Automotive Electronics, Newnes, 2003.
2. Current literature

Web Resources:

1. **https://onlinecourses.nptel.ac.in/noc22_ee33/preview**
2. **https://onlinecourses.nptel.ac.in/noc24_ee130/preview**

MICROCONTROLLER APPLICATIONS TO POWER ELECTRONICS
I M.TECH- IISEMESTER

Course Title: Microcontroller Applications To Power Electronics	Course Code: 2443PE04.3
Teaching Scheme (L:T:P): 3:0:0	Credits: 3
Type of Course: Lecture	
Continuous Internal Evaluation: 25 Marks	Semester End Exam: 75 Marks
Pre requisites: power electronics, micro controllers	

COURSE OBJECTIVES:

1.To study the internal structure and operation of PIC 16F876 microcontroller and 8051 Microcontrollers

2.To know assembly language program for the generation of firing and control signals employingThese microcontrollers..

3.Study the internal structure and operation of PIC 16F876 microcontroller and 8051 microcontroller; assembly language program for the generation of firing and control signals employing these microcontrollers

COURSE OUTCOMES:

CO#	Course Outcomes
CO1	Understand the architecture of8051 and 16F876 microcontrollers
CO2	Develop assembly language programs employing 8051 & 16F876 microcontrollers.
CO3	Analyze the microcontroller programming using MPLAB anddevelop typical programs for power converter applications
CO4	Develop interfacing to real worlddevices.
CO5	Learn use of hardware &software tools.

COURSE CONTENT (SYLLABUS)

UNIT– I:8051 microcontrollers:

Architecture, Addressing modes, I/O ports, Instruction sets, Simple assembly language programming.

Self-Learning Topics: Architecture of 8051

UNIT– II

Use of microcontrollers for pulse generation in power converters, Overview of Zero-Crossing Detectors,Typical firing/gate-drive circuits, Firing/gate pulses for typical single-phase and three-phase power converters.

Self-Learning Topics: Gate Drive Circuits

UNIT – III: PIC16F876 Micro-controller:

Device overview, Pin diagrams, Memory organization, Special FunctionRegisters, I/O ports, Timers, Capture/ Compare/ PWM modules (CCP).

Self-Learning Topics: Pin Diagram

UNIT- IV:

Analog to Digital Converter module, Instruction set, Instruction description, Introduction to PIC microcontroller programming, Oscillator selection, Reset, Interrupts, Watch dog timer.

Self-Learning Topics: A/D Converter Module

UNIT-V:

Introduction to MPLAB IDE and PICSTART plus, Device Programming using MPLAB and PICSTARTplus, Generation of firing / gating pulses for typical power converters.

Self-Learning Topics: Gating Pulses of Power Converters

TEXTBOOKS:

1. S. N. Bhadra, D.Kastha, S.Banerjee, "Wind Electrical Systems", Oxford University Press, 2005.
2. B.H.Khan, "Non-conventional Energy sources", Tata McGraw-hill Publishing Company, NewDelhi, 2009.

REFERENCES:

1. Rashid .M. H, "Power electronics Hand book", Academic press, 2001.
2. Ion Boldea, "Variable speed generators", Taylor & Francis group, 2006.
3. Rai. G.D, "Non-conventional energy sources", Khanna Publishes, 1993.
4. Gray, L. Johnson, "Wind energy system", Prentice Hall linc, 1995.
5. Andrzej M. Trzynnadlowski, "Introduction to Modern Power Electronics", 2ndEdition, Wiley India Pvt. Ltd, 2012.

WEB REFERENCES:

https://archive.nptel.ac.in/courses/108/107/108107128/

ELECTRIC DRIVES SIMULATION LABORATORY
I M.TECH- IISEMESTER

Course Title*:* Electric Drives Simulation Laboratory	Course Code: 2443PC07
Teaching Scheme (L:T:P): 0:0:4	Credits: 2
Type of Course:Practical	
Continuous Internal Evaluation: 25 Marks	Semester End Exam: 75 Marks
Pre requisites: electric drives	

COURSE OBJECTIVES:

The student should be able to understand the simulate different electrical machines and drives

COURSE OUTCOMES:

CO#	Course Outcomes
CO1	The student should be able to understand the simulate differentelectrical machines and drives

List of Experiments

1. Simulation of DC shunt machine as motor & generator.
2. Simulate the speed control of DC motor using chopper converter.
3. Simulation of induction motor modes using d-q model.
4. Simulate the speed control of induction motor by using V/f control.
5. Simulate the BLDC motor and observe the speed transients.
6. Simulate speed control of induction motor by using vector control.
7. Compare the transient performance of induction motor controlled by v/f control & vector controlmethods.
8. Simulate PMSM motor by using d-q model.
9. Simulate the multi-level inverter fed induction motor drive.
10. Simulate the re-generative braking of inverter fed induction motor.
11. Study of PWM controlled inverter fed PMSM drive.
12. Evaluation of switching frequency effect on electric drive**.**

NOTE: Any 10 of the following experiments are to be conducted.

Exercise Problems

1. Explain briefly about Fundamentals of torque equation?
2. What are the different types of torque that involved in drive system?
3. Derive the expression for torque equation in electrical drives.
4. Describe briefly about multi quadrant operation of drives.
5. Derive the expression for torque in multi-quadrant drive system.

ELECTRIC DRIVES LABORATORY
I M.TECH- IISEMESTER

Course Title: Electric Drives Laboratory	Course Code: 2443PC08
Teaching Scheme (L:T:P): 0:0:4	Credits: 2
Type of Course: Practical	
Continuous Internal Evaluation: 25 Marks	Semester End Exam: 75 Marks
Pre requisites: Electric drives	

COURSE OBJECTIVES:

To study the speed control methods of DC & AC drives.

COURSE OUTCOMES:

CO#	Course Outcomes
CO1	The student should be able to understand the different electricalmachines and drives

List of Experiments:

1. Study of armature controlled separately excited DC drive with 1-ϕ full converter.
2. Study of chopper controlled separately excited DC drive
3. Study of armature controlled separately excited DC drive with 3-ϕ full converter
4. Study of dynamic braking of DC drives.
5. Study of regenerative braking of DC drive.
6. Study of performance characteristics of a 3-ϕ induction motor using V/f control.
7. Vector control based speed control of induction motor.
8. Study of direct torque control of induction motor.
9. Speed control of PMSM drive with 3-ϕ inverter.
10. Speed control of BLDC drive with 3-ϕ inverter.
11. Speed control of switched reluctance motor drive.

NOTE: Any 10 of the following experiments are to be conducted.

Exercise Problems:

1. Explain briefly about Fundamentals of torque equation?
2. What are the different types of torque that involved in drive system?
3. Derive the expression for torque equation in electrical drives.
4. Describe briefly about multi quadrant operation of drives.
5. Derive the expression for torque in multi-quadrant drive system.
6. Explain four quadrant operation of motor drive system with hoist load.

MINI PROJECT WITH SEMINAR
I M.TECH- IISEMESTER

Course Title: MINI PROJECT	Course Code: 2443PR01
Teaching Scheme (L:T:P): 3:0:0	Credits: 2
Type of Course: Lecture	
Continuous Internal Evaluation: 100 Marks	Semester End Exam: 70 Marks
Pre requisites:	

Syllabus Contents

The students are required to search / gather the material / information on a specific a topic comprehend it and present / discuss in the class.

Course Outcomes

At the end of this course, students will be able to

1. Understand of contemporary / emerging technology for various processes and systems.
2. Share knowledge effectively in oral and written form and formulate documents

CONSTITUTION OF INDIA
I M.TECH- IISEMESTER

Course Title: CONSTITUTION OF INDIA	Course Code: 24MTAC02.1
Teaching Scheme (L:T:P): 2:0:0	Credits: 0
Type of Course: Lecture	
Continuous Internal Evaluation: 0	Semester End Exam: 0
Pre requisites:	

Course Objectives:

Students will be able to:

1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. To address the growth of Indian opinion regarding modern Indian intellectuals" constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
3. To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

COURSE OUTCOMES:

CO#	Course Outcomes
CO1	Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
CO2	Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
CO3	circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
CO4	Discuss the passage of the Hindu Code Bill of 1956.

COURSE CONTENT (SYLLABUS)

UNIT-I:

History of Making of the Indian Constitution: History, Drafting Committee,(Composition & Working)

UNIT-2:

Philosophy of the Indian Constitution, Preamble Salient Features

Contours of Constitutional Rights & Duties: Fundamental Rights Right to Equality Right to Freedom. Right against Exploitation Right to Freedom of Religion Cultural and Educational Rights. Right to Constitutional Remedies Directive Principles of State Policy Fundamental Duties.

Unit-3

Organs of Governance:

Parliament Composition, Qualifications and Disqualifications Powers and Functions Executive President Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications Powers and Functions.

Unit-4

Local Administration:

District‟s Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CE of Municipal Corporation. Pachayati raj: Introduction, PRI: ZilaPachayat. Elected officials and their roles, CEO ZilaPachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy

Unit-5

Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.

References:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

VALUE EDUCATION
I M.TECH- IISEMESTER

Course Title: Value Education	Course Code: 24MTAC02.2
Teaching Scheme (L:T:P): 2:0:0	Credits: 0
Type of Course: Lecture	
Continuous Internal Evaluation: 0	Semester End Exam: 0
Pre requisites:	

COURSE OBJECTIVES:

Students will be able to

1. Understand value of education and self- development
2. Imbibe good values in students
3. Let the should know about the importance of character

COURSE OUTCOMES:

CO#	Course Outcomes
CO1	Knowledge of self-development
CO2	Learn the importance of Human values
CO3	Developing the overall personality

COURSE CONTENT (SYLLABUS)

Unit-1:Values and self-development

Social values and individual attitudes. Work ethics, Indian vision of humanism, Moral and non-moral valuation. Standards and principles, Value judgements.

Unit-2:Importance of cultivation of values.

Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness, Honesty, Humanity. Power of faith, National Unity, Patriotism, Love for nature ,Discipline.

Unit-3:Personality and Behavior Development

Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness, Avoid fault Thinking, Free from anger, Dignity of labor, Universal brotherhood and religious tolerance, True friendship, Happiness Vs suffering, love for truth, Aware of self-destructive habits, Association and Cooperation, Doing best for saving nature. Character and Competence –Holy books vs Blind faith, Self-management and Good health, Science of reincarnation, Equality, Nonviolence ,Humility, Role of Women. All religions and same message.Mind your Mind, Self-control.Honesty, Studying effectively

1 Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press, New Delhi

AVANTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY
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(Approved by A.I.C.T.E., New Delhi & Permanently Affiliated to JNTU-GV, Vizianagaram)
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Department of ELECTRICAL AND ELECTRONICS ENGINEERING

Program: M.Tech- POWER ELECTRONICS **Regulation:R24**

III Semester- Course Structure

S.No	Category	Course Code	Course Title	Hours per Week			
				L	T	P	Credits
1	PE		Program Elective-V	3	0	0	3
		R2443PE05.1	i.Digital Signal Processing Controlled Drives				
		R2443PE05.2	ii.Smart Grid Technologies				
		R2443PE05.3	iii.Modeling & Simulation of Power Electronic Systems				
2	OE		Open Elective	3	0	0	3
		R24430E01.1	i. Industrial Safety				
		R24430E01.2	i. Energy Audit, Conservation & Management				
		R24430E01.3	Composite Materials				
3	DP	R2443DP01	Dissertation Phase-I (To Be Continued And Evaluated Next Semester)	0	0	20	10

Category	Courses	Credits
PE-Program Elective Courses	1	3
OE- Open Elective	1	3
Total	**2**	**6**

Department of ELECTRICAL AND ELECTRONICS ENGINEERING

Program: M.Tech- POWER ELECTRONICS **Regulation:R24**

IV Semester- Course Structure

S.No	Category	Course Code	CourseTitle	Hours per Week			
				L	T	P	Credits
1	DP	Dissertation	Dissertation phase-II	0	0	32	16

III-Semester	Digital Signal Processor Controlled Drives (Program Elective - V)	Category	L-T-P 3-0-0	Credits 3

Pre-requisite: Applications of Digital Signal Processors, Power Electronic control of Electrical Drives.

Course Objectives:

1. To study DSP controllers.
2. To learn coding in DSP‟s to control the electric drive speed.
3. To learn speed control methods for induction motor, PMSM, BLDC motors.

Course Outcomes:

CO1: Interface the DSP platform with sensors such as hall-effect voltage sensors

CO2: Use hall-effect current sensors, shaft encoder for data acquisition for motor drive applications

CO3: Scale and normalize the data to suit the requirements of the drive system

CO4: Exploit the architectural features of the DSP platform to design and implement

CO5: Use algorithms for the realization of controllers, Pulse Width Modulators and observers

Course Outcomes(COS)	Mapping with POs and PSOs												DoK
	PO1	PO2	PO3	PO4	PO5	PO6	PO 7	PO8	PO9	PO1 0	P011	PSO 1	
CO1	3	3	2	-	3	-	-	-	-	-	2	3	L3
CO2	3	3	2	-	3	-	-	-	-	-	2	3	L3
CO3	3	3	2	2	3	-	-	-	-	-	2	3	L3,L4
CO4	3	3	3	2	3	-	-	-	-	2	2	3	L3,L 4,L6
CO5	3	3	3	2	3	-	-	-	-	2	2	3	L6

SYLLABUS

UNIT-1 **(12 hours)**

Overview of TMS320LF2407 DSP controller: Review of Instruction Set, Interrupts, normalization and number formatting. **CO'S-CO1**

UNIT-2 **(12 hours)**

Clarke's and Park's transformations: Review of Clarke's and Park's transformation Implementation of Clarke's and Park's transformation using TMS320LF2407 DSP **CO'S-CO2**

UNIT-3 **(12 hours)**

Implementation of PWM Techniques for 3-Ph VSI: Implementation of Sine-triangle and SVPWM withTMS320LF2407 DSP using the concept of imaginary switching time **CO'S-CO3**

UNIT-4 **(12 hours)**

Control of BLDC Motor: Principle of operation with Drive control system, implementation of control system using TMS320LF2407 DSP CO'S-CO4,CO5

UNIT-5

Control of PMSM:Principle of operation with drive control system, implementation of vector control using TMS320 LF2407DSP CO'S-CO5

UNIT-6

Control of Induction Motor:Implementation offield oriented control for the speed control of Induction Motor using TMS320LF2407 DSP. CO'S-CO4,CO5

Text Books:

1.Hamid A. Toliyat: DSP Based Electromechanical Motion Control, 1st Edition, CRC Press, 2004

2.Ned Mohan, T.M. Undeland and William P. Robbins: Power Electronics: Converters, Applications, 3rd Edition, John Wiley & Sons, 2009

Reference:

Application Notes from the website of Texas Instruments.

III-Semester	SMART GRID TECHNOLOGIES (ELECTIVE–V)	CATEGORY	L-T-P 3 -0-0	CREDITS 3

Pre-requisite: Basic knowledge on smart concept communication protocols, renewable energy systems and electronic circuits.

Course Objectives:

1. To understand concept of smart grid and developments on smart grid.
2. To understand smart grid technologies and application of smart grid concept in hybrid electric vehicles etc.
3. To have knowledge on smart substations, feeder automation and application for monitoring and protection.

COURSE OUTCOMES:

CO1: Understand smart grids and analyze the smart grid policies and developments in smart grids.

CO2: Develop concepts of smart grid technologies in hybrid electrical vehicles etc.

CO3: Understand smart substations, feeder automation, GIS etc

CO4: Analyze micro grids and distributed generation systems.

CO5: Analyze the effect of power quality in smart grid and to understand latest developments in ICT for smart grid

Course Outcomes(Cos)	Mapping with POs and PSOs												DoK
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	P011	PSO1	
CO1	3	3	-	-	2	3	-	-	-	2	2	3	L2,L4
CO2	3	3	3	-	3	2	-	-	-	2	2	3	L3,L6
CO3	3	2	-	-	3	2	-	-	-	-	1	2	L2
CO4	3	3	2	-	2	3	-	-	-	-	2	3	L4
CO5	3	3	-	-	3	3	-	-	-	-	2	3	L2,L4

SYLLABUS

UNIT – 1 **(12 hours)**

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. CO'S-CO1

UNIT – 2 **(12 hours)**

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. CO'S-CO2

UNIT – 3 **(12 hours)**

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). CO'S-CO3

UNIT – 4 **(12 hours)**

Micro grids and Distributed Energy Resources: Concept of micro grid, need & applications of micro grid, formation of microgrid, Issues of interconnection, protection & control of microgrid. Plastic & Organic solar cells, Thin film solar cells, Variable speed wind generators, fuel cells, microturbines, Captive power plants, Integration of renewable energy sources. CO'S-CO4

UNIT – 5 **(12 hours)**

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), Neighbourhood Area Network (NAN), Wide Area Network (WAN)

CO'S-CO5

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

Reference Books:

1. JanakaEkanayake, Nick Jenkins, KithsiriLiyanage, Jianzhong Wu, AkihikoYokoyama, "Smart Grid: Technology and Applications", Wiley

2. Jean Claude Sabonnadière, NouredineHadjsaïd, "Smart Grids", Wiley Blackwell 19

3. Peter S. Fox Penner, "Smart Power: Climate Changes, the Smart Grid, and the Future of Electric Utilities", Island Press; 1 edition 8 Jun 2010

4. S. Chowdhury, S. P. Chowdhury, P. Crossley, "Microgrids and Active Distribution Networks." Institution of Engineering and Technology, 30 Jun 2009

5. Stuart Borlase, "Smart Grids (Power Engineering)", CRC Press

6. Andres Carvallo, John Cooper, "The Advanced Smart Grid: Edge Power Driving Sustainability: 1", Artech House Publishers July 2011

III-Semester	Modeling and Simulation of Power Electronic Systems (Program Elective–V)	Category	L-T-P 3 -0-0	Credits 3

Pre requisite: Analysis of Power Electronic Converters

Course Educational Objectives:

1. To learn the simulation techniques in Power Electronic Converters.
2. To learn the modeling the Power Electronic Converters.
3. To simulate control methods for Power Electronic Converters.

Course Outcomes:

CO1: Understand the simulation process, equation solvers, and challenges in simulating power electronic circuits.

CO2: Apply numerical methods (MNA, ST, Newton-Raphson) and transient simulation techniques (FE, BE, TRZ) to analyze circuit behavior.

CO3: Simulate power electronic converters like buck converters and assess the impact of practical issues such as ringing and global error.

CO4: Develop mathematical models of converters using switching function techniques and represent them in multiple reference frames (abc, αβ, dq).

CO5: Analyze and model switching converters using state space averaging and hybrid modeling techniques.

Course Outcomes(Cos)	Mapping with POs and PSOs												DoK
	PO1	PO 2	PO 3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	P011	PSO1	
CO1	3	-	-	-	2	-	-	-	-	-	2	-	L2
CO2	3	2	-	3	3	-	-	-	-	-	2	3	L3,l4
CO3	3	3	3	3	3	1	-	-	-	2	2	3	L3,L4
CO4	3	2	3	-	3	-	-	-	-	2	2	3	L3,L6
CO5	3	3	3	3	3	-	-	-	-	2	2	3	L4,L6

SYLLABUS

UNIT-1 Introduction: **(12 hours)**

Challenges in computer simulation - Simulation process - mechanics of simulation, Solution techniques for time domain analysis - Equation solvers, circuit-oriented simulators. CO'S-CO1

UNIT-2: Simulation Of Power Electrnic Converters: **(15hours)**

MNA and ST Approaches- Nodal Analysis, Modified Nodal nalysis, The Spare Tableau Approach, Nonlinear Circuits - The Newton- Raphson Method, Computation Time, Convergence Issues, Nonlinear Circuit Equations, Introduction to Transient Simulation - Introduction, Discretization of Time, Transient

Analysis, Accuracy and Stability, Explicit and Implicit Schemes, Methods for Transient Simulation - FE, BE and TRZ Transient Analysis in Circuit Simulation, Equivalent Circuit Approach: RC Circuit, Buck Converter; Some Practical Aspects: Undamped Oscillations, Ringing, Global Error in Switching Circuits, Round-off Error, Assessment of Accuracy, Singular Matrix Problem, Trapezoidal integration, M & N method for simulating power electronic converters (with buck converter as a representative example). **CO'S-CO2**

UNIT-3: **Switching function:** **(12 hours)**

Introduction, Application of the switching function technique, Properties of the switching function, Voltage-Current relations in switched circuits - Single Switch, Parallel Switch, Pulse Width Modulation- Unipolar, PWM Signal of a composite function, bipolar square wave modulation, Mathematical Modeling of Buck Converter, Modeling using switching function-buck converter, Rectifier, 3-phase VSI inverter, matrix converter, m-phase rectifier. PWM rectifier topologies, Modeling of power electronic converters - PWM rectifier in different frames- abc, alpha-beta and d-q. **CO'S-CO3**

UNIT-4: Modeling, simulation of switching converters with state space averaging, hybrid model:

(12 hours)

State space approach, averaging method, State Space Averaging Technique – Modeling AND linearization of converter transfer functions- Hybrid Modeling for DC-DC converter. **CO'S-CO4,CO5**

Text book:

1. M. B. Patil, V. Ramnarayanan, V. T. Ranganathan**:** Simulation of Power Electronic Converters**,** 1st ed., Narosa Publishers, 2010

Reference book:

1. Ned Mohan, Undeland and Robbins**, "**Power Electronics: Converters, Design and control**"-** 2nd ed., John Wiley.

III-Semester	Industrial Safety (Open Elective)	Category	L-T-P 3 -0-0	Credits 3

Pre-requisite: Engineering Fundamentals

Course Educational Objectives:

1. To learn safety aspects of any industrial area
2. To learn fundamentals and types of maintenance engineering
3. To learn causes and effects of wear and Corrosion and their prevention
4. To learn identification of faults and their repair
5. To learn preventive maintenance- periodic an preventive-maintenance of industrial systems

COURSE OUTCOMES:

CO1: Understand the general industrial requirements like lighting, cleanliness prevention from hazards and accidents.

CO2: Analyze maintenance requirements of the industry and cost associated

CO3: Analyze wear and corrosion aspects of the industry and their prevention

CO4: Identify the faults prone areas and their repair and periodic maintenance.

Course Outcomes	Mapping with POs and PSOs												DoK
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	P011	PSO1	
CO1	2	2	-	-	-	3	2	2	-	-	1	2	L2
CO2	3	3	-	2	2	2	-	-	-	2	2	3	L4.L5
CO3	3	3	-	2	2	2	-	-	-	-	2	3	L3,L4
CO4	3	2	2	-	2	2	-	2	2	2	2	3	L1,L3, L6

SYLLABUS

Unit-I Industrial safety **(12 Hours)**

Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety colour codes. Fire prevention and fire fighting, equipment and methods. **CO'S-CO1**

Unit-II Fundamentals of maintenance engineering **(12 Hours)**

Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

CO'S-CO2

Unit-III Wear and Corrosion and their prevention (12 Hours)

Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods. **CO'S-CO3**

Unit-IV Fault tracing (12 Hours)

Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes. **CO'S-CO4**

Unit-V Periodic and preventive maintenance (12 Hours)

Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of:i. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance **CO'S-CO4**

Reference Books:

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

III-Semester	Energy Audit Conservation & Management (Open Elective)	Category	L-T-P 3 -0-0	Credits 3

Pre–requisite: Concepts of utilization of electrical energy, electrical machines and electrical measurements.

Course Objectives:

1. To learn principle of energy audit as well as management for industries and utilities and buildings.
2. To study the energy efficient motors and lighting.
3. To learn power factor improvement methods and operation of different energy instruments.
4. To compute depreciation methods of equipment for energy saving.

Course Outcomes:

CO1: Understand the principle of energy audit and their economic aspects.

CO2: Recommend energy efficient motors and design good lighting system.

CO3: Understand advantages to improve the power factor.

CO4: Evaluate the depreciation of equipment.

Course Outcomes(COS)	Mapping with POs and PSOs												DoK
	PO1	PO2	PO3	PO4	PO5	PO6	PO 7	PO8	PO9	PO1 0	P011	PSO 1	
CO1	3	2	-	-	-	2	-	-	-	3	2	2	L2,L 4
CO2	3	3	3	-	2	2	-	-	-	2	2	3	L3,L 6
CO3	3	2	2	-	-	2	-	-	-	1	1	2	L2,L 3
CO4	2	2	-	-	2	-	-	-	3	2	2	2	L5

SYLLABUS

UNIT– 1 Basic Principles of Energy Audit: (12 hours)

Energy audit- definitions, concept , types of audit, energy index, cost index ,pie charts, Sankey diagrams and load profiles, Energy conservation schemes- Energy audit of industries- energy saving potential, energy audit of process industry, thermal power station, building energy audit. **CO'S-CO1**

UNIT– 2 Energy Management: (12 hours)

Principles of energy management, organizing energy management program, initiating, planning,controlling, promoting, monitoring, reporting. Energy manager, qualities and functions, language, Questionnaire – check list for top management**.** **CO'S-CO2**

UNIT– 3 Energy Efficient Motors and Lighting: (12 hours)

Energy efficient motors, factors affecting efficiency, loss distribution, constructional details, characteristics – variable speed , variable duty cycle systems, RMS - voltage variation-voltage unbalance- over motoring-motor energy audit. lighting system design and practice, lighting control, lighting energy audit **CO'S-CO3**

UNIT– 4 Power Factor Improvement and energy instruments: (12 hours)

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 **CO'S-CO4**

UNIT– 5 Economic Aspects and their computation: (12 hours)

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 value method- Power factor correction, lighting – Applications of life cycle costing analysis, return on investment. **CO'S-CO5**

Text Books:

1. Energy management by W.R.Murphy&G.Mckay Butter worth, Heinemann publications, 1982.
2. Energy management hand book by W.CTurner, John Wiley and sons, 1982.

Reference Books:

1. Energy efficient electric motors by John.C.Andreas, Marcel Dekker Inc Ltd-2nd edition,1995
2. Energy management by Paul o" Callaghan, Mc-graw Hill Book company-1st edition, 1998
3. Energy management and good lighting practice : fuel efficiency- booklet12-EEO.

III-Semester	Composite Materials (Open Elective)	Category	L-T-P 3 -0-0	Credits 3

Pre –requisite: Engineering Physics

Course Objectives:

1. To learn characteristics of composite materials and know effects of reinforcement
2. To learn application of different fibers, understand rules of mixtures
3. To learn manufacturing of ceramic matrix, carbon matrix and applications
4. To learn preparation of moulding compounds ,properties and applications
5. To learn strength and failure criteria

Course Outcomes:

CO1: Understand characteristics and advantages of composite materials

CO2: Acquire knowledge of reinforcement, glass fiber, etc

CO3: Identify the usage of metal matrix composites

CO4: Understand manufacturing of polymer matrix composites

CO5: Identify different types of failures

Course Outcomes	Mapping with POs and PSOs												DoK
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	P011	PSO1	
CO1	3	-	2	-	2	2	-	-	-	-	-	-	L2
CO2	3	2	-	-	3	-	-	-	-	-	1	2	L1,L2
CO3	2	2	-	-	2	1	-	-	-	-	-	2	L2
CO4	3	-	2	-	2	-	-	-	-	-	-	-	L2
CO5	2	1	-	-	1	2	-	-	-	-	-	-	L2,L4

SYLLABUS

UNIT–1: INTRODUCTION **(12 hours)**

Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance. CO'S-CO1

UNIT – 2: REINFORCEMENTS **(12 hours)**

Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior

of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.

CO'S-CO2

UNIT – 3: Manufacturing of Metal Matrix Composites (12 hours)

Casting – Solid State diffusion technique, Cladding – Hot isostaticpressing, Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications. CO'S-CO3

UNIT–4: Manufacturing of Polymer Matrix Composites (12 hours)

Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications. CO'S-CO4

UNIT – 5: Strength (12 hours)

Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hydrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations. CO'S-CO5

Text Books:

1. Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.
2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R.Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.

Reference Books:

1. Hand Book of Composite Materials-ed-Lubin.
2. Composite Materials – K.K.Chawla.
3. Composite Materials Science and Applications – Deborah D.L. Chung.
4. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W. Tasi.