Estd: 1980
KITSW

KAKATIYA INSTITUTE OF TECHNOLOGY & SCIENCE

Opp : Yerragattu Gutta, Hasanparthy (Mandal), WARANGAL - 506 015, Telangana, INDIA

काकतीय प्रौद्योगिकी एवं विज्ञान संस्थान, वरंगल - ५०६ ०१५ तेलंगाना, भारत

కాకతీయ సాంకేతిక విజ్ఞాన శాస్త్ర విద్యాలయం, వరంగల్ - ౫౦౬ ౦౧౫ తెలంగాణ, భారతదేశము

(An Autonomous Institute under Kakatiya University, Warangal)

(Approved by AICTE, New Delhi; Recognised by UGC under 2(f) & 12(B); Sponsored by EKASILA EDUCATION SOCIETY)

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

M.TECH. - POWER ELECTRONICS

RULES & REGULATIONS FOR POSTGRADUATE PROGRAMME
M.TECH. 2-YEAR DEGREE PROGRAMME (PRR14-R18)

SYLLABI (I to IV Semesters)

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DEPARTMENT OF
ELECTRICAL AND ELECTRONICS ENGINEERING

• M.Tech. •

POWER ELECTRONICS

Rules & Regulations for postgraduate Programme
M.Tech. 2-Year Degree Programme (PRR14-R18)

SYLLABI (I to IV SEMESTERS)

VISION OF THE INSTITUTE

- *To make our students technologically superior and ethically strong by providing quality education with the help of our dedicated faculty and staff and thus improve the quality of human life*

MISSION OF THE INSTITUTE

- *To provide latest technical knowledge, analytical and practical skills, managerial competence and interactive abilities to students, so that their employability is enhanced*
- *To provide a strong human resource base for catering to the changing needs of the Industry and Commerce*
- *To inculcate a sense of brotherhood and national integrity*

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

VISION OF THE DEPARTMENT

- *To fulfill the needs of the industry and society through excellence in education and research in electrical engineerin*

MISSION OF THE DEPARTMENT

- *To produce globally competent engineers in Electrical and Electronics Engineering*
- *To promote scientific inclination and cultivate professional ethics*
- *To serve organization and society as adaptable engineers, entrepreneurs, or leaders*

PG - M.Tech. (POWER ELECTRONICS) **PROGRAM EDUCATIONAL OBJECTIVES (PEOs)**	
PROGRAM EDUCATIONAL OBJECTIVES (PEOs)	***The postgraduates of POWER ELECTRONICS will be able to***
PEO1 (Research and Innovation)	*engage in research, innovation and teaching in the fields related to power electronics & drives*
PEO2 (Technical expertise and Successful career)	*excel in professional practices relevant to industry and engage in entrepreneurship with latest technologies in the areas of power converters, renewable energy, smart electric grid, industrial drives and electric vehicles*
PEO3 (Soft skills and Lifelong learning)	*exhibit professional ethics, effective communication skills and spirit of teamwork by carrying out research for a sustainable development*

PG - M.Tech. (POWER ELECTRONICS)

PROGRAM OUTCOMES (POs)

PO1	*An ability to independently carry out research/investigation and development work to solve practical problems.*
PO2	*An ability to write and present an effective technical report/ document.*
PO3	*Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.*

PROGRAM SPECIFIC OUTCOMES (PSOs):

At the time of graduation, the post graduates of PE will be able to …

PSO1	*apply knowledge of power electronics for the development of effective and innovative solutions to problems pertaining to the renewable energy sources, smart electric grids and electric vehicles*
PSO2	*analyze complex engineering problems related to power electronics industry and develop solutions with the latest hardware and software tools*

KITSW
Estd: 1980

KAKATIYA INSTITUTE OF TECHNOLOGY & SCIENCE, WARANGAL
DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING
Scheme of Instruction and Evaluation for Two Year Post-graduate Programme
M.TECH.(POWER ELECTRONICS)

SEMESTER-I

Course Code	Course Name	Periods			Credits	Evaluation Scheme				
						CIE			ESE	Total Marks
		L	T	P		TA	MSE	Total		
P14PE101	Alternative Sources of Electrical Energy	3	1	0	4	15	25	40	60	100
P14PE102	Analysis of Power Electronic Converters	3	1	0	4	15	25	40	60	100
P14PE103	Modern Control Theory	3	1	0	4	15	25	40	60	100
P14PE104	Power Electronic Control of DC Drives	3	1	0	4	15	25	40	60	100
P14PE105	Elective –I	3	1	0	4	15	25	40	60	100
P14PE106	Elective –II	3	1	0	4	15	25	40	60	100
P14PE107	Power Electronics Laboratory	0	0	3	2	40	-	40	60	100
P14PE108	Power Electronic Simulation Laboratory	0	0	3	2	40	-	40	60	100
P14PE109	Seminar	-	-	-	2	-	-	100	-	100
	Total	**18**	**6**	**6**	**30**			**420**	**480**	**900**

Elective –I

P14PE105A High Voltage DC Transmissions
P14PE105B Design of Digital Systems
P14PE105C Optimization Techniques
P14PE105D Modeling and Simulation of Power Electronic Systems

Elective –II

P14PE106A Digital Signal Processor
P14PE106B Dynamics of Electrical Machines
P14PE106C Electro Magnetic Interference and Compatibility
P14PE106D Reliability Engineering

KAKATIYA INSTITUTE OF TECHNOLOGY & SCIENCE, WARANGAL
DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING
Scheme of Instruction and Evaluation for Two Year Post-graduate Programme
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SEMESTER-II

Course Code	Course Name	Periods			Credits	Evaluation Scheme				
						CIE			ESE	Total Marks
		L	T	P		TA	MSE	Total		
P14PE201	Power Electronic Control of AC Drives	3	1	0	4	15	25	40	60	100
P14PE202	Machine Modeling & Analysis	3	1	0	4	15	25	40	60	100
P14PE203	Advanced Power Electronics	3	1	0	4	15	25	40	60	100
P14PE204	Artificial Intelligence Applications in Electrical Engineering	3	1	0	4	15	25	40	60	100
P14PE205	Elective -III	3	1	0	4	15	25	40	60	100
P14PE206	Elective -IV	3	1	0	4	15	25	40	60	100
P14PE207	Electric Drives Laboratory	0	0	3	2	40	-	40	60	100
P14PE208	Alternative Sources of Electrical Energy Laboratory	0	0	3	2	40	-	40	60	100
P14PE209	Comprehensive Viva-Voce	-	-	-	2	-	-	-	100	100
	Total	**18**	**6**	**6**	**30**			**320**	**580**	**900**

Elective –III

P14PE205A Digital Control Systems
P14PE205B Power Quality
P14PE205C Microprocessor and Microcontroller
P14PE205D Applications of Power Converters

Elective –IV

P14PE206A Electrical Machine Design
P14PE206B Electric Smart Grid
P14PE206C Digital Signal Processor Controlled Drives
P14PE206D Flexible AC Transmission Systems (FACTS)

DEPARTMENT OF ELECTRICAL&ELECTRONICS ENGINEERING
KAKATIYA INSTITUTE OF TECHNOLOGY & SCIENCE:: WARANGAL – 15
(An Autonomous Institute under Kakatiya university, Warangal)

Scheme of Instruction and Evaluation for Two Year Postgraduate Programme
M.TECH. (POWER ELECTRONICS)

SEMESTER – III

Course Code	Course Name	Periods per Week	Credits	Evaluation Scheme				
				CIE			ESE	Total Marks
				TA	MSE	Total		
P14PE301	Industrial Training	08 weeks	4	100	-	100	-	100
P14PE302	Dissertation	16 weeks	8	100	-	100	-	100
	Total	**24 weeks**	**12**	**200**	**-**	**200**	**-**	**200**

DEPARTMENT OF ELECTRICAL&ELECTRONICS ENGINEERING
KAKATIYA INSTITUTE OF TECHNOLOGY & SCIENCE:: WARANGAL – 15
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Scheme of Instruction and Evaluation for Two Year Postgraduate Programme
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SEMESTER – IV

Course Code	Name of the Course	Periods per Week	Credits	Evaluation Scheme				
				CIE			ESE	Total Marks
				TA	MSE	Total		
P14PE401	Dissertation	24 weeks	12	40	-	40	60	100
	Total	**24 weeks**	**12**	**40**	**-**	**40**	**60**	**100**

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కాకతీయ సాంకేతిక విజ్ఞాన శాస్త్ర విద్యాలయం, వరంగల్ - ౫౦౬ ౦౧౫ తెలంగాణ, భారతదేశము

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RULES AND REGULATIONS FOR POSTGRADUATE PROGRAMME – 2-YEAR M.TECH. DEGREE PROGRAMME (PRR-14 Revised)

(Applicable from the academic year 2018-19)

1. INTRODUCTION:

1.1 The provisions contained in these regulations given the conditions for imparting course of instructions, conducting examinations and evaluation of students performance leading to 2-year M.Tech. degree programme to be offered by the Kakatiya Institute of Technology & Science, Warangal and awarded by Kakatiya University, Warangal

1.2 These regulations shall be called the ***"Kakatiya Institute of Technology & Science, Warangal (KITSW) regulations for the award of 2-year M.Tech. degree programme"*** *by Kakatiya University, Warangal*

1.3 They shall come into effect from the date of getting approval from the Academic Council of the Kakatiya Institute of Technology & Science, Warangal

1.4 They shall be applicable for all students enrolling for 2-year M.Tech. degree programme at the Kakatiya Institute of Technology & Science, Warangal from the academic year 2014-15.

2. DEFINITIONS:

2.1 ***"M.Tech."*** means Master of Technology, a Post-Graduate Degree awarded from the Kakatiya University, Warangal

2.2 ***"University"*** means Kakatiya University, Warangal

2.3 ***"Institute"*** means Kakatiya Institute of Technology & Science, Warangal

2.4 ***"UGC"*** means University Grants Commission, New Delhi

2.5 ***"AICTE"*** means All India Council for Technical Education, New Delhi

2.6 ***"MHRD"*** means Ministry of Human Resource & Development, Govt. of India, New Delhi

2.7 ***"TSCHE"*** means Telangana State Council for Higher Education, Govt. of Telangana, Hyderabad

2.8 ***"GB"*** means Governing Body of the Institute

2.9 ***"AC"*** means Administrative Committee of the Institute

2.10 ***"FC"*** means Finance Committee of the Institute

2.11 ***"Council"*** means Academic Council of the Institute

2.12 ***"Principal"*** means Principal of the Institute

2.13 ***"Dean"*** means Dean of specific affairs of the Institute

2.14 ***"HoD"*** means Head of the Department of specific programme offered by the Institute

2.15 ***"BoS"*** means Board of Studies in the engineering of a specific programme offered by the Institute

2.16 ***"CoE"*** means Controller of Examinations of the Institute.

3. POST GRADUATE PROGRAMMES:

3.1 The Institute shall offer the following Post Graduate Programmes:

1. ***Structural & Construction Engineering** (offered by the Dept. of Civil Engineering)*
2. ***Design Engineering** (offered by the Dept. of Mechanical Engineering)*
3. ***Digital Communications** (offered by the Dept. of Electronics & Communication Engineering)*
4. ***Software Engineering** (offered by the Dept. of Computer Science & Engineering)*
5. ***VLSI & Embedded Systems** (offered by the Dept. of Electronics & Instrumentation Engineering)*
6. ***Power Electronics** (offered by the Dept. of Electrical & Electronics Engineering)*

3.2 The provisions of these regulations shall also be applicable to any new postgraduate programmes that are introduced from time to time with approval from appropriate bodies such as MHRD / AICTE / UGC, etc.

4. ADMISSION:

4.1

Course	Specialization	Eligibility		
		Qualifying Degree	GATE/ GPAT Exam	PGECET Exam
M.Tech.	Structural & Construction Engg.	B.E. / B.Tech. / AMIE in Civil Engineering / Construction Engineering or equivalent. They should have qualified at GATE/ PGECET	CE	CE
M.Tech.	Design Engineering	B.E. / B.Tech./ AMIE in Mechanical Engineering / Production Engineering / Industrial Engineering / Aeronautical Engineering Marine Engineering. They should have qualified at GATE / PGECET	ME	ME
M.Tech.	Digital Communication	B. E. / B.Tech. / AMIE in ECE, AMIE (Electronics & Telecommunication Engg. / B.E. / B.Tech. in Electrical or Electrical & Electronics Engg. EIE and Bio-medical Engg. or equivalent. They should have qualified at GATE / PGECET	EC / IN	ECE
M.Tech.	Software Engineering	B.E. / B.Tech. / AMIE in any branch of Engg. / Tech. (Or) equivalent Master's Degree in Physics, Statistics, Mathematics, Applied Mathematics, Applied Statistics, Applied Physics, Geophysics, M.Sc. (Computer Science), M.Sc. (Information Systems) (Computer Applications & Electronics) and MCA or equivalent. They should have qualified at GATE / PGECET	CS	CS
M.Tech.	VLSI & Embedded System	B.E. / B.Tech. / AMIE in ECE, EIE, EEE, CSE, IT (Or) equivalent. They should have qualified at GATE / PGECET	CS / EC / IN / EE	EC
M.Tech.	Power Electronics	B.E. / B.Tech. / AMIE in Electrical & Electronics Engg. / Electrical Engg. or equivalent	EE	EE

4.1 **For GATE candidates**

The candidates should have passed B.E./B.Tech./AMIE in any branch of Engg./ Tech. (or) equivalent Master's Degree in Physics, Statistics, Mathematics or Applied Mathematics, Applied Statistics, Applied Physics, Geophysics, M.Sc. (Comp. Sc.), M.Sc. (Information Systems) (Computer Applications and Electronics) and MCA or equivalent. They should have qualified at the GATE and possess a valid GATE score. The seats will be assigned purely on the basis of merit of GATE.

For Sponsored seats

The candidates should have passed BE/B.Tech./AMIE in any branch of Engg./ Tech. (or) equivalent Master's Degree in Physics, Statistics, Mathematics or Applied Mathematics, Applied Statistics, Applied Physics, Geophysics, M.Sc. (Comp. Sc.), M.Sc. (Information Systems) (Computer Applications and Electronics) and MCA or equivalent.

The criterion for selection of sponsored candidates shall be by their merit at the entrance examination to be conducted by the PGECET

Admission shall made into sponsored category only with the candidates who are qualified either GATE/ PGECET or as decided by the admission committee.

1. His/ Her application shall be duly recommended by the sponsoring agency for admission to the course and forwarded to the Convener, PGECET
2. He/ She must be permanent employee with the sponsoring agency for at least two years, after obtaining the qualifying degree.

3. The sponsoring agency must be a Government establishment or a public-sector undertaking, or a reputed private engineering college
4. The sponsoring agency shall certify that the candidates will be granted leave for pursuing the M.E./ M.Tech. Regular course of study.
5. The candidates who are working Research Projects approved by the competent authority are also required to fulfill the above conditions before they are sponsored for admission

4.2 The Admissions shall be made in accordance with the guidelines issued by TSCHE

5 ACADEMIC SESSION:

5.1 Each academic session is divided into two semesters (odd and even), each of 15 weeks including two Mid Semester Examinations.

a) **Odd Semester**: from 3rd week of June to Second week of October. However, academic session of the first semester will be decided based on counseling schedule declared by the TSCHE.

b) **Even Semester**: from the last week of November to 3rd week of March.

5.2 The Institute shall announce the schedule for all the academic activities well before the commencement of the academic year and take all the necessary steps to follow them scrupulously.

5.3 The academic activities in a semester normally include registration, course work, Continuous Internal Evaluation (CIE), End Semester Examination (ESE) and declaration of results.

6. REGISTRATION:

6.1 All the students are required to register in person at the beginning of each academic year on the dates specified in the academic calendar.

6.2 The sole responsibility for registration rests with the student concerned.

6.3 Registration of students will be centrally organized by the Academic Section.

6.4 The Registration procedure involves:

a) Filling of the prescribed registration form

b) Payment of fees and clearance of outstanding dues (if any).

c) Signing undertakings (undertaking for regular attendance, discipline and against ragging) along with the parents.

6.5 If for any compelling reasons like illness, etc., a student is unable to register on the announced day of registration, he/she can register within 12 working days from the beginning of the academic year on payment of an additional late fee as prescribed by the Institute.

6.6 **No late registration shall be permitted after 12th working day** from the scheduled date of commencement of class work for that academic year.

6.7 Only those students will be permitted to register who have

a) cleared all institute and hostel dues of previous semesters.

b) paid all required prescribed fees for the current academic year.

c) not been debarred / detained from registering for a specified period on disciplinary or any other grounds.

d) cleared the minimum academic requirement as detailed in Regulation No. 14.

7. CURRICULUM

7.1 The duration of the programme leading to 2-year M.Tech. degree will be 4 semesters (2 academic years).

7.2 The curricula for different degree programmes as proposed by the department and recommended by the BoS shall have the approval of the Academic Council.

7.3 The curricula to be followed for all the M.Tech. programmes is as specified and approved by the BoS.

7.4 The courses offered would have a ***Lecture – Tutorial - Practical (L-T-P)*** component to indicate contact hours. Separate laboratory (practical) course may exist (0-0-P) in certain cases as decided.

7.5 The academic programmes of the Institute follow the credit system.

7.6 Each course shall have an integer number of credits(C), which reflects its weightage. The number of credits of a course in a semester shall ordinarily be calculated as under:

Number of credits of a course, $C = L + (T+P)/2$

- where L, T, P represent the No. of Lecture, Tutorial and Practical hours / week.
- The fraction to be rounded off to next integer value.

7.7 **Course Code:** Each course offered in the Postgraduate (M.Tech.) curriculum at this institute shall be listed by using a total of 8 digits, as follows:

Ex: **P14SC101**

1. The first letter, to represent the Post Graduate Programme
   Ex. P for Postgraduate Course
2. The next two numericals, to represent the year in which the syllabus is proposed / revised.
   Ex. 14 for the year 2014 from which syllabus is applicable for the batches admitted from academic year 2014-15.
3. The next two letters, to represent the specialization offered.
   Ex. SC for Structural & Construction Engineering
4. The last three numericals, to represent the course number and semester in which it is being offered.
   Ex. XYZ; X - Semester number ; YZ – Course number
   101 represents course number 01 offered in first semester

In general, a **course code "P14SC101"** represents an **Postgraduate Course number-01 offered for the batches admitted from the year 2014 in Structural & Construction Engineering in first semester.**

7.8 The syllabus of each course in the M.Tech. curriculum shall be divided into Four units.

8. ATTENDANCE:

8.1 All the students are normally required to have full (100%) attendance.

8.2 However, the attendance in no case should be less than 75% of the total classes held in all the courses offered in a semester for that academic year.

8.3 Students having attendance less than 75% in aggregate will be detained and will not be allowed to appear for the end semester examination of that semester.

8.4 All such students who are detained have to repeat the entire semester when it is offered.

9. CONDUCT AND DISCIPLINE:

9.1 All students shall be required to conduct themselves in a manner befitting the reputation of the institution, within and outside the premises of the Institute; and are expected to complete their studies without any break.

9.2 As per the order of Hon'ble Supreme Court of India, ragging in any form is strictly banned. Involvement of a student in ragging will be considered as a gross indiscipline and may lead to his / her expulsion from the Institute.

9.3 Detailed rules regarding the conduct and discipline (code of conduct) are given in Appendix – I.

10 EVALUATION PROCEDURE:

10.1 The evaluation of students in a course for all 2-year M.Tech. programme (4 semesters) is a continuous process and is based on their performance in different examinations as mentioned below:

a) Sessional, involving **Continuous Internal Evaluation (CIE)** conducted all through the semester which includes **Mid-Semester Exams (MSE)** and **Teachers Assessment (TA)** through assignments.

b) Terminal, often designated as **End Semester Examination (ESE)** which includes a written examination for theory courses, practical, comprehensive viva-voce, dissertation examination with built-in oral part for laboratory / comprehensive viva-voce / dissertation courses.

10.2 A student's performance in a course (subject) shall be judged by taking into account the result of Continuous Internal Evaluation (CIE) and End Semester Examination (ESE) together.

10.3 Continuous Internal Evaluation (CIE) and End Semester Examination (ESE) shall have 40:60 weightage.

i.e. Continuous Internal Evaluation (CIE) carrying 40% weightage and End Semester Examination (ESE) carrying 60% weightage.

10.4 **Continuous Internal Evaluation (CIE) for Theory courses:**

10.4.1 The Continuous Internal Evaluation (CIE) throughout the semester shall consist of Teachers Assessment (TA) and Mid Semester Examination (MSE).

10.4.2 For assigning marks in Teachers Assessment (TA), performance in assignments is to be considered. Teacher shall give at least 2 assignments per each unit of syllabus covering the entire contents of that unit.

10.4.3There shall be two mid semester examinations (MSE-I and MSE-II) of two hour duration for each course.

The average of the marks scored in MSE-I and MSE-II will be considered for evaluation under MSE. Hence, **it is mandatory for the student to take both the mid semester examinations.**

10.4.4 The distribution given to each component of Continuous Internal Evaluation (CIE) for a theory course is given below:

S. No.	Particulars	Weightage
1.	Teacher's Assessment (TA) (Assignments)	15%
2.	Mid Semester Examination (MSE) (MSE-I & MSE-II)	25%
	Total Weightage::	**40%**

10.4.5 The marks obtained by the students in Mid Semester Examination (MSE) must be submitted to the Controller of Examination (CoE) the teachers within 10 days from the date of conduct of the examination.

10.4.6 The dates for Mid Semester Examination (MSE) and End Semester Examination (ESE) will be declared by the CoE in consultation with the Dean, Academic Affairs.

10.5 **End Semester Examination (ESE) for Theory Course**:

There shall be an End Semester Examination (ESE) at the end of each semester for three hour duration for each course.

10.6 **Continuous Internal Evaluation (CIE) for Practical (Laboratory) Course:**

10.6.1 Continuous Internal Evaluation (CIE) for practical course shall carry 40% Weightage.

10.6.2 The Continuous Internal Evaluation (CIE) throughout the semester shall consist of the following:

Assessment	Weightage
Regular Experimentation / Job work	10%
Regular submission of record	10%
Quiz / Skill Test at the end of semester	10%
Viva-voce at the end of semester	10%
Total Weightage	**40%**

10.7 **End Semester Examination (ESE) for Practical (Laboratory) Course:**

10.7.1 There shall be an End Semester Examination (ESE) at the end of each semester for three hour duration for each practical course.

10.7.2 The End Semester Examination (ESE) for practical course shall carry 60% Weightage.

10.7.3 The marks distribution at End Semester Examination (ESE) shall be as follows:

Assessment	Weightage
Procedure / Experimentation / Tabulation / Result, as applicable …	40%
Viva-voce	20%
Total Weightage	**60%**

10.8 **Continuous Internal Evaluation (CIE) for Seminar :**

10.8.1 There shall be only Continuous Internal Evaluation (CIE) for Seminar.

10.8.2 A teacher will be allotted to a student for guiding in

(i) selection of topic

(ii) work to be carried out

(iii) report writing and

(iv) presentation (PPT) before Internal Seminar / Mini Project evaluation committee

10.9 **Continuous Internal Evaluation (CIE) for Comprehensive Viva-voce :**

External oral examination shall be conducted on a pre-notified date in the presence of an internal examiner. The oral examination shall cover the entire content of courses covered in First and Second Semester.

10.10 **Continuous Internal Evaluation (CIE) for Project Work:**

10.10.1 Project work shall be normally conducted in two stages, spread over two sequential semesters i.e. third and fourth semester.

10.10.2 At the end of first stage (third semester), student shall be required to submit a preliminary report of work done for evaluation to the project coordinator and present the same before an Internal Project Evaluation Committee. The Continuous Internal Evaluation (CIE) for the seventh semester is as follows:

Assessment	Weightage
Project Supervisor Assessment	50%
Internal Project Evaluation Committee Assessment	50%
Total Weightage:	**100%**

10.10.3 At the end of second stage (fourth semester), student shall be required to submit two bound copies, one being for the department and other for the Project Supervisor. The project report shall be evaluated by the Project Evaluation Committee and external oral examination shall be conducted on a pre-notified date. The project work evaluation for the fourth semester is as follows:

Assessment	Weightage
Project Supervisor Assessment	20%
Internal Project Evaluation Committee Assessment	20%
ESE (Presentation & Viva Voce)	60%

11 MINIMUM REQUIREMENT FOR PASSING A COURSE

11.1 **Theory Course**: A student is deemed to have passed in a theory course, if he / she secures

(a) 35 percent of marks assigned to End Semester Examination (ESE) and

(b) 35 percent of marks assigned to the Mid Semester Examination (MSE) and End Semester Examination (ESE) of the course taken together.

11.2 The average of the marks scored in both Mid Semester Examination (MSE) (as per the Regulation No. 10.4.4) will be considered for the evaluation under Mid Semester Examination (MSE).

11.3 **Laboratory Course**: A student is deemed to have passed in a laboratory course, if he/she secures

(a) 35 percent of marks assigned to End Semester Examination (ESE) and

(b) 35 percent of marks assigned to the Teachers Assessment (TA) and End Semester Examination (ESE) of the laboratory course taken together.

12 GRADING SYSTEM

12.1 At the end of the semester a student is awarded a letter grade in each of his / her courses taking into account his / her performance in Continuous Internal Evaluation (CIE) and End Semester Examination (ESE).

12.2 The typical grades and their numerical equivalents on 10-point scale (called Grade Points) are as follows:

Performance	Letter Grade	Grade Points (G_i)
Superior	S	10
Excellent	A	9
Very Good	B	8
Good	C	7
Average	D	6
Pass	P	4
Fail	F	0

12.3 F-Grade is a Fail Grade. The course in which the student has earned F-Grade will be termed as backlog Course.

12.4 In addition, there shall be a transitional M-grade.
M-Grade for "Debarred" due to indiscipline / malpractice during examination.

12.5 The Institute shall follow absolute grading system. The grades will be awarded as under:

Grade	Percentage Score (X)
S	$X \geq 90$
A	$80 \leq X < 90$
B	$70 \leq X < 80$
C	$60 \leq X < 70$
D	$45 \leq X < 60$
P	$35 \leq X < 45$
F	$X < 35$

12.6 For arriving at a grade obtained by a student in a particular course (subject), initially numeric marks obtained by the student out of 100 are to be determined. Once a numeric mark is obtained, the same is to be converted to a letter grade following the guidelines given in 12.5.

12.7 A Semester Grade Point Average (SGPA) will be computed for each semester. The SGPA will be calculated as follows:

$$\text{SGPA} = \sum_{i=1}^{n} C_i G_i \Big/ \sum_{i=1}^{n} C_i$$

where 'n' is the no. of courses (subjects) offered (excluding mandatory courses) for the semester, 'C_i' is the credits allotted to a particular course, 'G_i' is the grade-points carried by the letter corresponding to the grade awarded to the student for the course as illustrated in 12.2.

12.8 The SGPA would indicate the performance of the student in the semester to which it refers. SGPA will be rounded off to the second place of decimal and recorded as such.

12.9 Starting from the second semester, at the end of each semester, a Cumulative Grade Point Average (CGPA) will be computed for every student as follows:

$$\text{CGPA} = \sum_{i=1}^{m} C_i G_i \Big/ \sum_{i=1}^{m} C_i$$

where 'm' is the total number of courses (subjects) the student has been offered from the first semester onwards upto and including the present semester, 'C_i 'and 'G_i' are as explained in 12.7.

12.10 The CGPA would indicate the cumulative performance of the student from the first semester up to the end of the semester to which it refers. CGPA will be rounded off to the second place of decimal and recorded as such.

12.11 SGPA and CGPA are calculated in consideration of only credits cleared, i.e. F-grade credits are not included for calculation.

13 SUPPLEMENTARY EXAMINATIONS

13.1 A student who obtained the F-grade in a course (theory or practical) can appear in a subsequent End Semester Examination (ESE) in the same course as supplementary candidate.

13.2 However the marks secured in Continuous Internal Evaluation (CIE) by the student in that course during the semester study shall remain unaltered.

13.3 The students those who have passed in the supplementary examination will be awarded grade with '*' marked on the courses passed in the supplementary.

15 IMPROVEMENT EXAMINATION

15.1 Students who wish to improve their SGPA / CGPA are permitted for SGPA / CGPA improvement only for theory courses. The student may opt to re-appear all the courses of a semester at the immediately succeeding End Semester Examination (ESE) for improving his / her grades. However, the students should clear all the courses of a particular semester in which he / she intends to take an improvement examination.

15.2 Further, when once the student appears for the improvement examination he / she shall forego the grades secured in the earlier End Semester Examination (ESE) in the whole set of courses prescribed for that semester. However, the marks secured in Continuous Internal Evaluation (CIE) by the student in those courses during the semester study shall remain unaltered.

15.3 Students those who have re-appeared for improvement will be awarded grade with '$' marked on the courses appeared for improvement examination. '$' will state the grade improvement. Such improved grades will not be counted for the award of Prizes, Medals and Rank.

15.4 However, the students who register for improvement examinations and wish to drop from appearing the examinations, by written application to the CoE, before commencement of examinations, shall be permitted to retain their earlier grades.

16 GRADUATION REQUIREMENT

16.1 A student shall be declared to be eligible for award of the M.Tech. degree, if he / she has registered and completed all the courses with a minimum P-grade scored in every course

16.2 Normally a student should complete all the requirements consecutively in 4 semesters (2 academic years) for the award of M.Tech. degree. However, the students who fail to fulfill all the requirements for the award of M.Tech. degree within a period of 8 consecutive semesters (4 academic years from the registration in 1st semester) shall forfeit his / her enrolment to the program.

16.4 CGPA to Percentage (%) and Class Conversion is as follows:

S. No.	Division	Eligibility Criteria
1	First Division with Distinction	a) Student should secure CGPA $\geq$8.0. b) Student should pass all the courses along with the batch of students admitted with him/her within 8 consecutive semesters (6 consecutive semesters for lateral entry students). c) Student who appeared for improvement examination upto 6th semester will also be considered. d) The failed candidate in any course shall not be awarded Distinction.
2	First Division	Student should secure CGPA, which is $6.5 \leq CGPA < 8.0$ within the time frame of the programme i.e. 16 semesters (12 semesters in case of lateral entry students).
3	Second Division	Student should secure CGPA, which is $5.0 \leq CGPA < 6.5$ within the time frame of the programme i.e. 16 semesters (12 semesters in case of lateral entry students).
4.	Pass Division	Student should secure CGPA, which is $4.0 \leq CGPA < 5.0$ within the time frame of the programme i.e. 16 semesters (12 semesters in case of lateral entry students).

16.5 The University will award degrees to the students who are evaluated and recommended by the Institute.

17 MALPRACTICE IN EXAMINATION

17.1 Malpractice in examination is an illegal activity and is prohibited.

17.2 Mobile phones are strictly prohibited in the examination hall.

17.3 Exchange of question paper and material like pen, pencil, sharpener, eraser, scale, calculator, etc., during examination is strictly prohibited.

17.4 Malpractice in examination is viewed very seriously. Malpractice includes oral communication between candidates, possessing forbidden material, mobile phones (switched off/on) etc.

17.5 Any malpractice or engaging in any improper conduct and violation of the examination code by the student during examinations is liable for the punishment as given below:

S. No	Nature of Malpractice	S. No	Punishment
1.	Taking help from others, consulting and or helping other examinees during the examination period inside the examination hall or outside it, with or without their consent or helping other candidates to receive help from anyone else.	a)	Cancelling the examination of the paper in which he / she indulged in malpractices.
2	If the examinee attempts to disclose his / her identity to the valuer by writing his / her Hall-Ticket Number at a place other than the place prescribed for it or any coded message including his / her name or addressing the valuer in any manner in the answer book.		Cancelling the examination of the paper in which he / she indulged in malpractices.
3.	Candidate is found in possession of forbidden material; relevant or not relevant but not used.	b)	Cancellation of the result of all examinations taken or proposed to be taken during that session. However, he/ she shall be promoted to next semester/ year as per the promotion rules in vogue.
4.	Destroying the material found in his / her possession or acting in any other manner with a view to destroying evidence.	c)	Cancellation of the result of all examinations taken or proposed to be taken during that session and prohibiting his/her admission to or continuation in any course of the Institute for a period of one year. The student will be eligible to appear for the next corresponding semester / year examination in the succeeding academic year.
5.	Smuggling main answer book / additional answer book / question paper / matter in to or out of the examination hall & Conspiring to interchange Hall Ticket Numbers.		-do-
6.	Candidate is found in possession of forbidden material, relevant or not relevant but used.		-do-
7.	In case of (i) impersonation, (ii) misbehavior with the invigilators/any person related to examination work, (iii) insertion of written sheets in different hand writing in the main/additional answer book, and (iv) creation of disturbance in and around the examination hall during or before the examination.	d)	Cancellation of the result of all examinations taken or proposed to be taken during that session and prohibiting his/her admission in to or continuation in any course of the Institute for a period of two years. Further, the candidate shall not be allowed to appear for any examination during the period of punishment.
8.	If a candidate is found guilty of malpractice in the improvement examination (after completion of course).	e)	Punishment will be awarded subject to the above rules and further, he/she will not be permitted to appear for further improvement examination.

18 ROLL NUMBERS ALLOTMENT

The Roll Number given to the student shall have a total 8 digits as follows:

Ex: **M14SC007**

1. The first letter, to represent Masters (M.Tech.) degree programme.
   Ex: M for Masters programme
2. The next two numerical, to represent the year in which the student admitted into I semester.
   Ex: 14 for 2014
3. The next two letters, to represent the concerned specialization to which the student belongs.
   Ex: SC for Structural & Construction Engineering
4. The last three numerical, to represent the three digit roll number of the student.
   In general, a **student with roll number "P14SC007"** represents a **Masters student with a specialization of Structural & Construction Engineering admitted in the year 2014 bearing a roll number of 007.**

19 AMENDMENTS

Notwithstanding anything contained in this manual, the Academic Council of the Institute reserves the right to modify / amend the curricula, requirements and rules & regulations pertaining to its undergraduate programmes, without any further notice.

KAKATIYA INSTITUTE OF TECHNOLOGY & SCIENCE, WARANGAL
DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING
Scheme of Instruction and Evaluation for Two Year Post-graduate Programme
M.TECH.(POWER ELECTRONICS)

Estd: 1980
KITSW

SEMESTER-I

Course Code	Course Name	Periods			Credits	Evaluation Scheme				
						CIE			ESE	Total Marks
		L	T	P		TA	MSE	Total		
P14PE101	Alternative Sources of Electrical Energy	3	1	0	4	15	25	40	60	100
P14PE102	Analysis of Power Electronic Converters	3	1	0	4	15	25	40	60	100
P14PE103	Modern Control Theory	3	1	0	4	15	25	40	60	100
P14PE104	Power Electronic Control of DC Drives	3	1	0	4	15	25	40	60	100
P14PE105	Elective –I	3	1	0	4	15	25	40	60	100
P14PE106	Elective –II	3	1	0	4	15	25	40	60	100
P14PE107	Power Electronics Laboratory	0	0	3	2	40	-	40	60	100
P14PE108	Power Electronic Simulation Laboratory	0	0	3	2	40	-	40	60	100
P14PE109	Seminar	-	-	-	2	-	-	100	-	100
	Total	**18**	**6**	**6**	**30**			**420**	**480**	**900**

Elective –I

P14PE105A High Voltage DC Transmissions
P14PE105B Design of Digital Systems
P14PE105C Optimization Techniques
P14PE105D Modeling and Simulation of Power Electronic Systems

Elective –II

P14PE106A Digital Signal Processor
P14PE106B Dynamics of Electrical Machines
P14PE106C Electro Magnetic Interference and Compatibility
P14PE106D Reliability Engineering

P14PE101 ALTERNATIVE SOURCES OF ELECTRICAL ENERGY

Class: M.Tech. I Semester **Branch:** Power Electronics

Teaching Scheme:

L	T	P	C
4	-	-	4

Examination Scheme:

Continuous Internal Evaluation	:	40 marks
End Semester Exam	:	60 marks

Course Learning Objectives:

- *To know the characteristics and performance of solar cells.*
- *To learn the principles of wind energy conversion*
- *To learn the concept of Distributed Generation , Demand& Supply Side Management .*
- *To learn the Energy Storage Systems*

UNIT – I (12)

Renewable Sources of Energy; Grid-Supplied Electricity; Distributed Generation; Renewable Energy Economics - Calculation of Electricity Generation Costs; Demand-Side Management Options; Supply-Side Management Options; Electricity Act 2003,Energy conservation &integrated policy

UNIT – II (12)

Wind Power Plants:

Appropriate Location; Evaluation of Wind Intensity; Topography; Purpose of the Energy Generated - 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 Generating Systems

UNIT – III (12)

Photovoltaic Power Plants:

Solar Energy; Generation of Electricity by Photovoltaic Effect; Dependence of a PV Cell Characteristic on Temperature; Solar Cell Output Characteristics - Equivalent Models and Parameters for Photovoltaic Panels; Photovoltaic Systems - Applications of Photovoltaic Solar Energy; Economical Analysis of Solar Energy

UNIT – IV (12)

Energy Storage Systems:

Energy Storage Parameters; Lead–Acid Batteries; Ultracapacitors; Flywheels - Superconducting Magnetic Storage System; Pumped Hydroelectric Energy Storage; Compressed Air Energy Storage - Storage Heat; Energy Storage as an Economic Resource

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.

3. Gilbert M. Masters, "*Renewable and Efficient Electric Power Systems*", John Wiley & Sons, 2004
4. B.H.Khan, *"Non conventional Energy Resources'',* Tata McGraw Hill Pvt. Ltd, New Delhi
5. G.D.Rai, *"Non conventional Sources of Energy''* Khanna publishers New delhi
6. 6.Vittal V. and Ayyanar R. (2012), "*Grid Integration and Dynamic Impact of Wind Energy*", Springer

Reference Books:

1. Rakosh das Begamudre, "*Energy Conversion Systems*" New Age International Publishers, New Delhi, 2000.
2. John Twidell and Tony Weir, "*Renewable Energy Resources*" 2nd Edn., Fspon & Co.
3. Bollen M. H. and Hassan F. "*Integration of Distributed Generation in the Power System*", Wiley-IEEE Press, 2011
4. Keyhani A. "*Design of Smart Power Grid Renewable Energy Systems*", Wiley–IEEE Press, 2011
5. Gellings C. W. "*The Smart Grid: Enabling Energy Efficiency and Demand Respons*", First Edition, CRC Press, 2009

Course Learning Outcomes:

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

- *Understand the characteristics and performance of solar cells.*
- *Understand the principles of wind energy conversion*
- *Understand the concept of Distributed Generation, Demand& Supply Sid Management*
- *Understand the Learn the Energy Storage Systems*

P14PE101 ALTERNATIVE SOURCES OF ELECTRICAL ENERGY						
Course Outcomes		PO1	PO2	PO3	PSO1	PSO2
Understand the characteristics and performance of solar cells.	CO1	3	2	3	3	3
Understand the principles of wind energy conversion	CO2	3	2	2	3	2
Understand the concept of Distributed Generation, Demand& Supply Sid Management	CO3	2	3	2	3	2
Understand the Learn the Energy Storage Systems	CO4	3	2	2	3	3
	AVG	2.75	2.25	2.25	3	2.5

P14PE102 ANALYSES OF POWER ELECTRONIC CONVERTERS

Class: M.Tech. I Semester **Branch:** Power Electronics

Teaching Scheme:

L	T	P	C
4	-	-	4

Examination Scheme:

Continuous Internal Evaluation	:	40 marks
End Semester Exam	:	60 marks

Course Learning Objectives:

- *To analyze the performance of controlled AC-DC converters.*
- *To understand designing concepts of AC-AC voltage controllers and Cycloconverters.*
- *To learn the designing of DC-DC chopper circuits.*
- *To understand and analyze PWM techniques for Inverters.*

UNIT – I (12)

Single Phase AC Voltage Controllers: Single phase AC voltage controllers with Resistive, Resistive-inductive and Resistive-inductive-induced e.m.f. loads .

Three Phase AC Voltage Controllers: Three phase AC voltage controllers - Analysis of controllers with star and delta Connected Resistive, Resistive-inductive loads - Effects of source and load inductances - Synchronous tap changers-. ac voltage controllers with PW Control ,Applications - numerical problems.

Cycloconverters. Single phase to single phase cycloconverters - analysis of midpoint and bridge Configurations - Three phase to three phase cycloconverters - analysis of Midpoint and bridge configurations - Limitations - Advantages - Applications- numerical problems.

UNIT – II (12)

Single 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 - Extinction angle control - symmetrical angle control - PWM -single phase sinusoidal PWM - single phase series converters - Applications -Numerical problems.

Three Phase Converters. 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 - three phase PWM - twelve pulse converters - applications -Numerical problems.

UNIT – III (12)

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 - Numerical problems.

UNIT – IV (12)

Pulse Width Modulated Inverters(single phase):
Principle of operation - performance parameters - single phase bridge inverter -evaluation of output voltage and current with resistive, inductive and Capacitive loads - Voltage control of single phase inverters - single PWM - Multiple PWM - sinusoidal PWM - modified PWM - phase displacement Control - Advanced modulation techniques for improved performance - Trapezoidal, staircase, stepped, harmonic injection and delta modulation - Advantage - application - numerical problems.
Pulse Width Modulated Inverters(three phase). Three phase inverters - analysis of 180 degree condition for output voltage And current with resistive, inductive loads - analysis of 120 degree Conduction - voltage control of three phase inverters - sinusoidal PWM - Third Harmonic PWM – 60 degree PWM – space vector modulation - Comparison of PWM techniques - harmonic reductions - Current Source Inverter - variable d.c. link inverter - boost inverter - buck and boost inverter - inverter circuit design - advantages -applications - numerical problems.
Multilevel inverters

Text Books:

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

Course Learning Outcomes:
At the end of the course the student will be able to:

- *Select an appropriate power semiconductor device and design a power converter for the required application*
- *Determine the power circuit configuration needed to fulfill the required power conversion with applicable constraints.*
- *Design the control circuit and the power circuit for a given power converter.*
- *Determine the drive circuit requirements in terms of electrical isolation and the requirement of bipolar drive and ease of control.*

P14PE102 ANALYSIS OF POWER ELECTRONIC CONVERTERS						
Course Outcomes		PO1	PO2	PO3	PSO1	PSO2
Select an appropriate power semiconductor device and design a power converter for the required application	CO1	2	-	2	2	2
Determine the power circuit configuration needed to fulfill the required power conversion with applicable constraints.	CO2	3	-	2	3	1
Design the control circuit and the power circuit for a given power converter.	CO3	3	-	2	3	2
Determine the drive circuit requirements in terms of electrical isolation and the requirement of bipolar drive and ease of control.	CO4	3	-	2	2	2
	AVG	2.75		2	2.5	1.75

P14PE103 MODERN CONTROL THEORY

Class: M.Tech. I Semester **Branch:** Power Electronics

Teaching Scheme:

L	T	P	C
4	-	-	4

Examination Scheme:

Continuous Internal Evaluation	:	40 marks
End Semester Exam	:	60 marks

Course Learning Objectives:

- *To know the basic concepts of matrices, Eigen values & Eigen vectors and to model of systems by using state space Analysis*
- *To know the design of controllers for several classes of plants.*
- *To know the Harmonic Analysis and Stability of Non- Linear Systems*
- *To know the control problems such as dead bent control, external Disturbances and sensitivity problems in optimal linear regulators.*

UNIT – I (12)

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

STATE VARIABLE ANALYSIS: Linear Continuous time models for Physical systems– Existence and Uniqueness of Solutions to Continuous-Time State Equations – Solutions of Linear Time Invariant Continuous-Time State Equations – State transition matrix and it's properties.

CONTROLLABILITY AND OBSERVABILITY

General concept of controllability – General concept of Observability – Controllability tests for Continuous-Time Invariant Systems – Observability tests for Continuous-Time Invariant Systems – Controllability and Observability of State Model in Jordan Canonical form – Controllability and Observability Canonical forms of State model.

UNIT – II (12)

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

UNIT – III (12)

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

STATE FEEDBACK CONTROLLERS AND OBSERVERS
State feedback controller design through Pole Assignment – State observers: Full order and Reduced order

UNIT – IV (12)

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

Text books:

1. M.Gopal, "*Modern Control System Theory*", New Age International, 1984.
2. Ogata.K, "*Modern Control Engineering*" Prentice Hall, 1997

Reference Books:

1. Kircks, "*Optimal control*"

Course Learning Outcomes:

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

- *Develop mathematical models of physical systems.*
- *Design optimal controllers for physical systems including power electronic and power systems.*
- *Analyze the issues related to the stability of automatic control systems.*
- *Design complex nonlinear systems by linearizing them*

P14PE103 MODERN CONTROL THEORY						
Course Outcomes		PO1	PO2	PO3	PSO1	PSO2
Develop mathematical models of physical systems.	CO1	2	1	1	1	1
Design optimal controllers for physical systems including power electronic and power systems.	CO2	2	-	-	3	2
Analyze the issues related to the stability of automatic control systems	CO3	3	1	1	2	1
Design complex nonlinear systems by linearizing them	CO4	3	1	1	1	2
	AVG	2.5	1	1	1.75	1.5

P14PE104 POWER ELECTRONIC CONTROL OF DC DRIVES

Class: M.Tech. I Semester **Branch:** Power Electronics

Teaching Scheme:

L	T	P	C
4	-	-	4

Examination Scheme:

Continuous Internal Evaluation	:	40 marks
End Semester Exam	:	60 marks

Course Learning Objectives:

- *To Design motor starting, braking and reversing electrical circuits.*
- *To Control Speed of the DC motor by using different controllers.*
- *To Design and modeling of current and speed controllers for DC motors*
- *To Determine drive system stability by calculating different system parameters.*
- *To Calculate harmonics and their associated problems.*

UNIT – I (12)

Controlled Bridge Rectifier (1-Φ) with DC Motor Load: Separately exited DC motors with rectified single-phase supply – single phase semi converter and single phase full converter for continuous and discontinuous modes of operation – power and power factor.

Controlled Bridge Rectifier (3-Φ) with DC Motor Load: Three-phase semi converter and three phase full converter for continuous and discontinuous modes of operation – power and power factor – Addition of freewheeling diode-

Three phase naturally commutated bridge circuit as a rectifier or as an inverter: Three phase controlled bridge rectifier with passive load impedance, resistive load and ideal supply – Highly inductive load and ideal supply for load side and supply side quantities.

UNIT – II (12)

Phase controlled DC Motor drives: Three phase controlled converter, control circuit, control modeling of three phase converter – Steady state analysis of three phase converter control DC motor drive – Two quadrant, three phase converter controlled DC motor dive – DC motor and load converter.

Current and Speed Controlled DC Motor drives:

Current and speed controllers – current and speed feedback – Design of controllers – current and speed controllers – Motor equations – filter in the speed feedback loop speed controller – current reference generator – current controller and flow chart for simulation – Harmonics and associated problems – sixth harmonics torque.

UNIT – III (12)

Chopper controlled DC Motor drives

Principles of operation of the chopper – four-quadrant chopper circuit – chopper for inversion – Chopper with other power devices – model of the chopper –input to the chopper steady state analysis of chopper controlled DC motor drives – rating of the devices – Pulsating torque.

UNIT – IV (12)

Closed loop operation of DC Motor drives

Speed controlled drive system – current control loop – pulse width modulated current controller – hysteresis current controller – modeling of current controller – design of current controller.

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

References Books:

1. Shepherd, Hulley, Liang, *"Power Electronic and Motor Control"*, 2nd Edn., Cambridge University Press.
2. R. Krishnan, *"Electronic Motor Drives Modeling, Analysis and Control"*, I Edn., PHI.
3. M. H. Rashid, *"Power Electronic circuits, Drives and Applications"*, PHI – I Edn, 1995
4. G.K. Dubey, *"Fundamentals of Electric Drives"*, Narosa Publications, 1995
5. S.B. Dewan and A. Straughen, *"Power Semiconductor Drives"*, 1975

Course Learning Outcomes:

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

- *Control of DC motors with single and three phase bridge rectifiers.*
- *Current and speed controllers for DC motor drives.*
- *Modeling of chopper circuits to control DC motor drives*
- *Design and Modeling of current and speed controllers for DC motor drives under closed loop and perform simulation study*

P14PE104 POWER ELECTRONIC CONTROL OF DC DRIVES						
Course Outcomes		PO1	PO2	PO3	PSO1	PSO2
Control of DC motors with single and three phase Bridge Rectifiers.	CO1	3	1	3	3	1
Current and speed controllers for DC motor drives.	CO2	2	1	2	3	2
Modeling of chopper circuits to control DC motor drives.	CO3	2	1	1	3	2
Design and Modeling of current and speed controllers for DC motor drives.	CO4	2	1	1	3	2
	AVG	2.25	1	1.75	3	1.75

P14PE105A HIGH VOLTAGE DC TRANSMISSION
(Elective-I)

M.Tech. Semester: I **Branch:** EEE (Power Electronics)

Teaching Scheme:

L	T	P	C
4	-	-	4

Examination Scheme:

Continuous Internal Evaluation	:	40 marks
End Semester Exam	:	60 marks

Course Objectives:

- To learn the importance of HVDC transmission.
- To analyze HVDC converters and power flow control in HVDC system
- To know the concepts of multiterminal DC links.
- To know the faults and protections required in HVDC system

UNIT – I (12 Hrs)

H.V.D.C. Transmission: General considerations, Power Handling Capabilities of HVDC Lines, Basic Conversion principles, static converter configuration. Static Power Converters: 3-pulse, 6-pu!se and 12-pulse converters, converter station and Terminal equipment, commutation process, Rectifier and inverter operation, equivalent circuit for converter -special features of converter transformers. Harmonics in HVDC Systems, Harmonic elimination, AC and DC filters.

UNIT – II (12 Hrs)

Control of HVDC Converters and systems: constant current, constant extinction angle and constant Ignition angle control- Individual phase control and equidistant firing angle control, DC power flow control. Interaction between MV AC and DC systems - Voltage interaction, Harmonic instability problems and DC power modulation.

UNIT – III (12 Hrs)

Multi-terminal DC links and systems; series, parallel and series parallel systems, their operation and control. Transient over voltages in HVDC systems: Over voltages due to disturbances on DC side, over voltages due to DC and AC side line faults.

UNIT – IV (12 Hrs)

Converter faults and protection in HVDC Systems: Converter faults, over current protection - valve group, and DC line protection. Over voltage protection of converters, surge arresters.

REFERENCE BOOKS:

1. E.W. Kimbark : Direct current Transmission, Wiely Inter Science - New York.
2. J.AriMaga : H/V.D.C. Transmission Peter Peregrinus ltd., London UK 1983
3. K_.R.Padiyar: High Voltage Direct current Transmission, Wiely Eastern Ltd, New Delhi – 1992.
4. E.Uhlman : Power Transmission by Direct Current, Springer Verlag, Berlin Helberg – 1985

Course Outcomes:

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

- *Control of DC motors with single and three phase bridge rectifiers.*
- *Current and speed controllers for DC motor drives.*
- *Modeling of chopper circuits to control DC motor drives*
- *Design and Modeling of current and speed controllers for DC motor drives under closed loop and perform simulation study*

P14PE105A HIGH VOLTAGE DC TRANSMISSION						
Course Outcomes		PO1	PO2	PO3	PSO1	PSO2
Control of DC motors with single and three phase Bridge Rectifiers.	CO1	3	1	3	3	1
Current and speed controllers for DC motor drives.	CO2	2	1	2	3	2
Modeling of chopper circuits to control DC motor drives.	CO3	2	1	1	3	2
Design and Modeling of current and speed controllers for DC motor drives under closed loop and perform simulation study	CO4	2	1	1	3	2
	AVG	2.25	1	1.75	3	1.75

P14PE105B DESIGN OF DIGITAL SYSTEMS
(Elective-I)

M.Tech. Semester: I **Branch:** EEE (Power Electronics)

Teaching Scheme:

L	T	P	C
4	-	-	4

Examination Scheme:

Continuous Internal Evaluation	:	40 marks
End Semester Exam	:	60 marks

Course Objectives:

- To understand the principles of sequential logic design
- To represent the state machines of flip-flops
- To learn the concepts of synchronous state machines
- Use of VHDL for designing sequential and combination circuits

UNIT – I (12 Hrs)

Principles of Sequential logic design: Concept of FSM – Metastability

UNIT – II (12 Hrs)

State machine structures: Moore machine - Mealy machine, Analysis of state machine with D and J-K Flip-flops

UNIT – III (12 Hrs)

Design of Finite State Machines: Clocked synchronous state machine design, Designing state machine using state diagrams, State machine synthesis using transition list, Clock skew Overview of PLDs, CPLDs and FPGAs

UNIT – IV (12 Hrs)

RT level combinational circuit, Regular sequential circuit Design examples with VHDL

REFERENCE BOOKS:

1. J. F. Wakerly: Digital Design-Principles and Practices, 4th Edition, Pearson, 2008.
2. Pong P. Chu: FPGA Prototyping by VHDL Examples: Xilinx Spartan-3 Version, 1st Edition, Wiley-Interscience, 2008

Course Outcomes:

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

- *Evaluate the stability of sequential logic system*
- *Represent the Moore and Mealy state machines for flip flop operations*
- *Design synchronous state machines*
- *Write VHDL code for sequential and combination circuits.*

P14PE105B DESIGN OF DIGITAL SYSTEMS						
Course Outcomes		PO1	PO2	PO3	PSO1	PSO2
Evaluate the stability of sequential logic system	**CO1**	**2**	**2**	**2**	**1**	**1**
Represent the Moore and Mealy state machines for flip flop operations	**CO2**	**2**	**1**	**2**	**1**	**1**
Design synchronous state machines	**CO3**	**1**	**2**	**2**	**1**	**1**
Write VHDL code for sequential and combination circuits	**CO4**	**1**	**2**	**2**	**1**	**1**
	AVG	**1.5**	**1.75**	**2**	**1**	**1**

P14PE105 C OPTIMIZATION TECHNIQUES
(Elective-I)

M.Tech. Semester: I **Branch:** EEE (Power Electronics)

Teaching Scheme:

L	T	P	C
4	-	-	4

Examination Scheme:

Continuous Internal Evaluation	:	40 marks
End Semester Exam	:	60 marks

Course Objectives:
- concepts to solve linear programming problems which arise in real life using various methods and their advantages
- concepts to solve nonlinear programming problems
- Understand concepts of searching techniques in a given list
- Know the techniques for dynamic programming and integer linear programming

UNIT – I (12 Hrs)

Linear Programming: Introduction and formulation of models - Convexity - simplex method - Big-M method - two-phase method - degeneracy - non-existent and unbounded solutions - duality in LPP - dual simplex method - sensitivity analysis - revised simplex method - transportation and assignment problems - traveling salesman problem.

UNIT – II (12 Hrs)

Nonlinear Programming: Classical optimization methods - equality and inequality constraints - Lagrange multipliers and Kuhn-Tucker conditions - quadratic forms - quadratic programming problem and Wolfes' method.

UNIT – III (12 Hrs)

Search Methods: One dimensional optimization - sequential search - fibonacci search - multidimensional search methods - univariate search - gradient methods - steepest descent/ascent methods - conjugate gradient method - Fletcher-Reeves method - penalty function approach.

UNIT – IV (12 Hrs)

Dynamic Programming: Principle of optimality - recursive relations - solution of LPP - simple examples.

Integer Linear Programming: Gomory's cutting plane method - Branch and bound algorithm - Knapsack problem - linear 0-1 problem.

REFERENCE BOOKS:

1. J.C. Pant, "Introduction to Optimization", Jain Brothers, 2004
2. S.S. Rao, "Optimization Theory and applications", Wiley Eastern Ltd. 2009
3. K.V. Mittal, "Optimization Methods", Wiley Eastern Ltd., 2005

Course Outcomes:

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

- *Solve the optimization problems using linear programming with simplex and revised simplex methods*
- *Perform optimization of nonlinear equations using quadratic programming*
- *Identify the given item using suitable searching techniques*
- *Optimize the system using dynamic and integer linear programming approaches.*

P14PE105C OPTIMIZATION TECHNIQUES						
Course Outcomes		PO1	PO2	PO3	PSO1	PSO2
Solve the optimization problems using linear programming with simplex and revised simplex methods	CO1	1	1	1	1	1
Perform optimization of nonlinear equations using quadratic programming	CO2	2	1	2	1	1
Identify the given item using suitable searching techniques	CO3	2	1	2	1	1
Optimize the system using dynamic and integer linear programming approaches	CO4	1	1	1	1	1
	AVG	1.5	1	1.5	1	1

P14PE105 D MODELING AND SIMULATION OF POWER ELECTRONIC SYSTEMS (Elective-I)

M.Tech. Semester: I **Branch:** EEE (Power Electronics)

Teaching Scheme:

L	T	P	C
4	-	-	4

Examination Scheme:

Continuous Internal Evaluation	**:**	40 marks
End Semester Exam	**:**	60 marks

Course Objectives:

- Power electronic converters & with appropriate drive steps
- Modeling & simulation of power electronic converter circuits
- Identification of different control methods for modeling of drives
- Behavior of power converters with state space analysis

UNIT-I (12 Hrs)

Introduction: Challenges in computer simulation - Simulation process - mechanics of simulation - Solution techniques for time domain analysis - Equation solvers - circuit-oriented simulators

UNIT-II (12 Hrs)

Simulation of Power Electronic Converters: State-space representation of power electronic converters (with buck converter as a representative example) - Trapezoidal integration - M & N method for simulating power electronic converters (with buck converter as a representative example) - Introduction to MATLAB and Simulink - Simulation of rectifiers - choppers and inverter circuits along with PWM techniques

UNIT-III (12 Hrs)

Simulation of Electric Drives: Modeling of power electronic converters with transportation delay - Concept of control gain - linearization of rectifiers with inverse cosine control - State space model of 3-Ph IM - Principle of Vector control - Modeling and simulation of Vector controlled 3-Ph IM with a 3-level inverter drive

UNIT-IV (12 Hrs)

Modeling - Simulation of Switching Converters with State Space Averaging: State Space Averaging Technique– Modeling AND linearization of converter transfer functions - Simulation and Design of power electronic converters using State-space averaged models

REFERENCE BOOKS:

1. M. B. Patil - V. Ramnarayanan, V. T. Ranganathan: *Simulation of Power Electronic Converters*, 1st ed., Narosa Publishers, 2010
2. Ned Mohan, Undeland and Robbins, "Power Electronics: Converters, Design and control"- 2nd ed., John Wiley

Course Outcomes:

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

- *Specify the time step requirements to simulate dynamic models pertaining to power converters & drives*
- *Assess the performance of PWM techniques for power electronic converters*
- *Design control strategies for electric drives*
- *Analyze the performance of DC-CC converters using the state-space averaging techniques*

P14PE105D MODELING AND SIMULATION OF POWER ELECTRONIC SYSTEMS						
Course Outcomes		PO1	PO2	PO3	PSO1	PSO2
Specify the time step requirements to simulate dynamic models pertaining to power converters & drives	CO1	3	2	2	2	1
Assess the performance of PWM techniques for power electronic converters	CO2	3	2	2	2	1
Design control strategies for electric drives	CO3	3	2	2	2	1
Analyze the performance of DC-CC converters using the state-space averaging techniques	CO4	3	2	2	2	1
	AVG	3	2	2	2	1

P14PE106A DIGITAL SIGNAL PROCESSOR
(Elective-II)

M.Tech. Semester: I

Branch: EEE (Power Electronics)

Teaching Scheme:

L	T	P	C
4	-	-	4

Examination Scheme:

Continuous Internal Evaluation	:	40 marks
End Semester Exam	:	60 marks

Course Objectives:

- To Write Assembly Language Programs for the Digital Signal Processors
- To Configure and use digital Input/ Output lines and ADCs
- To Configure and use Interrupts for real-time control applications
- To Configure and use Event Managers for PWM generation

UNIT-I (12 Hrs)

Introduction to the TMS320LF2407 DSP Controller: Basic architectural features - Physical Memory - Software Tools

C2xx DSP CPU and Instruction Set: Introduction & code Generation - Components of the C2xx DSP core - Mapping External Devices to the C2xx core - peripheral interface - system configuration registers - Memory - Memory Addressing Modes - Assembly Programming Using the C2xx DSP Instruction set

UNIT-II (12 Hrs)

General Purpose Input/Output (GPIO) Functionality: Pin Multiplexing (MUX) and General Purpose I/O Overview - Multiplexing - General Purpose I/O control registers - Using the General Purpose I/O Ports

UNIT-III (12 Hrs)

Interrupts on the TMS320LF2407: Introduction to Interrupts - Interrupt Hierarchy - Interrupt Control Registers - Initializing and Servicing Interrupts in Software

The Analog-to-Digital Converter (ADC): ADC Overview - Operation of the ADC and programming modes

UNIT-IV (12 Hrs)

The Event Managers (EVA - EVB): Overview of the Event Manager - Event Manager Interrupts - General Purpose Timers - Compare Units - Capture Units and Quadrature Encoded Pulse (QEP) -General Event Manager Information - PWM signal Generation with Event Manager

REFERENCE BOOKS:

1. Hamid A. Tolyat, "DSP Based Electro Mechanical Motion Control"-CRC press, 2004.
   Application Notes from the webpage of Texas Instruments

Course Outcome:

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

- *Understand the Assembly Language Programs for the Digital Signal Processors*
- Configure and use digital Input/ Output lines and ADCs
- Configure and use Interrupts for real-time control applications
- Configure and use Event Managers for PWM generation

P14PE106A DIGITAL SIGNAL PROCESSOR						
Course Outcomes		PO1	PO2	PO3	PSO1	PSO2
Understand the Assembly Language Programs for the Digital Signal Processors	CO1	2	-	3	2	-
Configure and use digital Input/ Output lines and ADCs	CO2	3	-	3	2	-
Configure and use Interrupts for real-time control applications	CO3	2	-	3	2	-
Configure and use Event Managers for PWM generation	CO4	3	-	3	2	-
	AVG	2.5		2.5	2	-

P14PE106B DYNAMICS OF ELECTRICAL MACHINES
(Elective-II)

M.Tech. **Semester:** I **Branch:** EEE (Power Electronics)

Teaching Scheme:

L	T	P	C
4	-	-	4

Examination Scheme:

Continuous Internal Evaluation	:	40 marks
End Semester Exam	:	60 marks

Course Objectives:

- To learn various design and characteristics of electrical machines.
- To learn the electromechanical analogy of the electrical machines
- To learn the dynamics characteristics of DC machine with generalized machine theory.
- To know and study the operation and dynamics characteristics of the induction motor. and synchronous machines

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UNIT – I (12 Hrs)

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

UNIT – II (12 Hrs)

Electro dynamical equation and their solutions: Spring and Plunger system - Rotational motion – mutually coupled coils – Lagrange's equation – Application of Lagrange's equation solution of Electro dynamical equations.

UNIT – III (12 Hrs)

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

UNIT – IV (12 Hrs)

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

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

REFERENCE BOOKS:

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

Course Outcomes:

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

- *Learn various design and characteristics of electrical machines.*
- *Learn the electromechanical analogy of the electrical machines*
- *Learn the dynamics characteristics of DC machine with generalized machine theory.*
- *Study the operation and dynamics characteristics of the induction motor and synchronous machines.*

P14PE106B DYNAMICS OF ELECTRICAL MACHINES						
Course Outcomes		PO1	PO2	PO3	PSO1	PSO2
Learn various design and characteristics of electrical machines.	CO1	1	1	-	1	1
Learn the electromechanical analogy of the electrical machines	CO2	1	1	-	1	1
Learn the dynamics characteristics of DC machine with generalized machine theory	CO3	1	1	1	1	1
Study the operation and dynamics characteristics of the induction motor and synchronous machines	CO4	1	1	1	1	1
	AVG	1	1	1	1	1

P14PE106C ELECTRO MAGNETIC INTERFERENCE AND COMPATIBILITY
(Elective-II)

M.Tech. **Semester:** I **Branch:** EEE (Power Electronics)

Teaching Scheme:

L	T	P	C
4	-	-	4

Examination Scheme:

Continuous Internal Evaluation	:	40 marks
End Semester Exam	:	60 marks

Course Objectives:

- To Recognize the sources of conducted and radiated EMI in Power Electronic converters and consumer appliances
- Remedial measures to mitigate the noise problem in EMI circuits
- Need for EMI filter elements
- To Design EMI filters, common-mode and RC-snubber circuits chokes measures to keep the interference within tolerable limits

UNIT-I (12 Hrs)

Introduction: EMC standardization and description, measuring instruments, conducted EMI references, EMI in power electronic equipment: EMI from power semiconductors circuits.

UNIT-II (12 Hrs)

Noise suppression in relay systems: AC switching relays, shielded transformers, capacitor filters, EMI generation and reduction at source, influence of layout and control of parasites.

UNIT-III (12 Hrs)

EMI filter elements: Capacitors, choke coils, resistors, EMI filter circuits.

UNIT-IV (12 Hrs)

EMI filter design for insertion loss: Worst case insertion loss, design method for mismatched impedance condition and EMI filters with common mode choke-coils.

TEXT BOOKS

1. Laszlo Tihanyi: Electromagnetic Compatibility in Power Electronics, IEEE Press.
2. R. F. Ficchi: Practical Design for Electromagnetic Compatibility, Hayden Book Co.

Course Outcomes:

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

- *Recognize the sources of conducted and radiated EMI in Power Electronic converters and consumer appliances*
- *suggest remedial measures to mitigate the problems*
- *Assess the insertion loss and design EMI filters to reduce the loss*
- *Design EMI filters, common-mode and RC-snubber circuits chokes measures to keep the interference within tolerable limits*

P14PE106C ELECTRO MAGNETIC INTERFERENCE AND COMPATIBILITY						
Course Outcomes		PO1	PO2	PO3	PSO1	PSO2
Recognize the sources of conducted and radiated EMI in Power Electronic converters and consumer appliances	CO1	1	1	1	1	1
suggest remedial measures to mitigate the problems	CO2	1	1	1	1	1
Assess the insertion loss and design EMI filters to reduce the loss	CO3	1	1	1	1	1
Design EMI filters, common-mode and RC-snubber circuits chokes measures to keep the interference within tolerable limits	CO4	1	1	1	1	1
	AVG	1	1	1	1	1

P14PE106D RELIABILITY ENGINEERING
(Elective-II)

M.Tech. **Semester:** I **Branch:** EEE (Power Electronics)

Teaching Scheme:

L	T	P	C
4	-	-	4

Examination Scheme:

Continuous Internal Evaluation	:	40 marks
End Semester Exam	:	60 marks

Course Objectives:

- To learn about the elements of probability theory
- To learn about the significance of reliability and hazard models.
- To learn about the reliability logic diagrams.
- To learn about the Discrete Markov chains and reliability evaluation of repairable systems.

UNIT – I (12 Hrs)

Elements of probability theory Probability distributions: Random variables, density and distribution functions. Mathematical expectation. Binominal distribution, Poisson distribution, normal distribution, exponential distribution, Weibull distribution.

UNIT – II (12 Hrs)

Definition of Reliability. Significance of the terms appearing in the definition.
Component reliability, Hazard rate, derivation of the reliability function in terms of the hazarad rate. Hazard models.
Failures: Causes of failures, types of failures (early failures, chance failures and wear-out failures). Modes of failure. Bath tub curve. Effect of preventive maintenance. Measures of reliability: mean time to failure and mean time between failures.

UNIT – III (12 Hrs)

Reliability logic diagrams (reliability block diagrams) Classification of engineering systems: series, parallel, series-parallel, parallel-series and non-series-parallel configurations. Expressions for the reliability of the basic configurations.
Reliability evaluation of Non-series-parallel configurations: minimal tie-set, minimal cut-set and decomposition methods. Deduction of the minimal cutsets from the minimal pathsets.

UNIT – IV (12 Hrs)

Discrete Markov Chains: General modelling concepts, stochastic transitional probability matrix, time dependent probability evaluation and limiting state probability evaluation. Absorbing states.
Continuous Markov Processes: Modelling concepts, State space diagrams, Stochastic Transitional Probability Matrix, Evaluating limiting state Probabilities.
Reliability evaluation of repairable systems.
Series systems, parallel systems with two and more than two components, Network reduction techniques. Minimal cutset/failure mode approach.

TEXT BOOKS :

1. "RELIABILITY EVALUATION OF ENGINEERING SYSTEMS", Roy Billinton and Ronald N Allan, Plenum Press

Course Outcomes:

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

- *Represent various distribution functions used in probability theory*
- *Represent the reliability of a function and hazard models.*
- *Evaluate reliability of non-series parallel configurations*
- *Evaluate limiting state probabilities using discrete and continuous Markov processes*

P14PE106D RELIABILITY ENGINEERING						
Course Outcomes		PO1	PO2	PO3	PSO1	PSO2
Represent various distribution functions used in probability theory	CO1	1	1	1	1	1
Represent the reliability of a function and hazard models	CO2	1	1	1	1	1
Evaluate reliability of non-series parallel configurations	CO3	1	1	1	1	1
Evaluate limiting state probabilities using discrete and continuous Markov processes	CO4	1	1	1	1	1
	AVG	1	1	1	1	1

P14PE107 Power Electronics Laboratory

M.Tech. **Semester:** I **Branch:** EEE (Power Electronics)

Teaching Scheme:

L	T	P	C
-	-	3	2

Examination Scheme:

Continuous Internal Evaluation	:	40 marks
End Semester Exam	:	60 marks

Course Objectives:

- To Design the control circuit and the power circuit for DC-DC converters
- To Verify the compliance of spectral performance of a Three-phase voltage source Inverter
- To Critically compare various options available for the drive circuit requirements
- To Recognize possible modes of failure of a circuit- troubleshoot and repair

Detailed syllabus

1. Experimental study for characteristics of DC-DC Buck converter.
2. Experimental study for characteristics of DC-DC Boost converter.
3. Experimental study for characteristics of DC-DC Buck-Boost converter.
4. Experimental study for characteristics of single phase fully controlled Full-Bridge converter.
5. Experimental study for characteristics of single phase semi controlled Full-Bridge converter.
6. Experimental study for single phase AC voltage controller using TRIAC
7. Experimental study for single phase Inverter.
8. Experimental study for three phase Inverter.
9. Experimental study for characteristics of three phase fully controlled Full-Bridge converter.
10. Experimental study for characteristics of three phase semi controlled Full-Bridge converter

Course Outcome:

The students will be able to:

- *Design the control circuit and the power circuit for DC-DC converters*
- *Verify the compliance of spectral performance of a Three-phase voltage source Inverter*
- *Critically compare various options available for the drive circuit requirements*
- *Recognize possible modes of failure of a circuit- troubleshoot and repair*

P14PE107 POWER ELECTRONICS LABORATORY						
Course Outcomes		PO1	PO2	PO3	PSO1	PSO2
Design the control circuit and the power circuit for DC-DC converters	CO1	3	2	2	3	3
Verify the compliance of spectral performance of a Three-phase voltage source Inverter	CO2	3	2	2	3	3
critically compare various options available for the drive circuit requirements	CO3	2	-	2	2	2
Recognize possible modes of failure of a circuit- troubleshoot and repair	CO4	2	-	-	2	2
	AVG	2.5	2	2	2.5	2.5

P14PE108 Power Electronics Simulation Laboratory

M.Tech. Semester: I **Branch:** EEE (Power Electronics)

Teaching Scheme:

L	T	P	C
-	-	3	2

Examination Scheme:

Continuous Internal Evaluation	:	40 marks
End Semester Exam	:	60 marks

Course Objectives:
- To Perform simulations study of stability of system.
- To Write a program for steady state and transient stability analysis of a power System.
- To Perform simulation for load frequency control of a single-area and two area systems.
- To Perform simulation analysis of various power electronic converters with different loads.

1. Write program and simulate dynamical system of following models:
   a) I/O Model
   b) State variable model
   Also identify time domain specifications of each.
2. Obtain frequency response of a given system by using various methods:
   (a) General method of finding the frequency domain specifications.
   (b) Polar plot
   (c) Bode plot
   Also obtain the Gain margin and Phase margin.
3. Determine stability of a given dynamical system using following methods.
   a) Root locus
   b) Bode plot
   c) Nyquist plot
4. Design a compensator for a given systems for required specifications.
5. Design a PID controller.
6. PSPICE &MATLAB Simulation of Single phase full converter using RL and E loads.
7. PSPICE &MATLAB Simulation of Three phase full converter using RL and E loads.
8. PSPICE &MATLAB Simulation of Single phase AC Voltage controller using RL load.
9. PSPICE &MATLAB Simulation of Three phase inverter with PWM controller.
10. PSPICE &MATLAB Simulation of resonant pulse commutation circuit.
11. PSPICE &MATLAB Simulation of impulse commutation circuit.

Course Outcome:
The students will be able to:
- Perform simulations study of stability of system.
- Design a suitable compensator and controller for a given system
- Perform performance analysis of converter and AC voltage controllers for different loads
- Perform simulation analysis of inverters and commutation circuits.

P14PE108 POWER ELECTRONICS SIMULATION LABORATORY						
Course Outcomes		PO1	PO2	PO3	PSO1	PSO2
Perform simulations study of stability of system.	CO1	2	-	3	3	3
Design a suitable compensator and controller for a given system	CO2	3	-	3	3	3
Perform performance analysis of converter and AC voltage controllers for different loads	CO3	2	-	3	3	3
Perform simulation analysis of inverters and commutation circuits.	CO4	2	-	3	3	3
	AVG	2.25		3	3	3

P14PE109 SEMINAR

M.Tech. Semester: I **Branch:** EEE (Power Electronics)

Teaching Scheme:

L	T	P	C
-	-	-	2

Examination Scheme:

End Semester Exam	:	100 marks

The candidate should give an oral presentation before the Departmental Post-Graduate Review Committee (DPGRC) on any selected topic relevant to their specialization.

The students will submit a brief report as per specified format and present before the evaluation committee.

The seminar evaluation will be based on the day to day work report submission and presentation before the evaluation committee.

P14PE109 SEMINAR						
Course Outcomes		PO1	PO2	PO3	PSO1	PSO2
analyze the technical content and prepare a well-documented report	CO1	3	3	2	2	2
make effective seminar presentation by exhibiting the presentation skills with confidence in a logical sequence	CO2	1	3	-	2	2
explain the current and upcoming technologies	CO3	3	3	3	2	2
propose and defend opinions and technical ideas with conviction (not as mere recipient of ideas)	CO4	3	3	3	2	2
	AVG	**2.5**	**3**	**2.67**	**2**	**2**

KITSW Estd: 1980

KAKATIYA INSTITUTE OF TECHNOLOGY & SCIENCE, WARANGAL
DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING
Scheme of Instruction and Evaluation for Two Year Post-graduate Programme
M.TECH. (POWER ELECTRONICS)

SEMESTER-II

Course Code	Course Name	Periods			Credits	Evaluation Scheme				
						CIE			ESE	Total Marks
		L	T	P		TA	MSE	Total		
P14PE201	Power Electronic Control of AC Drives	3	1	0	4	15	25	40	60	100
P14PE202	Machine Modeling & Analysis	3	1	0	4	15	25	40	60	100
P14PE203	Advanced Power Electronics	3	1	0	4	15	25	40	60	100
P14PE204	Artificial Intelligence Applications in Electrical Engineering	3	1	0	4	15	25	40	60	100
P14PE205	Elective -III	3	1	0	4	15	25	40	60	100
P14PE206	Elective -IV	3	1	0	4	15	25	40	60	100
P14PE207	Electric Drives Laboratory	0	0	3	2	40	-	40	60	100
P14PE208	Alternative Sources of Electrical Energy Laboratory	0	0	3	2	40	-	40	60	100
P14PE209	Comprehensive Viva-Voce	-	-	-	2	-	-	-	100	100
	Total	**18**	**6**	**6**	**30**			**320**	**580**	**900**

Elective –III

P14PE205A Digital Control Systems
P14PE205B Power Quality
P14PE205C Microprocessor and Microcontroller
P14PE205D Applications of Power Converters

Elective –IV

P14PE206A Electrical Machine Design
P14PE206B Electric Smart Grid
P14PE206C Digital Signal Processor Controlled Drives
P14PE206D Flexible AC Transmission Systems (FACTS)

P14PE201 POWER ELECTRONIC CONTROL OF A.C. DRIVES

Class: M.Tech. II Semester **Branch:** Power Electronics

Teaching Scheme:

L	T	P	C
4	-	-	4

Examination Scheme:

Continuous Internal Evaluation	:	40 marks
End Semester Exam	:	60 marks

Course Learning Objectives:

- To draw torque speed characteristics for different control parameters by their equivalent circuit analysis and to know different slip recovery drive schemes for speed control of I.M. at rotor side.
- To study Vector control of Induction Motor Drive.
- To study and draw characteristics of synchronous motor using UPF and constant flux linkage control
- To speed Control of variable Reluctance motor drive and brushless DC motor drive.

UNIT – I (12)

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

Control of Induction motor drives at Stator side Scalar control – Voltage fed inverter control – Open loop volts/Hz control – speed control slip regulation – speed control with torque and flux control – current controlled voltage fed inverter drive – current – fed inverter control – Independent current and frequency control – Speed and flux control in Current –Fed inverter drive – Volts/Hz control of Current –fed inverter drive – Efficiency optimization control by flux program.

UNIT – II (12)

Control of Induction Motor Drive at Rotor Side and Vector Control Slip power recovery drives – Static Kramer Drive – Phasor diagram – Torque expression – speed control of a Kramer Drive – Static Scherbius Drive – modes of operation. Vector control of Induction Motor Drives: Principles of Vector control – Vector control methods – Direct methods of vector control – Indirect methods of vector control – Adaptive control principles – Self tuning regulator Model referencing control.

UNIT – III (12)

Control of Synchronous motor drives: Synchronous motor and its characteristics – Control strategies – Constant torque angle control – Unity power factor control – Constant mutual flux linkage control. **Controllers:** Flux weakening operation – Maximum speed – Direct flux weakening algorithm – Constant Torque mode controller – Flux Weakening controller – indirect flux weakening – Maximum permissible torque – speed control scheme – Implementation strategy speed controller design.

UNIT – IV (12)

Variable Reluctance and Brushless DC Motor drives: Variable Reluctance motor drive – Torque production in the variable reluctance motor Drive characteristics and control principles – Current control variable reluctance motor service drive.

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

References Books:

1. R. Krishnan, "*Electric Motor Drives Pearson Modeling, Analysis and control*"– 1st Edn., 2002.
2. B K Bose, "*Modern Power Electronics and AC Drives*" Pearson Publications 1st Edn.,
3. MD Murthy, "*Power Electronics and Control of AC Motors*" FG Turn Bull pergman Press (For Chapters II, III, V) 1st Edn.,
4. BK Bose, "*Power Electronics and AC Drives*" Prentice Hall Eagle Wood Diffs New Jersey (for chapters I, II, IV) - 1st Edn.,
5. M H Rashid, "*Power Electronic circuits Deices and Applications*" PHI, 1995.
6. G.K. Dubey, "*Fundamentals of Electrical Drives*" Narosa Publications, 1995 (for chapter II)
7. BK Bose, "*Power Electronics and Variable frequency drives*" – IEEE Press – Standard Publications, 1st Edn., 2002.

Course Learning Outcomes:

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

- *Implement sine-triangle and Space vector PWM techniques on analog and digital platforms.*
- *Understand and simulate the behavior of high performance induction motor drives using the principles of Vector Control and DTC.*
- *Understand various control techniques of synchronous motor drives*
- *Understanding the various concepts of Variable Reluctance and Brushless DC Motor drives and Brushless DC Motor drives.*

P14PE201 POWER ELECTRONIC CONTROL OF A.C. DRIVES						
Course Outcomes		PO1	PO2	PO3	PSO1	PSO2
Implement sine-triangle and Space vector PWM techniques on analog and digital platforms.	CO1	3	1	3	3	3
Understand and simulate the behavior of high performance induction motor drives using the principles of Vector Control and DTC.	CO2	3	2	3	3	3
Understand various control techniques of synchronous motor drives	CO3	3	-	1	3	1
Understanding the various concepts of Variable Reluctance and Brushless DC Motor drives and Brushless DC Motor drives	CO4	3	-	1	3	1
	AVG	3	1.5	2	3	2

P14PE202 MACHINE MODELLING AND ANALYSIS

Class: M.Tech. II Semester **Branch:** Power Electronics

Teaching Scheme:

L	T	P	C
4	-	-	4

Examination Scheme:

Continuous Internal Evaluation	:	40 marks
End Semester Exam	:	60 marks

Course Learning Objectives:

- *To understand the concept of 2-axis representation of an Electrical machine and to represent transfer function model of a DC machine.*
- *To understand the importance of 3-phase to 2-phase conversion.*
- *To know the representation of 3-phase induction motor in various reference frames*
- *To know the modeling of 3-phase synch. Motor in 2- axis representation.*

UNIT – I (12)

Basic Two-pole DC machine - primitive 2-axis machine - Voltage and Current relationship - Torque equation. Mathematical model of separately excited DC motor and DC Series motor in state variable form - Transfer function of the motor - Numerical problems. Mathematical model of D.C. shunt motor and D.C. Compound motor in state variable form - Transfer function of the motor - Numerical Problems.

UNIT – II (12)

Linear transformation - Phase transformation (a,b,c to α, β, o) - Active transformation (α, β, o to d, q). Circuit model of a 3 phase Induction motor – Linear transformation - Phase Transformation - Transformation to a Reference frame - Two axis models for Induction motor.

UNIT – III (12)

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

UNIT – IV (12)

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

Text Books:

1. Vedam Subramanyam, *"Thyristor control of Electric Drives"*.
2. Paul C.Krause , Oleg wasynezuk, Scott D.Sudhoff, *"Analysis of Electric Machinery and Drive Systems"*

Course Learning Outcomes:

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

- *Develop models for linear and nonlinear magnetic circuits*
- *Determine the developed torque in an electrical machines using the concepts of filed energy and co-energy and determine the dynamic model of a DC Machine*
- *Determine the dynamic model of an induction machine based on the dq0 transformation and determine instantaneous torque developed in an induction machine-which leads to advanced control strategies such as vector control and direct torque control.*
- *Determine the torque developed in a salient pole synchronous machine using the Park's transformation and identify contribution of saliency torque-damping torque and excitation torque.*

P14PE202 MACHINE MODELLING AND ANALYSIS						
Course Outcomes		PO1	PO2	PO3	PSO1	PSO2
Develop models for linear and nonlinear magnetic circuits	CO1	3	-	-	1	-
Determine the developed torque in an electrical machines using the concepts of filed energy and co-energy and determine the dynamic model of a DC Machine	CO2	2	-	1	1	-
Determine the dynamic model of an induction machine based on the dq0 transformation and determine instantaneous torque developed in an induction machine-which leads to advanced control strategies such as vector control and direct torque control.	CO3	2	-	1	1	-
Determine the torque developed in a salient pole synchronous machine using the park's transformation and identify contribution of saliency torque-damping torque and excitation torque.	CO4	2	-	1	1	-
	AVG	2.25	-	1	1	-

P14PE203 ADVANCED POWER ELECTRONICS

Class: M.Tech. II Semester **Branch:** Power Electronics

Teaching Scheme:

L	T	P	C
4	-	-	4

Examination Scheme:

Continuous Internal Evaluation	:	40 marks
End Semester Exam	:	60 marks

Course Learning Objectives:

- *To Model existing and modified power converters under small signal and steady state condition*
- *To Develop power converters with better performance for challenging applications*
- *To Analyze and design power converters and feedback loops*
- *To Analyze power quality problems and suggest solutions*

UNIT-I (12)

Resonant Converters:

Introduction - Basic resonant circuit concepts - Classification - Load resonant converters - Resonant switch converters - Zero voltage switching clamped voltage converters - Resonant DC link inverters High frequency link integral half cycle converters - Phase modulated resonant converters.

UNIT-II (12)

Modeling of DC-DC Converters:

Basic ac modeling approach - State space averaging - Circuit averaging and averaged switch modeling - Canonical circuit modeling - Converter transfer functions for buck - boost and buck-boost topologies.

Current Mode Control:

Introduction - types - advantages and disadvantages - Slope compensation - Determination of duty cycle and transfer functions for buck - boost and buck-boost converters.

UNIT-III (12)

Design of Switching Power Converters:

Controller Design: Introduction - mechanism of loop stabilization - Shaping E/A gains vs frequency characteristics - Conditional stability in feed-back loop - Stabilizing a continuous mode forward and fly-back converter - Feed-back loop stabilization with current mode control - right plane zero.

Design of Power Converters Components: Design of magnetic components-design of transformer - Design of Inductor and current transformer - Selection of filter capacitors - Selection of ratings for devices - input filter design - Thermal design.

UNIT-IV (12)

Power Quality Issues:

Introduction - Study and design of series - shunt and hybrid compensators - Single and three phase power factor correction.

Reference Books:

1. M.H.Rashid, *"Power Electronics-Circuits, Devices & Applications"* PHI.
2. NedMohan, T.M.Undeland, William P.Robbins, *"Power Electronics: Converters, Applications & Design"* John Wiley & Sons.
3. Abraham I. Pressman, *"Switching Power Supply Design"* McGraw Hill International.
4. IEEE Publications on Power Electronics

Course Learning Outcomes:

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

- *Model existing and modified power converters under small signal and steady state condition*
- *Develop power converters with better performance for challenging applications*
- *Analyze and design power converters and feedback loops*
- *Analyze power quality problems and suggest solutions*

P14PE203 ADVANCED POWER ELECTRONICS						
Course Outcomes		PO1	PO2	PO3	PSO1	PSO2
Model existing and modified power converters under small signal and steady state condition	CO1	3	-	2	2	2
Develop power converters with better performance for challenging applications	CO2	3	-	2	3	1
Analyze and design power converters and feedback loops	CO3	3	-	2	3	2
Analyze power quality problems and suggest solutions	CO4	3	-	2	2	2
	AVG	3	-	2	2.67	1.67

P14PE204 ARTIFICIAL INTELIGENCE APPLICATIONS IN ELECTRICAL ENGINEERING

Class: M.Tech. II Semester **Branch:** Power Electronics

Teaching Scheme:

L	T	P	C
4	-	-	4

Examination Scheme:

Continuous Internal Evaluation	:	40 marks
End Semester Exam	:	60 marks

Course Learning Objectives:

- *To understand properties & compositions of neural networks and learning process.*
- *To understand methods of minimization like LMS algorithm, back propagation algorithms, single & multi layer perceptions, self organized maps.*
- *To learn the use of Fuzzy logic and fuzzy system implementation*
- *To learn and understand associate memories.*

UNIT – I (12)

Introduction to Neural Networks Introduction, Humans and Computers, Organization of the Brain, Biological Neuron, Biological and Artificial Neuron Models, Hodgkin-Huxley Neuron Model, Integrate-and-Fire Neuron Model, Spiking Neuron Model, Characteristics of ANN, McCulloch-Pitts Model, Historical Developments, Potential Applications of ANN.

Essentials of Artificial Neural Networks Artificial Neuron Model, Operations of Artificial Neuron, Types of Neuron Activation Function, ANN Architectures, Classification Taxonomy of ANN – Connectivity, Neural Dynamics (Activation and Synaptic), Learning Strategy (Supervised, Unsupervised, Reinforcement), Learning Rules, Types of Application.

Feed Forward Neural Networks: Introduction, Perceptron Models: Discrete, Continuous and Multi-Category, Training Algorithms: Discrete and Continuous Perceptron Networks, Perceptron Convergence theorem, Limitations of the Perceptron Model, Applications.

UNIT – II (12)

Multilayer Feed forward Neural Networks Credit Assignment Problem, Generalized Delta Rule, Derivation of Backpropagation (BP) Training, Summary of Backpropagation Algorithm, Kolmogorov Theorem, Learning Difficulties and Improvements. **Associative Memories:** Paradigms of Associative Memory, Pattern Mathematics, Hebbian Learning, General Concepts of Associative Memory (Associative Matrix, Association Rules, Hamming Distance, The Linear Associator, Matrix Memories, Content Addressable Memory), Bidirectional Associative Memory (BAM) Architecture, BAM Training Algorithms: Storage and Recall Algorithm, BAM Energy Function, Proof of BAM Stability Theorem Architecture of Hopfield Network: Discrete and Continuous versions, Storage and Recall Algorithm, Stability Analysis, Capacity of the Hopfield Network in power and control applications

UNIT – III (12)

Self-Organizing Maps (SOM) and Adaptive Resonance Theory (ART) Introduction, Competitive Learning, Vector Quantization, Self-Organized Learning Networks, Kohonen Networks, Training Algorithms, Linear Vector Quantization, Stability-Plasticity Dilemma, Feed forward competition, Feedback Competition, Instar, Outstar, ART1, ART2, Applications. **Classical & Fuzzy Sets:** Introduction to classical sets - properties, Operations and relations; Fuzzy sets, Membership, Uncertainty, Operations, properties, fuzzy relations, cardinalities, membership functions.

UNIT – IV (12)

Fuzzy Logic System Components and Applications Fuzzification, Membership value assignment, development of rule base and decision making system, Defuzzification to crisp sets, Defuzzification methods. Applications: Neural network applications: Process identification, Function Approximation, control and Process Monitoring, fault diagnosis and load forecasting.

Fuzzy logic applications: Fuzzy logic control and Fuzzy classification in power and control applications.

Text Books:

1. Rajasekharan and Pai, *"Neural Networks, Fuzzy logic, Genetic Algorithms: Synthesis and Applications"*, PHI Publication.
2. Jacek M. Zuarda, *"Introduction to Artificial Neural Systems"*, Jaico Publishing House, 1997.

Reference Books:

1. N. Yadaiah and S. Bapi Raju, *"Neural and Fuzzy Systems: Foundation, Architectures and Applications"*, Pearson Education
2. James A Freeman and Davis Skapura, *"Neural Networks"*, Pearson, 2002.
3. Simon Hykins , *"Neural Networks"* Pearson Education
4. C.Eliasmith and CH.Anderson, *"Neural Engineering"* PHI
5. Bork Kosko, *"Neural Networks and Fuzzy Logic System"*, PHI Publications

Course Learning Outcomes:

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

- *Identify the application domain, wherein the conventional controllers can be replaced with ANNs and Fuzzy Systems.*
- *Synthesize ANNs and Fuzzy systems to derive the functionality needed to implement the control strategies, relevant to power converters and drives.*
- *Evaluate and quantify the advantages offered by ANNs and Fuzzy systems over the conventional control strategies.*
- *To learn the concept of fuzzifiation, Difuzzfication and fuzzy logic applications.*

P14PE204 ARTIFICIAL INTELIGENCE APPLICATIONS IN ELECTRICAL ENGINEERING						
Course Outcomes		PO1	PO2	PO3	PSO1	PSO2
Identify the application domain, wherein the conventional controllers can be replaced with ANNs and Fuzzy Systems.	CO1	3	3	3	2	1
Synthesize ANNs and Fuzzy systems to derive the functionality needed to implement the control strategies, relevant to power converters and drives.	CO2	2	3	3	2	2
Evaluate and quantify the advantages offered by ANNs and Fuzzy systems over the conventional control strategies.	CO3	2	3	2	2	1
To learn the concept of fuzzifiation, Difuzzfication and fuzzy logic applications.	CO4	3	2	-	1	1
	AVG	2.5	2.75	2.67	1.75	1.25

P14PE205A DIGITAL CONTROL SYSTEMS
(Professional Elective-III)

Class: M.Tech. II Semester **Branch:** Power Electronics

Teaching Scheme:

L	T	P	C
4	-	-	4

Examination Scheme:

Continuous Internal Evaluation	:	40 marks
End Semester Exam	:	60 marks

Course Learning Objectives:

- *To learn Z-transform of a function and mapping between S-plane and Z- plane.*
- *To learn the properties and computation of state transition matrix.*
- *To understand the stability analysis of closed loop system in Z-plane.*
- *To know the designing of state feedback controller.*

UNIT – I (12)

SAMPLING AND RECONSTRUCTION Introduction sample and hold operations, Sampling theorem, Reconstruction of original sampled signal to continuous-time signal.

THE Z – TRANSFORMS Introduction, Linear difference equations, pulse response, Z – transforms, Theorems of Z – Transforms, the inverse Z – transforms, Modified Z- Transforms.

Z-PLANE ANALYSIS OF DISCRETE-TIME CONTROL SYSTEM Z-Transform method for solving difference equations; Pulse transforms function, block diagram analysis of sampled – data systems, mapping between s-plane and z-plane: Primary strips and Complementary Strips.

UNIT – II (12)

STATE SPACE ANALYSIS State Space Representation of discrete time systems, Pulse Transfer Function Matrix solving discrete time state space equations, State transition matrix and it's Properties, Methods for Computation of State Transition Matrix, Discretization of continuous time state – space equations

CONTROLLABILITY AND OBSERVABILITY Concepts of Controllability and Observability, Tests for controllability and Observability. Duality between Controllability and Observability, Controllability and Observability conditions for Pulse Transfer Function.

UNIT – III (12)

STABILITY ANALYSIS Stability Analysis of closed loop systems in the Z-Plane. Jury stability test – Stability Analysis by use of the Bilinear Transformation and Routh Stability criterion. Stability analysis using Liapunov theorems.

DESIGN OF DISCRETE TIME CONTROL SYSTEM BY CONVENTIONAL METHODS
Design of digital control based on the frequency response method – Bilinear Transformation and Design procedure in the w-plane, Lead, Lag and Lead-Lag compensators and digital PID controllers. Design digital control through deadbeat response method.

UNIT – IV (12)

STATE FEEDBACK CONTROLLERS AND OBSERVERS Design of state feedback controller through pole placement – Necessary and sufficient conditions, Ackerman's formula.
State Observers – Full order and Reduced order observers.

Linear Quadratic Regulators
Min/Max principle, Linear Quadratic Regulators, Kalman filters, State estimation through Kalman filters, introduction to adaptive controls.

Text Books:

1. K. Ogata, *"Discrete-Time Control Systems"*, Pearson Education/PHI, 2nd Edition

2. M.Gopal, "*Digital Control and State Variable Methods*" TMH

Reference Books:

1. Kuo, "*Digital Control Systems*", Oxford University Press, 2nd Edn., 2003.
2. M.Gopal, "*Digital Control Engineering*"

Course Learning Outcomes:

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

- *Evaluate the output of a digital system for a given input.*
- *Describe the dynamics of a Linear, Time Invariant and Causal digital systems through difference equations.*
- *Analyze digital systems using the Z-transformation*
- *Design digital controllers for Power Electronics Systems*

P14PE205A DIGITAL CONTROL SYSTEMS						
Course Outcomes		PO1	PO2	PO3	PSO1	PSO2
Evaluate the output of a digital system for a given input.	CO1	2	1	1	1	1
Describe the dynamics of a Linear, Time Invariant and Causal digital systems through difference equations.	CO2	2	1	1	1	1
Analyze digital systems using the Z-transformation	CO3	2	1	1	1	1
Design digital controllers for Power Electronics Systems	CO4	2	1	1	2	1
	AVG	2	1	1	1.25	1

P14PE205B POWER QUALITY
(Professional Elective-III)

Class: M.Tech. II Semester **Branch:** Power Electronics

Teaching Scheme:

L	T	P	C
4	-	-	4

Examination Scheme:

Continuous Internal Evaluation	:	40 marks
End Semester Exam	:	60 marks

Course Learning Objectives:

- *To know the standards and classification of power quality disturbances*
- *To known the causes and effects of interruptions*
- *To understand the concepts of causes and measurement of voltage sag*
- *To get knowledge on effects and mitigation of voltage sag.*

UNIT – I (12)

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

UNIT – II (12)

Long Interruptions : Interruptions – Definition – Difference between failure, outage, Interruptions – causes of Long Interruptions – Origin of Interruptions – Limits for the Interruption frequency – Limits for the interruption duration – costs of Interruption – Overview of Reliability evaluation to power quality, comparison of observations and reliability evaluation.

Short Interruptions : Short interruptions – definition, origin of short interruptions, basic principle, fuse saving, voltage magnitude events due to re-closing, voltage during the interruption, monitoring of short interruptions, difference between medium and low voltage systems. Multiple events, single phase tripping – voltage and current during fault period, voltage and current at post fault period, stochastic prediction of short interruptions.

UNIT – III (12)

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

PQ considerations in Industrial Power Systems: Voltage sag – equipment behaviour of Power electronic loads, induction motors, synchronous motors, computers, consumer electronics, adjustable speed AC drives and its operation. Mitigation of AC Drives, adjustable speed DC drives and its operation, mitigation methods of DC drives.

UNIT – IV (12 Hrs)

Mitigation of Interruptions and Voltage Sags: Overview of mitigation methods – from fault to trip, reducing the number of faults, reducing the fault clearing time changing the power system, installing mitigation equipment, improving equipment immunity, different events and mitigation methods. System equipment interface – voltage source converter, series voltage controller, shunt controller, combined shunt and series controller.
Power Quality and EMC Standards: Introduction to standardization, IEC Electromagnetic compatibility standards, European voltage characteristics standards, PQ surveys.

Reference Book:

1. Math H J Bollen. "*Understanding Power Quality Problems*" IEEE Press.

Course Learning Outcomes:

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

- *Implement compensating techniques for a given power quality problem.*
- *Suggest protection techniques under different fault conditions.*
- *Develop control techniques for compensating devices.*
- *To Learn the concept of Overview of mitigation methods and Power Quality and EMC Standards*

P14PE205 B POWER QUALITY						
Course Outcomes		PO1	PO2	PO3	PSO1	PSO2
Implement compensating techniques for a given power quality problem.	CO1	3	2	2	3	-
Suggest protection techniques under different fault conditions.	CO2	3	2	2	3	3
Develop control techniques for compensating devices.	CO3	3	2	2	3	2
To Learn the concept of Overview of mitigation methods and Power Quality and EMC Standards	CO4	3	1	3	3	3
	AVG	3	1.75	2.25	3	2.67

P14PE205C **MICROPROCESSORS AND MICROCONTROLLERS (Elective-III)**

M.Tech. **Semester:** II **Branch:** EEE (Power Electronics)

Teaching Scheme:

L	T	P	C
4	-	-	4

Examination Scheme:

Continuous Internal Evaluation	:	40 marks
End Semester Exam	:	60 marks

Course Objectives:
- To learn and understand architecture and programming of 8086 processor
- To learn and understand interfacing techniques like memory and I/O interfacing
- To learn the various data transfer techniques like programmed I/O, interrupt I/O and direct memory access.
- To learn and understand architecture of advanced processors.

UNIT – I (12 Hrs)

8086/8088 processors: Introduction to 8086 Microprocessors, Architecture, Addressing modes, Instruction set, Register Organization, Assembler directives.

Hard ware description: Pin diagram signal description of min & max modes, bus timing, ready & wait states, 8086 based micro computing system. Special features & Related Programming: Stack structure of 8086, Memory segmentation, Interrupts, ISR, NMI, MI and interrupt Programming, Macros.

UNIT – II (12 Hrs)

Advanced Microprocessors: Intel 80386 programming model, memory paging, Introduction to 80486, Introduction to Pentium Microprocessors and special Pentium pro features. Basic peripherals & Their Interfacing:-Memory Interfacing (DRAM) PPI- Modes of operation of 8255, interfacing to ADC & DAC.

UNIT – III (12 Hrs)

Special Purpose of Programmable Peripheral Devices and Their interfacing:- Programmable interval timer, 8253, PIC 8259A, display controller Programmable communication Interface 8251, USART and Exercises.

UNIT – IV (12 Hrs)

Microcontrollers: Introduction to Intel 8-bit &16-bit Microcontrollers, 8051- Architecture, Memory organization, Addressing Modes and exercises. Hardware description of 8051: Instruction formats Instruction sets, interrupt Structure & interrupt priorities, Port structures &Operation linear counter Functions different Modes of Operation and Programming examples.

TEXT BOOKS:

1. The Intel Microprocessors, Architecture Programming & Interfacing by Barry B Brey

2. Advanceed Microprocessors by Kenrith J Ayala, Thomson publishers
3. Microcontrollers by Kentrith J Ayala, Thomson publishers

REFERENCE BOOKS:

1. Microprocessors & Interfacing Programming & Hard ware by Douglas V. Hall
2. Microprocessors & Microcontrollers by Prof. C.R. Sarma

Course Outcomes:

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

- *Describe the architecture of a 8086 microprocessor.*
- *Write the program by using 8086-assembly language by understanding the instruction set and addressing modes.*
- *Configure the interrupt structures and to use interrupt sub routines to implement real-time control.*
- *Interface the microcontroller with memory and I/O subsystems.*

P14PE205C MICROPROCESSORS AND MICROCONTROLLERS						
Course Outcomes		PO1	PO2	PO3	PSO1	PSO2
Describe the architecture of a 8086 microprocessor	CO1	-	1	-	-	-
Write the program by using 8086-assembly language by understanding the instruction set and addressing modes	CO2	1	1	1	1	1
Configure the interrupt structures and to use interrupt sub routines to implement real-time control	CO3	1	1	1	1	1
Interface the microcontroller with memory and I/O subsystems	CO4	1	1	1	1	1
	AVG	1	1	1	1	1

P14PE205D APPLICATIONS OF POWER CONVERTERS
(Professional Elective-III)

Class: M.Tech. II Semester **Branch:** Power Electronics

Teaching Scheme:

L	T	P	C
4	-	-	4

Examination Scheme:

Continuous Internal Evaluation	:	40 marks
End Semester Exam	:	60 marks

Course Learning Objectives:

- *To analyze the Power Electronic Application requirements.*
- *To identify suitable power converter from the available configurations.*
- *To develop improved power converters for any stringent application requirements.*
- *To improvise the existing control techniques to suit the application*

UNIT-I (12)

Overview of the course- Power converter topologies for Induction heating- Welding-Lighting.

UNIT-II (12)

High voltage power supplies - power supplies for X-ray applications - power supplies for radar applications - power supplies for space applications - Low voltage high current power supplies

UNIT-III (12)

Power Conditioners – UPS - Active Power Filters - Shunt active power filters - Series active power filters - Hybrid active power filters – UPQC

UNIT-IV (12)

Electric Vehicle – batteries, chargers, inverters, bi-directional DC-DC converters, motors, Automotive Electronics

Reference Books:

1. Ali Emadi, A. Nasiri, and S. B. Bekiarov, *"Uninterruptible Power Supplies and Active Filters"*, CRC Press, 2005.
2. M. Ehsani, Y. Gao, E. G. Sebastien and A. Emadi, *"Modern Electric, Hybrid Electric and Fuel Cell Vehicles"*, 1st Edn., CRC Press, 2004.
3. William Ribbens, *"Understanding Automotive Electronics"*, Newnes, 2003.

Course Learning Outcomes:

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

- *Analyze the Power Electronic Application requirements.*
- *Identify suitable power converter from the available configurations.*
- *Develop improved power converters for any stringent application requirements.*
- *Analyze the different types of converters and storage device require for Electric Vehicles.*

P14PE205D APPLICATIONS OF POWER CONVERTERS						
Course Outcomes		PO1	PO2	PO3	PSO1	PSO2
Analyze the Power Electronic Application requirements	CO1	2	1	2	1	1
Identify suitable power converter from the available configurations	CO2	2	1	2	1	1
Develop improved power converters for any stringent application requirements.	CO3	2	1	2	1	1
Analyze the different types of converters and storage device require for Electric Vehicles	CO4	2	1	2	2	1
	AVG	2	1	1	1.25	1

P14PE206A ELECTRICAL MACHINE DESIGN
(Elective-IV)

M.Tech. **Semester:** II **Branch:** EEE (Power Electronics)

Teaching Scheme:

L	T	P	C
4	-	-	4

Examination Scheme:

Continuous Internal Evaluation	:	40 marks
End Semester Exam	:	60 marks

Course Objectives:

- To evaluate and judge the options available for the thermal management of electrical machines
- To carryout optimal design of electrical machinery with due considerations for magnetic and electric circuits
- To design DC machines and transformers
- To design induction motor and alternators

UNIT-I (12 Hrs)

Thermal circuit: Enclosures-types, ventilation and cooling methods in electrical machines and transformers

UNIT-II (12 Hrs)

Magnetic circuit: Basic principles, flux density calculations.Electric circuit: Types AC windings, fractional Pitch.

UNIT-III (12 Hrs)

DC machines: Output equation and coefficient, design of pole. Transformer: Output coefficient and equation, window dimensions.

UNIT-IV (12 Hrs)

Induction motor: Output equation, main dimensions calculation.

Alternators: Output coefficient and calculation of main dimensions, short circuit ratio.

TEXT BOOKS:

1. A.K. Sawhney: A Course in Electrical Machine Design, New Age International Co., 1990.
2. R.K. Agarwal: Principles of Electrical Machine Design, 4th Edition, S.K. Kataria & Sons, 2002.

Course Outcomes:

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

- *Evaluate and judge the options available for the thermal management of electrical machines*
- *Carryout optimal design of electrical machinery with due considerations for magnetic and electric circuits.*
- *Design DC machines and transformers*
- *Design induction motor and alternators*

P14PE206A ELECTRICAL MACHINE DESIGN						
Course Outcomes		PO1	PO2	PO3	PSO1	PSO2
Evaluate and judge the options available for the thermal management of electrical machines	CO1	-	1	1	1	1
Carryout optimal design of electrical machinery with due considerations for magnetic and electric circuits.	CO2	1	1	1	1	1
Design DC machines and transformers	CO3	2	1	1	1	1
Design induction motor and alternators	CO4	2	1	1	1	1
	AVG	1.66	1	1	1	1

P14PE206B ELECTRIC SMART GRID
(Elective-IV)

M.Tech. **Semester:** II **Branch:** EEE (Power Electronics)

Teaching Scheme:

L	T	P	C
4	-	-	4

Examination Scheme:

Continuous Internal Evaluation	:	40 marks
End Semester Exam	:	60 marks

Course Objectives:

- To understand the concept of smart grid- electricity network
- To know the dc distribution & smart grid
- To know the understand of Energy system concept
- To understand the efficient electric end-use technology alternatives

UNIT–I (12 Hrs)

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

SMART GRID TO EVOLVE A PERFECT POWER SYSTEM: Introduction- Overview of the perfect power system configurations- Device level power system- Building integrated power systems- Distributed power systems- Fully integrated power system-Nodes of innovation.

DC DISTRIBUTION AND SMART GRID
AC vs DC sources-Benefits of and drives of DC power delivery systems-Powering equipment and appliances with DC-Data centers and information technology loads-Future neighborhood Potential future work and research.

INTELLIGRID ARCHITECTURE FOR THE SMARTGRID: Introduction- Launching intelligrid today- Smart grid vision based on the intelligrid architecture-Barriers and enabling technologies.

UNIT–II (12 Hrs)

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

UNIT–III (12 Hrs)

ENERGY PORT AS PART OF THE SMART GRID:
Concept of energy -Port, generic features of the energy port.

POLICIES AND PROGRAMS TO ENCOURAGE END – USE ENERGY EFFICIENCY:
Policiesand programs in action -multinational - national-state-city and corporate levels.

MARKET IMPLEMENTATION: Framework-factors influencing customer acceptance and response - program planning-monitoring and evaluation.

UNIT–IV (12 Hrs)

EFFICIENT ELECTRIC END – USE TECHNOLOGY ALTERNATIVES
Existing technologies – lighting - Space conditioning - Indoor air quality - Domestic water heating- hyper efficient appliances - Ductless residential heat pumps and air conditioners – Variable refrigerant flow air conditioning-Heat pump water heating - Hyper efficient residential appliances -Data center energy efficiency- LED street and area lighting - Industrial motors and drives -Equipment retrofit and replacement - Process heating - Cogeneration, Thermal energy storage -Industrial energy management programs - Manufacturing process-Electro-technologies, Residential, Commercial and industrial sectors.

TEXT BOOKS:

1. Clark W Gellings, "The Smart Grid, Enabling Energy Efficiency and Demand Side Response"- CRC Press, 2009.
2. Janaka Ekanayake, Kithsiri Liyanage,Jianzhong.Wu, Akihiko Yokoyama, Nick Jenkins, "Smart Grid: Technology and Applications"- Wiley, 2012.
3. James Momoh, "Smart Grid :Fundamentals of Design and Analysis"- Wiley, IEEE Press, 2012.

Course Outcomes:
At the end of the course the student will be able to:
- *Describe smart grid- Electricity network.*
- *Analyze the energy systems of distribution system*
- *Describe the policies and market implementation of smart grid*
- *Analyze the efficient electric end-use technology alternatives.*

P14PE206B ELECTRIC SMART GRID						
Course Outcomes		PO1	PO2	PO3	PSO1	PSO2
Describe smart grid- Electricity network.	CO1	1	1	1	1	1
Analyze the energy systems of distribution system	CO2	2	1	2	2	2
Describe the policies and market implementation of smart grid	CO3	2	1	2	2	2
Analyze the efficient electric end-use technology alternatives.	CO4	1	1	1	1	1
	AVG	1.5	1	1.5	1.5	1.5

P14PE206C DIGITAL SIGNAL PROCESSOR CONTROLLED DRIVES
(Elective-IV)

M.Tech. Semester: II **Branch:** EEE (Power Electronics)

Teaching Scheme:

L	T	P	C
4	-	-	4

Examination Scheme:

Continuous Internal Evaluation	:	40 marks
End Semester Exam	:	60 marks

Course Objectives:

- To know the instruction set and interrupts facility in DSP controller
- To understand the concepts of Clarke's and Park's transformation
- To understand the control BLDC and PMSM machines using DSP controller
- To understand the control induction motor using DSP controller

UNIT-I (12 Hrs)

Overview of TMSLF2407 DSP controller: Instruction Set, Interrupts. Clarke's and park's transformations:

UNIT-II (12 Hrs)

Implementation of Clarke's and Park's transformation.

UNIT-III (12 Hrs)

SVPWM, BLDC Motor Control System, permanent magnet synchronous machines control system,

UNIT-IV (12 Hrs)

Vector control of IM, field oriented control, Induction Motor Speed Control using LF2407 DSP.

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.

Course Outcomes:

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

- *implement interrupts facility in DSP controller using suitable instructions*
- *implement the concepts of Clarke's and Park's transformation used for abc-dq0 conversion*
- *design the control BLDC and PMSM machines using DSP controller*
- *program for speed control of induction motor using DSP controller*

P14PE206C DIGITAL SIGNAL PROCESSOR CONTROLLED DRIVES						
Course Outcomes		PO1	PO2	PO3	PSO1	PSO2
implement interrupts facility in DSP controller using suitable instructions	CO1	1	1	1	1	1
implement the concepts of Clarke's and Park's transformation used for abc-dq0 conversion	CO2	1	1	1	1	1
design the control BLDC and PMSM machines using DSP controller	CO3	1	1	1	1	1
program for speed control of induction motor using DSP controller	CO4	1	1	1	1	1
	AVG	1	1	1	1	1

P14PE206D FLEXIBLE A.C. TRANSMISSION SYSTEMS
(Professional Elective-III)

Class: M.Tech. II Semester **Branch:** Power Electronics

Teaching Scheme:

L	T	P	C
4	-	-	4

Examination Scheme:

Continuous Internal Evaluation	:	40 marks
End Semester Exam	:	60 marks

Course Learning Objectives:
- *To learn the power flow in transmission system concepts.*
- *To learn the operations of application voltage source converters*
- *To learn the Objectives of shunt & Series compensation*
- *To learn the behavior of various FACTS devices*

UNIT – I (12)

FACTS Concepts: Transmission interconnections power flow in an AC system, loading capability limits, Dynamic stability considerations, importance of controllable parameters basic types of FACTS controllers, benefits from FACTS controllers.

UNIT – II (12)

Voltage Source Converters: Single phase three phase full wave bridge converters transformer connections for 12 pulse 24 and 48 pulse operation. Three level voltage source converter, pulse width modulation converter, basic concept of current source Converters, comparison of current source converters with voltage source converters.

UNIT – III (12)

Static Shunt Compensation: Objectives of shunt compensation, mid point voltage regulation, voltage instability prevention, improvement of transient stability, Power oscillation damping, Methods of controllable var generation, variable impedance type static var generators switching converter type var generators hybrid var generators.

SVC and STATCOM: Regulation and slope transfer function and dynamic performance, transient stability enhancement and power oscillation damping operating point control and summary of compensator control.

UNIT – IV (12)

Static Series Compensators: Concept of series capacitive compensation, improvement of transient stability, power oscillation damping Functional requirements. GTO thyristor controlled series capacitor (GSC), thyristor switched series capacitor (TSSC), and thyristor controlled series capacitor (TCSC) control schemes for GSC TSSC and TCSC.

Text Book:

1. N.G. Hingorani and L. Gyugi, *"Understanding FACTS Devices"*, IEEE Press Publications 2000.

Course Learning Outcomes:

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

- *Understand the role of impedance control, phase angle control and voltage control in controlling real and reactive power in transmission systems.*
- *Identify configuration of FACTS controller required for a given application.*
- *Analyze the different compensators for transmission system.*
- *Analyze different types of series compensators*

P14PE206 D FLEXIBLE A.C. TRANSMISSION SYSTEMS						
Course Outcomes		PO1	PO2	PO3	PSO1	PSO2
Understand the role of impedance control, phase angle control and voltage control in controlling real and reactive power in transmission systems.	CO1	3	2	3	2	2
Identify configuration of FACTS controller required for a given application.	CO2	2	2	3	3	2
Analyze the different compensators for transmission system.	CO3	3	2	1	2	1
Analyze different types of series compensators	CO4	3	2	1	2	1
	AVG	2.75	2	2	2.25	1.5

P14PE207 ELECTRIC DRIVES LABORATORY

Class: M.Tech. II Semester **Branch:** Power Electronics

Teaching Scheme:

L	T	P	C
-	-	3	2

Examination Scheme:

Continuous Internal Evaluation	:	40 marks
End Semester Exam	:	60 marks

Course Learning Objectives:

- *To learn the advantages of closed loop control of electrical machines.*
- *To learn the control techniques for two and four quadrant operations of DC drives.*
- *To learn the speed control methods of induction motor.*
- *To learn the application of power electronic converters voltage control.*

List of Experiments:

1. Speed Measurement and closed loop control using PMDC motor
2. Thyristorised drive for PMDC Motor with speed measurement and closed loop control.
3. IGBT used single 4 quadrant chopper drive for PMDC motor with speed measurement and closed loop control.
4. Thyristorised drive for 1Hp DC motor with closed loop control.
5. 3 Phase input, thyristorised drive, 3 Hp DC motor with closed loop
6. 3 Phase input IGBT, 4 quadrant chopper drive for DC motor with closed loop control equipment.
7. Cycloconverter based AC Induction motor control equipment.
8. Speed control of 3 phase wound rotor Induction motor.
9. Single phase fully controlled converter with inductive load
10. Single phase half wave controlled converter with inductive load.

Course Learning Outcomes:

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

- *To understand the advantages of closed loop control of electrical machines.*
- *To understand the control techniques for two and four quadrant operations of DC drives.*
- *To understand the speed control methods of induction motor.*
- *To understand the application of power electronic converters voltage control.*

P14PE207 ELECTRIC DRIVES LABORATORY						
Course Outcomes		PO1	PO2	PO3	PSO1	PSO2
To understand the advantages of closed loop control of electrical machines.	CO1	3	2	3	3	-
To understand the control techniques for two and four quadrant operations of DC Drives.	CO2	3	2	2	3	-
To understand the speed control methods of induction motor.	CO3	3	2	2	3	-
To understand the application of power electronic converters voltage control	CO4	3	2	2	3	-
	AVG	3	2	2.25	3	-

U14EE208 ALTERNATIVE SOURCES OF ELECTRICAL ENERGY LABORATORY

Class: M.Tech., II-Semester **Branch:** Electrical & Electronics Engineering

Teaching Scheme: **Examination Scheme:**

L	T	P	C
-	-	3	2

Continuous Internal Evaluation	40 marks
End Semester Exam	60 marks

Course Learning Objectives (LOs):
This laboratory course will develop students' knowledge in/on
- *measurement of solar energy radiation and Sunshine with reference to time.*
- *performance charactertics of various PV devices and its series parallel Connections*
- *modeling and simulation of Solar and Wind turbine System.*
- *modeling and simulation of hybrid power system applications*

LIST OF EXPERIMENTS

1. Solar radiation measurement by using Pyrometer.
2. Solar radiation measurement by using Pyreheliometer.
3. Measurement of sun shine hours using sun shine recorder.
4. Performance characteristics of solar photovoltaic devices.
   a. Single crystalline silicon PV module.
   b. Multi crystalline silicon PV module.
5. Performance evaluation of solar PV collector for series and parallel connection.
6. Effect of tilt angle on solar PV Panel.
7. Effect of surrounding temperature and intensity on solar PV Panel.
8. Wind Turbine Modeling and Simulation using Matlab -simulink .
9. Solar Panel Modeling and Simulation using Matlab –simulink.
10. Simulation of Stand-alone PV systems using Matlab -Simulink.
11. Simulation of Grid Connected PV systems using Matlab -Simulink.
12. Maximum power tracking of a wind energy system.
13. Modeling and Simulation of wind turbine grid connection using Matlab –simulink.
14. Simulation of model of a variable pitch wind turbine using Matlab –Simulink.

Laboratory Manual:
1. Manual for "Renewable Energy Systems Laboratory" *prepared by the Department of EEE.*

Text books:

1. Solanki "Renewable Energy Technologies: Practical Guide For Beginneers", *PHI Learning Pvt. Ltd.*, 2008.
2. D.Mukherjee "Fundamentals of Renewable Energy Systems", *New Age International publishers*, 2007.
3. Remus Teodorescu, Marco Liserre, Pedro Rodríguez "Grid Converters for Photovoltaic and Wind Power Systems", *John Wiley & Sons*, 2011.
4. Gilbert M. Masters "Renewable and Efficient Electric Power Systems", *John Wiley & Sons*, 2004.

Course Learning Outcomes (COs):

After completion of this course, students will be able to

- *observe the variation of solar energy radiation &Sunshine with reference to time*
- *analyze the Performance character tics various PV devices and its series parallel Connections*
- *assess the Performance of Solar& Wind turbine System*
- *design of Different Hybrid power system applications.*

P14PE208 ALTERNATIVE SOURCES OF ELECTRICAL ENERGY LABORATORY						
Course Outcomes		PO1	PO2	PO3	PSO1	PSO2
observe the variation of solar energy radiation & Sunshine with reference to time	CO1	2	2	2	2	-
analyze the Performance character tics various PV devices and its series parallel Connections	CO2	2	2	2	2	-
asses the Performance of Solar & Wind turbine System	CO3	2	2	2	2	-
design of Different Hybrid power system applications.	CO4	2	2	2	2	1
	AVG	**2**	**2**	**2**	**2**	**1**

P14PE209 COMPREHENSIVE VIVA

Class: M.Tech. II Semester **Branch:** Power Electronics

Teaching Scheme:

L	T	P	C
-	-	-	2

Examination Scheme:

End Semester Exam	**:**	100 marks

Course Learning Objectives:

- *To learn comprehend and correlate the understanding of various courses in design and operation of modern power electronic & drive systems.*
- *To understand the concepts of power converters*
- *To analyze the power converter application requirements.*
- *To design power converters for various applications*

The Viva includes question from all the subjects of first and second semesters with more emphasis on Power Electronics Concepts.

Course Learning Outcomes:

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

- *Comprehend and correlate the understanding of various courses in design and operation of modern power electronic & drive systems.*
- *Application of power electronics converters*
- *Design of Power converters for various applications.*
- *Understand the concept of different power converters*

P14PE209 COMPREHENSIVE VIVA						
Course Outcomes		PO1	PO2	PO3	PSO1	PSO2
Comprehend and correlate the understanding of various courses in design and operation of modern power electronic & drive systems.	CO1	3	3	2	3	3
Application of power electronics converters	CO2	3	2	2	3	2
Design of Power converters for various applications.	CO3	3	2	2	3	2
Understand the concept of different power converters	CO4	3	2	2	3	2
	AVG	3	2.25	2	3	2.25

DEPARTMENT OF ELECTRICAL&ELECTRONICS ENGINEERING
KAKATIYA INSTITUTE OF TECHNOLOGY & SCIENCE:: WARANGAL – 15
(An Autonomous Institute under Kakatiya university, Warangal)

Scheme of Instruction and Evaluation for Two Year Postgraduate Programme
M.TECH. (POWER ELECTRONICS)

SEMESTER – III

Course Code	Course Name	Periods per Week	Credits	Evaluation Scheme				
				CIE			ESE	Total Marks
				TA	MSE	Total		
P14PE301	Industrial Training	08 weeks	4	100	-	100	-	100
P14PE302	Dissertation	16 weeks	8	100	-	100	-	100
	Total	**24 weeks**	**12**	**200**	**-**	**200**	**-**	**200**

P14PE301 **INDUSTRIAL TRAINING**

M.Tech. **Semester:** III **Branch:** EEE (Power Electronics)

Teaching Scheme:

L	T	P	C
-	-	-	4

Examination Scheme:

End Semester Exam	**:**	100 marks

Course Objectives:

1. To Understand advanced topics in power electronics & drives.
2. To Improve language and communication skills
3. To Enrich employability & entrepreneurial skills by providing necessary inputs in line with global vision through Industry-Institute Interaction.

The candidate should submit the report and present talk on the training undergone highlighting the contents of the Report before the Departmental Post-Graduate Review Committee (DPGRC).

Course Outcomes:

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

- *Understand advanced topics in power electronics & drives.*
- *Improve language and communication skills*
- *Enrich employability & entrepreneurial skills by providing necessary inputs in line with global vision through Industry-Institute Interaction.*
- *create informative PPTs with effective oral presentation, showing knowledge on industrial training*

P14PE301 INDUSTRIAL TRAINING						
Course Outcomes		**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
Understand advanced topics in power electronics & drives.	CO1	2	-	2	2	2
Improve language and communication skills	CO2	2	-	2	2	2
Enrich employability & entrepreneurial skills by providing necessary inputs in line with global vision through Industry-Institute Interaction.	CO3	-	2	-	1	1
create informative PPTs with effective oral presentation, showing knowledge on industrial training	CO4	-	2	-	1	1
	AVG	**2**	**2**	**2**	**1.5**	**1.5**

P14PE302 DISSERTATION

M.Tech. **Semester:** III **Branch:** EEE (Power Electronics)

Teaching Scheme:

L	T	P	C
-	-	-	8

Examination Scheme:

Continuous Internal Evaluation	:	40 marks
End Semester Exam	:	60 marks

Course Objectives:

1. Recognize and formulate a problem to analyze, synthesize, evaluate, simulate and create a power electronic converter and / or a drive system.
2. Carryout modeling and simulation studies pertaining to the system and prepare a presentation.

The candidate will chose the topic of the Project Work in consultation with the Guide allotted. A report in the prescribed format is to be submitted that includes extensive survey of literature on the topic, highlighting the scope of the work. It should also state the methodology to be adopted and work involved in different modules of the Project Work. The report should clearly specify the expected outcome.

The candidate should submit the report and present talk on the work done, highlighting the contents of the Report before the Departmental Post-Graduate Review Committee (DPGRC).

Course Outcomes:

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

1. *demonstrate creativity in the design of components, systems or processes of their program of study*
2. *design an innovative product by applying current knowledge and adopt to emerging applications of engineering & technology*
3. *work cooperatively with others to achieve shared goal by motivating team-mates with a clear sense of direction, values and ethics*
4. *write concisely & convey meaning in a manner appropriate to different readers and verbally express ideas easily understood by others who are unfamiliar with the topic*

P14PE302 DISSERTATION						
Course Outcomes		PO1	PO2	PO3	PSO1	PSO2
demonstrate creativity in the design of components, systems or processes of their program of study	CO1	3	3	3	3	3
design an innovative product by applying current knowledge and adopt to emerging applications of engineering & technology	CO2	3	3	3	3	3
work cooperatively with others to achieve shared goal by motivating team-mates with a clear sense of direction, values and ethics	CO3	3	3	3	3	3
write concisely & convey meaning in a manner appropriate to different readers and verbally express ideas easily understood by others who are unfamiliar with the topic	CO4	3	3	3	3	3
	AVG	**3**	**3**	**3**	**3**	**3**

KITSW Estd: 1980

DEPARTMENT OF ELECTRICAL&ELECTRONICS ENGINEERING
KAKATIYA INSTITUTE OF TECHNOLOGY & SCIENCE:: WARANGAL – 15
(An Autonomous Institute under Kakatiya university, Warangal)

Scheme of Instruction and Evaluation for Two Year Postgraduate Programme
M.TECH. (POWER ELECTRONICS)

SEMESTER – IV

Course Code	Name of the Course	Periods per Week	Credits	Evaluation Scheme				
				CIE			ESE	Total Marks
				TA	MSE	Total		
P14PE401	Dissertation	24 weeks	12	40	-	40	60	100
	Total	**24 weeks**	**12**	**40**	**-**	**40**	**60**	**100**

P14PE401 DISSERTATION & VIVA-VOCE

M.Tech. **Semester:** IV **Branch:** EEE (Power Electronics)

Teaching Scheme:

L	T	P	C
12	-	-	12

Examination Scheme:

Continuous Internal Evaluation	:	40 marks
End Semester Exam	:	60 marks

Course Objectives:
1. To Build the hardware to demonstrate the principle of working.
2. To Correlate the analytical, simulation and experimental results.
3. To Deduce conclusions and draw inferences worthy of publication.

The candidate should submit the report and present talk on the work done, highlighting the conclusions drawn and outcome of the work before the Departmental Post-Graduate Review Committee (DPGRC).

Course Outcomes:
At the end of the course the student will be able to:
- *demonstrate creativity in the design of components, systems or processes of their program of study*
- *design an innovative product by applying current knowledge and adopt to emerging applications of engineering & technology*
- *work cooperatively with others to achieve shared goal by motivating team-mates with a clear sense of direction, values and ethics*
- *write concisely & convey meaning in a manner appropriate to different readers and verbally express ideas easily understood by others who are unfamiliar with the topic*

P14PE401 DISSERTATION						
Course Outcomes		PO1	PO2	PO3	PSO1	PSO2
demonstrate creativity in the design of components, systems or processes of their program of study	CO1	3	3	3	3	3
design an innovative product by applying current knowledge and adopt to emerging applications of engineering & technology	CO2	3	3	3	3	3
work cooperatively with others to achieve shared goal by motivating team-mates with a clear sense of direction, values and ethics	CO3	3	3	3	3	3
write concisely & convey meaning in a manner appropriate to different readers and verbally express ideas easily understood by others who are unfamiliar with the topic	CO4	3	3	3	3	3
	AVG	**3**	**3**	**3**	**3**	**3**

Estd: 1980
KITSW

KAKATIYA INSTITUTE OF TECHNOLOGY & SCIENCE

(An Autonomous Institute under Kakatiya University, Warangal)

(Sponsored by EKASILA EDUCATION SOCIETY)

(Approved by AICTE, New Delhi; Recognised by UGC under 2(f) & 12(B)

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