ACADEMIC REGULATIONS (R–15)
COURSE STRUCTURE
&
DETAILED SYLLABI

M. Tech Regular Two Year Degree Courses

(For the Batches Admitted From 2015-2016)

POWER ELECTRONICS AND ELECTRICAL DRIVES

(PE & ED)

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

SRI VENKATESWARA COLLEGE OF ENGINEERING AND TECHNOLOGY

(AUTONOMOUS)

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SRI VENKATESWARA COLLEGE OF ENGINNERING & TECHNOLOGY

(AUTONOMOUS)

(AFFILIATED TO JNTUA, ANANTAPURAMU)

ACADEMIC REGULATIONS

M.TECH REGULAR 2 YEAR DEGREE PROGRAMME

(FOR THE BATCHES ADMITTED FROM THE ACADEMIC YEAR 2015-16)

The Jawaharlal Nehru Technological University Anantapur shall confer M.Tech Post Graduate degree to candidates who are admitted to the Master of Technology Programs and fulfill all the requirements for the award of the degree.

1.0 ELIGIBILITY FOR ADMISSIONS:

Admission to the above programme shall be made subject to the eligibility, qualifications and specialization prescribed by the competent authority for each programme, from time to time. Admissions shall be made either on the basis of merit rank obtained by the qualified candidates at an Entrance Test conducted by the University or on the basis of GATE/PGECET score, subject to reservations and policies prescribed by the Government from time to time.

2.0 ADMISSION PROCEDURE:

As per the existing stipulations of AP State Council for Higher Education (APSCHE), Government of Andhra Pradesh, admissions are made into the first year as follows:

a) Category –A seats are to be filled by Convenor through GATE/PGECET score.
b) Category-B seats are to be filled by Management as per the norms stipulated by Government of A.P.

3.0 Specializations:

Sl. No	Department	Specializations
1.	CE	Structural Engg.
2.	EEE	Power Electronics & Electrical Drives
3.	EEE	Electrical Power Systems
4.	ME	CAD/CAM
5.	ME	Machine Design
6.	ECE	VLSI System Design
7.	ECE	Digital Electronics and Communication System
8.	ECE	Embedded systems
9.	CSE	Computer Science & Engg.
10.	CSE	Computer Science
11.	IT	Software Engg.

4.0 COURSE WORK:

4.1. A Candidate after securing admission must pursue the M.Tech course of study for Four Semesters duration.

4.2. Each semester shall have a minimum of 16 instructional weeks.

4.3. A candidate admitted to a programme should complete it within a period equal to twice the prescribed duration of the programme from the date of admission.

5.0 ATTENDANCE:

5.1. A candidate shall be deemed to have eligibility to write end semester examinations if he has put in at least 75% of attendance on cumulative basis of all subjects/courses in the semester.

5.2. Condonation of shortage of attendance up to 10% i.e., from 65% and above and less than 75% may be given by the college on the recommendation of the Principal.

5.3. Condonation of shortage of attendance shall be granted only on medical grounds and on representation by the candidate with supporting evidence.

5.4. If the candidate does not satisfy the attendance requirement he is detained for want of attendance and shall reregister for that semester. He shall not be promoted to the next semester.

6.0 EVALUATION:

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

6.1. For the theory subjects 60% of the marks will be for the External End Examination. While 40% of the marks will be for Internal Evaluation, based on the average of the marks secured in the two Mid Term-Examinations held, one in the middle of the Semester (first two units) and another immediately after the completion of instruction (last three units) with four questions to be answered out of five in 2 hours, evaluated for 40 marks.

For semester end examination (external paper setting & external evaluation) five questions shall be given for a maximum of 60 marks with one question from each unit with internal choice i.e. either or type. All questions carry equal marks.

6.2. For practical subjects, 60 marks shall be for the End Semester Examinations and 40 marks will be for internal evaluation based on the day to day performance (25 marks) and practical test at the end of the semester (15 marks).

6.3. Seminar is a continuous assessment process. For Seminar there will be an internal evaluation of 50 marks. A candidate has to secure a minimum of 50% to be declared successful. The assessment will be made by a board consisting of HOD and two internal experts.

6.4. For comprehensive viva voce there will be an internal evaluation of 100 marks. A candidate has to secure a minimum of 50% to be declared successful. The assessment will be made by a board consisting of HOD and two internal experts.

6.5. **A candidate shall be deemed to have secured the minimum academic requirement in a** subject if he secures a minimum of 40% of marks in the End Examination and a minimum aggregate of 50% of the total marks in the End Semester Examination and Internal Evaluation taken together.

6.6. In case the candidate does not secure the minimum academic requirement in any of the subjects (as specified in 6.5) he has to reappear for the Semester Examination either supplementary or regular in that subject, or repeat the subject when next offered or do any other specified subject as may be required.

6.7. **Revaluation / Recounting:**

Students shall be permitted for request for recounting/revaluation of the Semester-End examination answer scripts within a stipulated period after payment of prescribed fee. After recounting or revaluation, records are updated with changes if any and the student will be issued a revised grade sheet. If there are no changes, the same will be intimated to the students.

6.8 Supplementary Examination:

In addition to the regular Semester- End examinations conducted, the College may also schedule and conduct supplementary examinations for all the subjects of other semesters when feasible for the benefit of students. Such of the candidates writing supplementary examinations may have to write more than one examination per day.

7.0 RE-REGISTRATION:

Following are the conditions to avail the benefit of improvement of internal evaluation marks

7.1. The candidate should have completed the course work and obtained examinations results for I & II semesters.

7.2. He should have passed all the subjects for which the Internal evaluation marks secured are more than or equal to 50%.

7.3. Out of the subjects the candidate has failed in the examination due to Internal evaluation marks secured being less than 50%, the candidate shall be given one chance for each Theory subject and for a maximum of **three** Theory subjects for Improvement of Internal evaluation marks.

7.4. The candidate has to re-register for the chosen subjects and fulfill the academic requirements.

7.5. For each subject, the candidate has to pay a fee equivalent to one third of the semester tuition fee and the along with the requisition to the Principal of the college.

7.6. In the event of availing the Improvement of Internal evaluation marks, the internal evaluation marks as well as the End Examinations marks secured in the previous attempt(s) for the reregistered subjects stand cancelled.

8.0 EVALUATION OF PROJECT WORK:

Every candidate shall be required to submit thesis or dissertation after taking up a topic approved by the college/ institute.

8.1. Registration of Project work: A candidate is permitted to register for the project work after satisfying the attendance requirement of I & II Semesters.

8.2. An Internal Departmental Committee (I.D.C) consisting of HOD, Supervisor and one internal senior teacher shall monitor the progress of the project work.

8.3. The work on the project shall be initiated in the penultimate semester and continued in the final semester. The duration of the project is for two semesters. The candidate can submit Project thesis with the approval of I.D.C. after 36 weeks from the date of registration at the earliest. Extension of time within the total permissible limit for completing the programme is to be obtained from the Head of the Institution.

8.4. The student must submit status report at least in three different phases during the project work period. These reports must be approved by the I.D.C before submission of the Project Report and award internal assessment marks for 120.

8.5. A candidate shall be allowed to submit the Thesis / Dissertation only after passing in all the prescribed subjects (both theory and practical) and then take viva voce examination of the project. The viva voce examination may be conducted once in two months for all the candidates who have submitted thesis during that period.

8.6. Three copies of the Thesis / Dissertation certified in the prescribed form by the supervisor and HOD shall be presented to the H.OD. One copy is to be forwarded to the Controller Of Examinations and one copy to be sent to the examiner.

8.7. The Dept shall submit a panel of three experts for a maximum of 5 students at a time. However, the Thesis / Dissertation will be adjudicated by one examiner nominated by the Chief Controller Of Examinations.

8.8. If the report of the examiner is favorable viva-voce examination shall be conducted by a board consisting of the Supervisor, Head of the Department and the examiner who adjudicated the thesis / dissertation. The board shall jointly award the marks for 180.

8.9. A candidate shall be deemed to have secured the minimum academic requirement in the project work if he secures a minimum of 50% marks in the end viva-voce examination and a minimum aggregate of 50% of the total marks in the end viva-voce examination and the internal project report taken together. If he fails to get the minimum academic requirement he has to appear for the viva-voce examination again to get the minimum marks. If he fails to get the minimum marks at the second

viva-voce examination he will not be eligible for the award of the degree, unless the candidate is asked to revise and resubmit. If the candidate fails to secure minimum marks again, the project shall be summarily rejected.

9.0 Grades, Grade point Average, Cumulative Grade point Average:

9.1. Grade System: After all the components and sub-components of any subject (including laboratory subjects) are evaluated, the final total marks obtained will be converted to letter grades on a "10 point scale" described below.

% of marks obtained	Grade	Grade Points(GP)
90 to 100	**A+**	**10**
80 to 89	**A**	**9**
70 to 79	**B**	**8**
60 to 69	**C**	**7**
50 to 59	**D**	**6**
Less than 50 in sum of Int. and Ext. (or) Less than 40 in Ext.	**F**	**0**
Not Appeared	**N**	**0**

9.2. GPA: Grade Point Average (GPA) will be calculated as given below on a "10 Point scale" as an Index of the student's performance at the end of each semester:

$$\textbf{GPA} = \frac{\sum(CXGP)}{\sum C}$$

Where C denotes the credits assigned to the subjects undertaken in that semester and GP denotes the grade points earned by the student in the respective subjects

9.3. CGPA: At the end of every semester, a Cumulative Grade Point Average (CGPA) on a 10 Point scale is computed considering all the subjects passed up to that point as an index of overall Performance up to that Point as given below:

$$\textbf{CGPA} = \frac{\sum(CXGP)}{\sum C}$$

Where C denotes the credits assigned to subjects undertaken upto the end of the current semester and GP denotes the grade points earned by the student in the respective courses.

9.4. Grade sheet: A grade sheet (Marks Memorandum) will be issued to each student Indicating his performance in all subjects registered in that semester

indicating the GPA and CGPA. GPA and CGPA will be rounded off to the second place of decimal.

9.5 **Transcripts: After successful completion of the entire Program of study, a transcript containing performance of all semesters will be issued as a final record. Duplicate transcripts will also be issued, if required, after payment of requisite fee.**

10.0 Award of Degree: The Degree will be conferred and awarded by Jawaharlal Nehru Technological University Anantapur, Anantapur on the recommendation of The Principal of SVCET (Autonomous).

10.1 Eligibility: A student shall be eligible for the award of M.Tech. Degree if he fulfills all the following conditions:

- **Registered and successfully completed all the components prescribed in the program of study for which he is admitted.**
- **Successfully acquired the minimum required credits as specified in the curriculum corresponding to the specialization of study within the stipulated time.**
- **Obtained CGPA greater than or equal to 6.0 (Minimum requirement for declaring as passed.)**

10.2 Award of Class: Declaration of Class is based on CGPA.

Cumulative Grade Point Average	Class
≥7.75	First Class with Distinction
≥6.75 and<7.75	First Class
≥6.0 and <6.75	Second Class

11.0 WITH – HOLDING OF RESULTS: If the candidate has not paid dues to the university or If any case of in-discipline is pending against him, the result of the candidate shall be withheld and he will not be allowed / promoted into the next higher semester. The issue of degree is liable to be withheld in such cases.

12.0 TRANSITORY REGULATIONS:

Candidates who have discontinued or have been detained for want of attendance or who have failed after having undergone the course in earlier regulations and wish to continue the course are eligible for admission into the unfinished semester from the date of commencement of class work with the same or equivalent subjects as and when subjects are offered, subject to 6.5 and 4.3 sections. Whereas they continue to be in the academic regulations of the batch they join later.

13.0 GENERAL:

i. The academic regulations should be read as a whole for purpose of any interpretation.
ii. Disciplinary action for Malpractice/improper conduct in examinations is appended.
iii. Where the words "he", "him", "his", occur in the regulations, they include "she", "her", "hers".
iv. In the case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Principal is final.
v. The college may change or amend the academic regulations or syllabi at any time and the changes or amendments shall be made applicable to all the students on rolls with effect from the dates notified by the college.

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Identification of Courses

M. Tech

Each course shall be uniquely identified by an alphanumeric code of width 7 characters as given below.

No. of digits	Description
First two digits	Year of regulations Ex:15
Next one letter	Type of program: A: B. Tech B: M. Tech C: M.B.A D: M.C.A
Next two letters	Code of program: ST: Structural Engineering, P.E: Power Electronics & Electric Drives, PS: Electrical Power Systems, CM: CAD/CAM, MD: Machine Design, VL: VLSI, DE: DECS, EM: Embedded Systems, CS: Computer Science and Engineering, CO: Computer Science, SE: Software Engineering,
Last two digits	Indicate serial numbers: ≥ 01

Ex:

15BST01

15BPE01

15BPS01

15BCM01

15BMD01

15BVL01

15BDE01

15BEM01

15BCS01

15BCO01

15BSE01

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RULES FOR DISCIPLINARY ACTION FOR MALPRACTICE / IMPROPER CONDUCT IN EXAMINATIONS

	Nature of Malpractices / Improper conduct	**Punishment**
	If the candidate	
1. (a)	Possesses or keeps accessible in examination hall, any paper, note book, programmable calculators, Cell phones, pager, palm computers or any other form of material concerned with or related to the subject of the examination (theory or practical) in which he is appearing but has not made use of (material shall include any marks on the body of the candidate which can be used as an aid in the subject of the examination)	Expulsion from the examination hall and cancellation of the performance in that subject only.
(b)	Gives assistance or guidance or receives it from any other candidate orally or by any other body language methods or communicates through cell phones with any candidate or persons in or outside the exam hall in respect of any matter.	Expulsion from the examination hall and cancellation of the performance in that subject only of all the candidates involved. In case of an outsider, he will be handed over to the police and a case is registered against him.
2.	Has copied in the examination hall from any paper, book, programmable calculators, palm computers or any other form of material relevant to the subject of the examination (theory or practical) in which the candidate is appearing.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the subjects of that Semester/year. The Hall Ticket of the candidate is to be cancelled.

3.	Comes in a drunken condition to the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the subjects of that Semester/year.
4.	Smuggles in the Answer book or additional sheet or takes out or arranges to send out the question paper during the examination or answer book or additional sheet, during or after the examination.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that Semester/year. The candidate is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
5.	Leaves the exam hall taking away answer script or intentionally tears of the script or any part thereof inside or outside the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that Semester/year. The candidate is also debarred for two

		consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
6.	Possess any lethal weapon or firearm in the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that Semester/year. The candidate is also debarred and forfeits of seat.
7.	Impersonates any other candidate in connection with the examination.	The candidate who has impersonated shall be expelled from examination hall. The candidate is also debarred and forfeits the seat. The performance of the original candidate who has been impersonated, shall be cancelled in all the subjects of the examination (including practicals and project work) already appeared and shall not be allowed to appear for examinations of the remaining subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by

		the candidate is subject to the academic regulations in connection with forfeiture of seat. If the impostor is an outsider, he will be handed over to the police and a case is registered against him.
8.	Refuses to obey the orders of the Chief Superintendent / Assistant – Superintendent / any officer on duty or misbehaves or creates disturbance of any kind in and around the examination hall or organizes a walk out or instigates others to walk out, or threatens the officer-in-charge or any person on duty in or outside the examination hall of any injury to his person or to any of his relations whether by words, either spoken or written or by signs or by visible representation, assaults the officer-in-charge, or any person on duty in or outside the examination hall or any of his relations, or indulges in any other act of misconduct or mischief which result in damage to or destruction or property in the examination hall or any part of the College campus or engages in any other act which in the opinion of the officer on duty amounts to use of unfair means or misconduct or has the tendency to disrupt the orderly conduct of the examination.	In case of students of the college, they shall be expelled from examination halls and cancellation of their performance in that subject and all other subjects the candidate(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the subjects of that semester/year. The candidates also are debarred and forfeit their seats. In case of outsiders, they will be handed over to the police and a police case is registered against them.

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

Malpractices identified by squad or special invigilators

1. Punishments to the candidates as per the above guidelines.

SCHEME OF INSTRUCTION AND EXAMINATIONS UNDER R15 REGULATIONS

I M.Tech, I Semester (PE & ED)

S.No	Code	Subject	Periods			Credits	Scheme of Examination (Maximum Marks)		
			L	T	P		Internal	External	Total
1	15BPE01	Advanced Power Semiconductor Devices and Protection	3	1	-	4	40	60	100
2	15BPE02	Analysis of Power Converters	3	1	-	4	40	60	100
3	15BPE03	Power Electronic Control of DC Drives	3	1	-	4	40	60	100
4	15BPE04	Principles of Machine modeling and Analysis	3	1	-	4	40	60	100
5		**Elective – I**	3	1	-	4	40	60	100
	15BPE05	DSP Applications in Electrical Engineering							
	15BPE06	Modern Power Electronics							
	15BPE07	Computer Aided Design of Electrical Machines							
6		**Elective – II**	3	1	-	4	40	60	100
	15BPE08	PIC Controllers and their Applications							
	15BPE09	Computer Aided Design of Power Electronics Circuits							
	15BPE10	Advanced Power System Operation & Control							
7	15BPE11	Simulation of Power Electronic Systems Lab	-	-	3	2	40	60	100
8	15BPE12	D.C. Drives lab	-	-	3	2	40	60	100
9	15BPE13	Seminar -I	-	-	-	2	50	-	50
		Total	**18**	**6**	**6**	**30**	**370**	**480**	**850**

I M.Tech, II Semester (PE & ED)

S.No	Code	Subject	Periods			Credits	Scheme of Examination (Maximum Marks)		
			L	T	P		Internal	External	Total
1	15BPE14	Analysis of Inverters	3	1	-	4	40	60	100
2	15BPE15	Power Electronic Control of AC Drives	3	1	-	4	40	60	100
3	15BPE16	Power Electronics for Renewable Energy Sources	3	1	-	4	40	60	100
4	15BPE17	Power Electronics Applications in Power Systems	3	1	-	4	40	60	100
5		**Elective –III**	3	1	-	4	40	60	100
	15BPE18	Embedded System Design							
	15BPE19	Intelligent Control of Electrical Drives							
	15BPE20	Modern Rectifiers and Resonant Converters							
6		**Elective –IV**	3	1	-	4	40	60	100
	15BPE21	Optimal Control Theory							
	15BPE22	System Identification and Adaptive Control							
	15BPE23	Electrical Distribution and Automation.							
7	15BPE24	A.C. Drives Lab	-	-	3	2	40	60	100
8	15BPE25	Embedded Systems Lab	-	-	3	2	40	60	100
9	15BPE26	Seminar -II	-	-	-	2	50	-	50
10	15BPE27	Comprehensive viva voce	-	-	-	2	100	-	100
		Total	**18**	**6**	**6**	**32**	**470**	**480**	**950**

SCHEME OF INSTRUCTION AND EXAMINATIONS UNDER R15 REGULATIONS

II M.Tech, III & IV Semester (PE & ED)

S.No	Code	Subject	Periods			Credits	Scheme of Examination (Maximum Marks)		
			L	T	P		Internal	External	Total
1	15BPE28	Project Work	-	-	-	12	120	180	300

SRI VENKATESWARA COLLEGE OF ENGINEERING AND TECHNOLOGY (AUTONOMOUS)

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

I M.Tech, I Semester (PE & ED)	**L**	**T**	**P**	**C**
	3	**1**	**-**	**4**

15BPE01 ADVANCED POWER SEMICONDUCTOR DEVICES AND PROTECTION

Objectives:

1. *To know various types of power semi conductor devices such as BJT, MOSFET, GTO, IGBT and their characteristics.*
2. *To obtain knowledge on various types of emerging power semi conductor devices such as power JFET and MOS controlled Thyristor.*
3. *To understand the Electromagnetic Interference due to switching in power electronic circuits.*
4. *To know the protection of power devices using snubber circuits.*

Outcomes:

After completion of this course, the student will be able to:

1. *Analyze the characteristics and operation of power semi conductor devices.*
2. *Design the cross section and switching characteristics of semi conductor devices.*
3. *Identify the occurrence of noise and measurement of noise.*
4. *Design the protection of power device and transient in the power electronic circuits.*

UNIT I

BJT ANDGATE TURN-OFF THYRISTOR (GTO):BJTIntroduction- vertical power transistor structures-I-V characteristics-physics of BJT operation - switching characteristics-break down voltages-second break down-on-state losses-safe operation areas - design of drive circuits for BJTs-snubber circuits for BJT and Darlington's–GTOIntroduction-basic structures-I-V characteristics-physics of device operation-GTO switching characteristics-snubber circuits - over protection of GTO

UNIT II

POWER MOSFET: Power MOSFET Introduction-basic structures-I-V characteristics-physics of device operation-switching characteristics-operation limitations and safe operating areas-design of gate drive circuits-snubber circuits.

UNIT III

INSULATED GATE BIPOLAR TRANSISTOR (IGBT):–IGBT Introduction-basic structures-I-V characteristics-physics of device operation-Latch in IGBTs-switching characteristics-Device limits and safe operating areas-drive and snubber circuits.

UNIT IV

EMERGING DEVICES: Introduction-Power junction field effect transistors-field controlled Thyristor-JFET based devices versus other power devices-MOS controlled Thyristors – Switching Characteristics.

UNIT V

PROTECTION OF POWER DEVICES & CIRCUITS: Cooling & Heat sinks – Thermal modeling of power switching devices- snubbercircuits – Reverse recovery transients – Supply and load side transients – voltage protections – current protections.

Text Books:

1. Mohan and Undeland:*Power Electronics –Converters, Applications and Design,*John Wiley&Sons
2. M.H.Rashid:*Power Electronics Circuits, Devices and Applications,*PHI-Publication
3. B.W Williams:*Power Electronics Circuit Devices and Applications,* New York, Halsted Press, 1987.

References:

1. Joseph Vithayathil:*Power Electronics Circuits,* 2nd Edition, Tata MC Graw Hill.
2. W.C. Lander:*Power Electronics Circuits,* 3rd Edition, Tata MC Graw Hill.
3. LoganathanUmanand:*Power Electronics: Essentials and Applications,* Wiley India Pvt. Ltd, 2009.
4. http://nptelonlinecourses.iitm.ac.in/courses/108104011/

SRI VENKATESWARA COLLEGE OF ENGINEERING AND TECHNOLOGY

(AUTONOMOUS)

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

I M.Tech, I Semester (PE & ED)	**L**	**T**	**P**	**C**
	3	**1**	**-**	**4**

15BPE02 ANALYSIS OF POWER CONVERTERS

Objectives:

1. *To understand the operation and static & dynamic characteristics of all semiconductor devices.*
2. *To acquire knowledge about the operation and performance characteristics of single and three phase converters.*
3. *To study the principle and operation of DC and AC choppers.*
4. *To know the operation and performance characteristics of dual and cyclo converters.*

Outcomes:

After completion of this course, the student will be able to:

1. *Apply the knowledge about static and dynamic characteristics all semiconductor devices.*
2. *Design the single and three phase converters.*
3. *Design DC to DC converters and analyze the switched mode regulators.*
4. *Design and simulate about three phase AC voltage controllers, Cycloconverters and dual converters.*

UNIT I

SINGLE PHASE AC-DC CONVERTER:Introduction to semiconductor Devices - Static and Dynamic Characteristics of SCR, MOSFET, IGBT and GTO- Single phase 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-single phase sinusoidal PWM - Applications - Numerical problems

UNIT II

THREE PHASE AC-DC CONVERTER: Three Phase Converters- Half controlled and fully controlled Converters – Evaluation of input power factor and harmonic factor-Continuous and Discontinuous load current – Applications- Numerical problems

UNIT III

D.C. TO D.C CONVERTERS:

D.C. CHOPPERS:Principle and operation of step down chopper condition of duty cycle-step down converter with R load –Performance parameter 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-Boost Regulators-Cuk Regulators- Condition for continuous inductor and capacitor voltage – Application- Numerical problems

UNIT IV

SINGLE PHASE & THREE PHASE AC VOLTAGE CONTROLLERS: Single Phase AC Voltage Controllers with R, RL and RLE loads-ac voltage controller's with PWM control-Effect of source and load inductances –synchronous tap changers –Applications- Three Phase AC Voltage controllers-Analysis of Controllers with star and delta connected R, RL loads-Effect of source and load inductances–Application- numerical problems.

UNIT V

DUAL CONVERTERS &CYCLOCONVERTERS: Single phase & three phase dual converters-Principle of operation –control strategy - Power factor improvements-three phase PWM-twelve pulse converters–Application- Numerical problems- 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.

Text Books:

1. Rashid M.H:*"Power Electronics – Circuits, Devices & Applications",* Prentice Hall of India, 3rd Edition, New Delhi, 2005.
2. P.S.Bimbra:*"Power Electronics",* Khanna Publishers, Eleventh Edition, 2003
3. Mohan .N, Undeland& Robbins:*"Power Electronics – Converters, Application & Design",* John Wiley & Sons, Inc,2nd Edition, NewYork, 2001.

References:

1. P.C Sen:*"Modern Power Electronics",* Wheeler publishing Co, First Edition, New Delhi, 1998.
2. Rashid M.H:*"Hand book on Power Electronics",*Academic Press,Imprint of Elesvier,California.
3. M.D. Singh & K.B. Khanchandani:*"Power Electronics",* Tata Mc Graw Hill Publishing Company Limited, 2nd Edition, Fourth Print 2009.
4. http://nptel.ac.in/courses/Webcourse-contents/IIT%20Kharagpur/Power%20Electronics/New_index1.html

I M.Tech, I Semester (PE & ED)

L	T	P	C
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15BPE03 POWER ELECTRONIC CONTROL OF DC DRIVES

Objectives:

1. *To study 1-φ & 3-φ controlled bridge rectifier with motor load on continuous and discontinuous modes of operation and effect of freewheeling diode on converter performance*
2. *To understand the operation of three phase naturally commutated bridge as a rectifier and inverter.*
3. *To study the steady state analysis of three phase converter controlled and chopper controlled DC motor drives and design of speed and current controller*
4. *To know the closed loop operation and dynamic simulation of DC motor drive system with current controller.*

Outcomes:

After completion of this course, the student will be able to:

1. *Design the 1- φ & 3-φ controlled drive system for the specified load torque.*
2. *Analyze the performance parameters of three phase controlled converter on load side and supply side.*
3. *Design a chopper controlled DC drive for industrial application*
4. *Simulate the closed loop drive system to predetermine the design parameters of drive system for specific application.*

UNIT I

CONTROLLED BRIDGE RECTIFIER (1-Φ& 3-Φ) WITH DC MOTOR LOAD: Separately excited DC motors with rectified single phase supply- single phase semi converter and single phase full converter for continuous and discontinuous modes of operation – power and power factor - 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 double converter.

UNIT II

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, shunt capacitor compensation, three phase controlled bridge rectifier inverter,

UNIT III

THREE 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 –Current and Speed controllers - current and speed feedback – Design of Current and Speed controllers – Motor equations – current reference generator – current controller and flow chart for simulation – Harmonics and associated problems – sixth harmonic torque.

UNIT IV

CHOPPER CONTROLLED DC MOTOR DRIVES: Principle of operation of the chopper – Four quadrant chopper circuit – Chopper for inversion – Chopper with other power devices – model of the chopper –input to the chopper – Steady state analysis of chopper controlled DC motor drives – rating of the devices – Pulsating torque.

UNIT V

CLOSED LOOP OPERATION AND DYNAMIC SIMULATION OF DC MOTOR DRIVES: Speed controlled drive system – current control loop – pulse width modulated current controller – hysterisis current controller – modeling of current controller – design of current Controller,Dynamic simulations of the speed controlled DC motor drives – Speed feedback speed controller – command current generator – current controller.

Text Books:

1. Shepherd,Hulley Liang: *Power Electronics and motor control,* 2nd Edition, CU Press
2. G. K. Dubey:*Fundamentals of Electric Drives,* Narosa Publications, 1995.
3. R. Krishnan:*Electric motor drives modeling, Analysis and control,* 1stEdition, PHI.

References:

1. M.H.Rashid:*Power Electronic Circuits*, *Devices and Applications,* PHI, 1st Edition.
2. S.B. Dewan and A. Straughen:*Power Semiconductor drives*, 1975.
3. S.K.Pillai:*First course on Electric drives,* New age international publishers Ltd, 2012.

I M.Tech, I Semester (PE & ED)

L	T	P	C
3	1	-	4

15BPE04 PRINCIPLES OF MACHINE MODELING AND ANALYSIS

Objectives:

1. *To know the basic two-pole machine representation of commutator machines, kron'sprimitive machine and acquire the knowledge about mathematical model of DC machines.*
2. *To understand the transformation from three phase to two phase and vice-versa, rotating axes to stationery axes & vice-versa and application of generalized machine theory.*
3. *To impart knowledge of D-Q model of induction machines in various reference frames, per unit model and its dynamic simulation of induction machine*
4. *To emphasize the different models of synchronous machine and also mathematical modelings of various special machines and know about single phase motors.*

Outcomes:

After completion of this course, the student will be able to:

1. *Design and simulate the modeling concepts of 3-phase synchronous machine and 3-phase Induction machine, Kron's primitive machine equations.*
2. *Analyze the mathematical model of separately excited D.C Motor, D.C Series & shunt motor and its steady state, transient state analysis.*
3. *Transforms from 3-phase to 2-phase, Park's transformation of Induction machine, signal flow graph of the Induction machine.*
4. *Design the modeling of 1-phase and poly phase Induction machine, cross field theory, modeling of synchronous machine.*

UNIT I

BASIC CONCEPTS OF MACHINE MODELINGAND DC MACHINE: Basic Two-pole Machine representation of Commutator machines, 3-phase synchronous machine with and without damper bars and 3-phase induction machine, Kron's primitive Machine-voltage, current and Torque equations.Mathematical model of separately excited D.C motor – Steady State analysis-Transient State analysis-Sudden application of Inertia Load-Transfer function of separately excited D.C Motor- Mathematical model of D.C Series motor, steady state analysis -Linearization Techniques for small perturbations

UNIT II

LINEAR TRANSFORMATION IN MACHINES: Transformation from Three phase to two phase and Vice Versa - Transformation from Rotating axes to stationary axes and vice versa – Park's Transformation and it's physical concepts – Transformer Impedance – How to apply generalized theory – Electrical Torque – Restriction Matrix.

UNIT III

THREE PHASE INDUCTION MACHINE:D-Q model of induction machine in Stator reference Frame, Rotor reference Frame and Synchronously rotating reference Frame -Small signal equations of induction machine-d-q flux linkages model derivation- Signal flow graph of the induction machine-Per unit model -Dynamic simulation of induction machine.

UNIT IV

SINGLE PHASE INDUCTION MOTORS& SYNCHRONOUS MACHINE: Comparison between single phase and poly-phase induction motors - Cross field theory - steady state analysis – steady state torque –Synchronous Machine/Synchronous machine inductances –The phase Co-ordinate model-The Space phasor (d-q) model-Steady state operation-Mathematical model of PM Synchronous motor.

UNIT V

SPECIAL MACHINES: Mathematical Modeling of Permanent Magnet Brushless DC Motorand Switched Reluctance Motor – Operating principle of PM Brushless DC motor-PMDC Motor Drive Scheme, -Operating principle of SRM -Construction and functional Aspects-Average

torque and Energy Conversion Ratio-The Commutation windings-The flux current position curve fitting.

Text Books:

1. P.S.Bimbhra: *Generalized Theory of Electrical Machines,* Khanna publications, 5th Edition,1995.
2. R.Krishnan: *Electric Motor Drives Pearson Modeling, Analysis& control,* 1st edition, 2002.
3. P.C.Krause:*Analysis of Electrical Machinery,*Tata McGraw Hill, 1980.

References:

1. C.V.jones, Butterworth:*The Unified Theory of Electrical Machines*, London, 1967
2. Boldea& S.A. Nasar:*Electrical Drives-I*,The Oxford Press Ltd.
3. D.P. Sengupta& J.B. Lynn:*Electrical Machine Dynamics*, The Macmillan Press
4. Woodson & Melcher:*Electromechanical Dynamics*, John Wiley & Sons

I M.Tech, I Semester (PE & ED)

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15BPE05 DSP APPLICATIONS IN ELECTRICAL ENGINEERING (ELECTIVE – I)

Objectives:

1. *To know the importance of Digital Signal Processing and digital filter structures.*
2. *To study the operation of IIR and FIR digital filters.*
3. *To acquire knowledge about realization of digital filters and fourier transform computations*
4. *To understand the operation of C2XXX, peripherals and DSP controlled AC & DC drives.*

Outcomes:

After completion of this course, the student will be able to:

1. *Analyze the linear time invariant system, DFT, design of FIR digital filters.*
2. *Design the IIR digital filters and FIR filter.*
3. *Emphasize the finite word length effects, architecture of TMS320LF2407A.*
4. *Design the operation of DSP controlled DC motor drives and peripherals.*

UNIT I

INTRODUCTION TO DIGITAL SIGNAL PROCESSING AND DIGITAL FILTER STRUCTURES: Introduction -Linear time invariant systems- A Digital Signal Processing System, The sampling -quantization – Discrete time sequences – Discrete Fourier Transform (DFT), Fast Fourier Transform (FFT, Digital filters Decimation & Interpolation - Block Diagram representation, Equivalent structures, Basic FIR Digital Filter structures, Basic IIR Digital Filter structures, Realization of Basic structures using MATLAB, All pass filters, Computational complexity of Digital filter structures.

UNIT II

IIR & FIR DIGITAL FILTER DESIGN: Preliminary considerations, Bilinear transformation method of IIR Filter design, Design of low pass IIR Digital filters, Design of High pass, Band pass and band stop IIR digital filters, Spectral Transformations of IIR filter - Preliminary considerations, FIR filter design based on windowed Fourier series, Computer aided design of Equiripple Linear phase FIR filters, Design of Minimum phase FIR filters. Design of computationally efficient FIR digital filters.

UNIT III

FINITE WORD LENGTH EFFECTS AND ARCHITECTURE OF TMS320LF 2407A: Introduction-Effects of coefficients on Quantization- Quantization in sampling analog signals- Finite register length effects in realization of Digital Filters- Discrete Fourier transform computations - Architectural overview – Memory and I/O spaces -Internal architecture – Central Processing Unit (CPU) – Program control.

UNIT IV

ADDRESSING MODES AND ASSEMBLY LANGUAGE INSTRUCTIONS OF C2XXX& PERIPHERALS (THE EVENT MANAGERS): Data formats – Addressing modes – groups of addressing mode – Assembly language instructions- Event Manager (EV) Functional Blocks-Event Manager (EV) Register Addresses- General-Purpose (GP) Timers -Compare Units- PWM Circuits Associated with Compare Units-PWM Waveform Generation with Compare Units and PWM Circuits-Space Vector PWM- Capture Units- Quadrature Encoder Pulse (QEP) Circuit - Event Manager (EV) Interrupts

UNIT V

APPLICATIONS IN DSP CONTROLLER: Applications – DSP controlled DC motor drives –DSP controlled AC motor drives-Different types of PWM Techniques using DSP-Model for converter and inverter-6 pulse and 24 pulse controllers for cycloconverter- Comparison of FPGA controller with DSP controller.

Text Books:

1. Emmanuel C. Ifeachor, Barrie W. Jervis: "*Digital Signal Processing: A PracticalApproach",* Pearson Education India Series, New Delhi, 2nd Edition,2004
2. Sanjit K Mitra:" *Digital Signals Processing: A Computer Based Approach",* TataMcGraw- Hill Publishing Company Limited, 2nd Edition, 2004.
3. Alan Oppenheim. V and Ronald W.Schafer:"*Digital Signal Processing",* PrenticeHall of India Private. Limited., New Delhi, 1989.

References:

1. B.Venkatramani, M.Bhaskar:"*Digital Signal Processors- Architecture, programming and applications",* Tata McGraw- Hill Publishing Company Limited.

2. John G. Proakis and Manolakis. D.G:*"Digital Signal Processing: Principles Algorithms and Applications,"* Prentice Hall of India, New Delhi, 2004.

3. TMS320F/C24x DSP Controllers-Reference Guide-CPU and Instruction Set
4. TMS320LF/LC240Xa-DSP Controllers-Reference Guide-System and Peripherals.

I M.Tech, I Semester (PE & ED)

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15BPE06 MODERN POWER ELECTRONICS (ELECTIVE – I)

Objectives:

1. *To know static and dynamic characteristics of modern power semiconductor devices.*
2. *To know design of resonant converters and its time and frequency responses.*
3. *To know the concept of multilevel inverter and its performances.*
4. *To know the principle and operation of AC and DC power supplies.*

Outcomes:

After completion of this course, the student will be able to:

1. *Design the modern power semiconductor devices & static and dyanamic characteristics of all modern power semiconductor devices.*
2. *Emphasize the different types of resonant pulse inverters and also know the time and frequency response.*
3. *Simulate and Design the operation of multi level inverters and its importances.*
4. *Design the DC and AC power supplies using advanced techniques.*

UNIT I

MODERN POWER SEMICONDUCTOR DEVICES: Modern power semiconductor devices- MOS Turn Off Thyristor (MTO) – Emitter Turn Off Thyristor (ETO) – Integrated Gate – Commutated thyristor (IGCTs) – MOS – controlled thyristors (MCTs) – Static induction Thyristors (SITHs) – Power integrated circuits (PICs) – Symbol, structure and equivalent circuit- comparison of their features.

UNIT II

RESONANT PULSE INVERTERS: Resonant pulse inverters – series resonant inverters- series resonant inverters with unidirectional switches – series resonant inverters with bidirectional switches- analysis of half bride resonant inverter- evaluation of currents and Voltages of a simple resonant inverter – analysis of half bridge and full bridge resonant inverter with bidirectional switches – Frequency response of series resonant inverter- for series loaded inverter – for parallel resonant inverters – Voltage control of resonant inverters-class E resonant inverter – class E resonant rectifier- evaluation of values of C's and L's for class E inverter and Class E rectifier – numerical problems.

UNIT III

MULTILEVEL INVERTERS: Multilevel concept- Classification of multilevel inverters – Diode clamped Multilevel inverter- Principle of operation – main features- improved diode clamped inverter – principle of operation – Flying capacitors multilevel inverter – principle of operation – main features - Cascaded multilevel inverter – principle of operation – main features- multilevel inverter applications – reactive power compensation – back to back intertie system – adjustable drives – switching device currents – dc link capacitor voltage balancing –features of Multilevel inverters – comparisons of multilevel converters.

UNIT IV

DC POWER SUPPLIES: DC power supplies – classification- switched mode dc power supplies – fly back Converter- forward converter- push –pull converter –half bridge converter –Full bridge converter – Resonant DC power supplies- bidirectional power supplies- Application.

UNIT V

AC POWER SUPPLIES: AC power supplies – classification – switched mode ac power supplies Resonant AC power supplies-bidirectional ac power supplies – multistage conversions-control circuits- UPS & applications.

Text Books:

1. Mohammed H.Rashid:Power Electronics, Pearson Education- Third Edition –first Indian reprint – 2004.
2. Ned Mohan, Tore M.Undeland and William P.Robbind: Power Electronics, John wiley& Sons, 2nd Edition.
3. Jai P. Agarwal:*Power Electronics Systems,* Pearson Education, Second Edition, 2002

References:

1. L. Umanand:*Power Electronics – Essentials & Applications,* Wiley Publication,2009
2. http://freevideolectures.com/Course/3345/Pulse-width-Modulation-for-Power-Electronic-Converters/3
3. http://freevideolectures.com/Course/3345/Pulse-width-Modulation-for-Power-Electronic-Converters/4
4. http://freevideolectures.com/Course/3345/Pulse-width-Modulation-for-Power-Electronic-Converters/5

I M.Tech, I Semester (PE & ED)

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15BPE07 COMPUTER AIDED DESIGN OF ELECTRICAL MACHINES (ELECTIVE – I)

Objectives:

1. *To acquire knowledge about the concepts of mathematical formulation of electromagnetic field equations and Stored Energy in field problems.*
2. *To understand the principles of energy conversion.*
3. *To know the importance of finite element methods for design of electrical machines.*
4. *To understand electrical machine design using CAD elements.*

Outcomes:

After completion of this course, the student will be able to:

1. *Design the concepts of conventional design procedures and need for field analysis based design.*
2. *Analyze Laplace and Poisson's equations.*
3. *Analyze the concepts of Energy minimization, 2D field problems, shape functions and stiffness matrix etc.*
4. *Simulate the CAD packages for design applications of machines.*

UNIT I

INTRODUCTION AND MATHEMATICAL FORMULATION OF FIELD PROBLEMS: Conventional design procedures – Limitations – Need for field analysis based design - Electromagnetic Field Equations – Magnetic Vector/Scalar potential – Electrical vector /Scalar potential – Stored energy in field problems – Inductance - Development of torque/force.

UNIT II

LAPLACE AND POISSON'S EQUATIONS: Laplace and Poisson's Equations – Energy functional - Principle of energy conversion.

UNIT III

PHILOSOPHY OF FEM –I AND FEM – II: Mathematical models – Differential/Integral equations – Finite Difference method – Finite element method – Energy minimization - Variational method - 2D field problems – Discretisation – Shape functions – Stiffness matrix – Solution techniques.

UNIT IV

CAD PACKAGES: Elements of CAD System – Pre-processing – Modelling – Meshing Material properties - Boundary Conditions– Setting up solution – Post processing.

UNIT V

DESIGN APPLICATIONS –I& II: Design of Solenoid Actuator – Induction Motor - Insulators – Power transformer.

Text Books:

1. S.J Salon:*"Finite Element Analysis of Electrical Machines",* Kluwer Academic Publishers, London, 1995.
2. S.R.H.Hoole:*"Computer – Aided, Analysis and Design of Electromagnetic Devices",* Elsevier, New York, Amsterdam, London, 1989.
3. A.K.Sawhney:*"A Course in Electrical Machine Design",*Dhanpat Rai & Co, 5th Edition, Reprint 2002.

References:

1. P.P. Silvester and Ferrari:*"Finite Elements for Electrical Engineers",* Cambridge University press, 1983.
2. D.A.Lowther and P.P Silvester:*"Computer Aided Design in Magnetics",* Springer verlag, New York, 1986.

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I M.Tech, I Semester (PE & ED)

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15BPE08 PIC CONTROLLERS &THEIR APPLICATIONS
(ELECTIVE – II)
(Common to PE& ED and EPS)

Objectives:

1. *To understand the review of basic models of 8-bit microcontrollers like MCS-51 and Atmel.*
2. *To know in detail the PIC microcontrollers.*
3. *To understand interface some of the peripheral devices with the microcontroller.*
4. *To study some Industrial applications of PIC Controllers.*

Outcomes:

After completion of this course, the student will be able to:

1. *Distinguish between CISC and RISC processors*
2. *Design the concept of PIC Controllers and Flash microcontrollers*
3. *Implement the concept of connecting PIC controllers with various interfacing devices for several applications.*
4. *Utilize the knowledge of PIC controllers for various Industrial applications related with Electrical Engineering.*

UNIT I

INTRODUCTION TO MICROCONTROLLERS:8-bit & 16-bit microcontrollers – CISC and RISC processors – Harvard and Van Neumann architecture –MCS-51 Architecture –MCS-51 Instruction Set-Simple Programs-ATMEL Microcontroller(89CXX and 89C20XX)-Architectural Overview of ATMEL 89C51 and ATMEL 89C2051-PIN Description of 89C51and 89C2051

UNIT II

PIC CONTROLLERS: Overview and Features – PIC 16C6X/7X – FSR (File Selection Register) [Indirect Data memory Address Pointer]**-** PIC Reset actions – PIC Oscillator connections - PIC Memory organization - PIC 16C6X/7X Instructions - Addressing modes – I/O Ports – Interrupts in PIC 16C61/71 – PIC 16C61/71 Timers

UNIT III

PIC 16F8XX FLASH MICROCONTROLLERS: Introduction - PIN diagram of 16F8XX –STATUS register – OPTION-REG register – Power control register – PIC 16F8XX Program memory – PIC 16F8XX Data memory, Data EEPROM and Flash program EEPROM - Interrupts in 16F877 – I/O Ports – Timers.

UNIT IV

INTERFACING AND MICROCONTROLLER APPLICATIONS: Introduction – Light Emitting Diodes (LEDs), Push buttons, Relays and Latch Connections - Key board interfacing – Interfacing 7-segment Displays – LCD Interfacing – ADC and DAC interfacing with 89C51 microcontrollers

UNIT V

INDUSTRIAL APPLICATIONS: Introduction – Measurement Applications – Sensing Robot Arm position –Linear Variable Differential Transformer (LVDT) – RPM meter – Digital Thermometer – Load cell. Automation and Control applications – Digital PID Controllers – Power controlling devices – Stepper motor drive

Text Books:

1. Ajay V Deshmukh:*Microcontrollers – Theory and Applications*, Mc Graw Hills.

References:

1. Kenneth J Aayala:*8051 Microcontrollers Architecture, Programing and Applications,* 2nd edition, Thomson Publishing
2. Prof C.R. Sarma:*Microprocessor and Microcontrollers.*
3. John B Peatman:*Design with PIC Microcontrollers*, Pearson Education Inc.

I M.Tech, I Semester (PE & ED)

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15BPE09 COMPUTER AIDED DESIGN OF POWER ELECTRONIC CIRCUITS (ELECTIVE – II)

Objectives:

1. *To know importance of simulation of power electronic circuits*
2. *To study operation of coupled and decoupled system using different types of algorithms.*
3. *To design modeling of semi conductor devices.*
4. *To acquire knowledge about time domain, Fourier analysis and simulation of converters*

Outcomes:

After completion of this course, the student will be able to:

1. *Design simulation of power electronic circuits using MATLAB*
2. *Analyze the power electronic systems and modeling of power electronic devices.*
3. *Able to apply the concept of transients and time domain analysis of all semiconductor devices.*
4. *Design and Simulation of converters, choppers and inverters using relevant*

UNIT I

INTRODUCTION: Importance of simulation – General purpose circuit analysis – Methods of analysis of power electronic systems – Review of power electronic devices and circuits.

UNIT II

ADVANCED TECHNIQUES IN SIMULATION –I: Analysis of power electronic systems in a sequential manner – coupled and decoupled systems- Various algorithms for computing steady state solution in power electronic systems – Future trends in computer simulation.

UNIT III

MODELING OF POWER ELCTRONIC DEVICES: Introduction – AC sweep and DC sweep analysis – Transients and the time domain analysis – Fourier series and harmonic components – BJT, FET, MOSFET and its model- Amplifiers and Oscillator – Non-linear devices.

UNIT IV

SIMULATION OF CIRCUITS: Introduction – Schematic capture and libraries – Time domain analysis – System level integration and analysis –Monte Carlo analysis – Sensitivity/stress analysis – Fourier analysis.

UNIT V

CASE STUDIES: Simulation of Converters, Choppers, Inverters, AC voltage controllers, Cycloconverters feeding R, R-L, and R-L-E loads Computation of performance parameters: harmonics, power factor, angle of overlap.

Text Books:

1. Rashid, M:*Simulation of Power Electronic Circuits using PSPICE*, PHI, 2006.
2. Rajagopalan, V:*"Computer Aided Analysis of Power Electronic systems"*Marcell – Dekker Inc., 1987.

References:

1. John Keown:*"Microsim, Pspice and circuit analysis",* Prentice Hall Inc., 1998.

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

I M.Tech, I Semester (PE & ED)	**L**	**T**	**P**	**C**
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15BPE10 ADVANCED POWER SYSTEM OPERATION AND CONTROL (ELECTIVE – II)

Objectives:

1. *To Study economic dispatch, Unit commitment solution and hydrothermal scheduling problem by various methods.*
2. *To understand the load frequency control and economic dispatch control with different control techniques.*
3. *To know the concept of Economic interchange between interconnected utilities, power pools and power flow methods.*
4. *To understand the reactive power control, methods of voltage control and computer control of power systems.*

Outcomes:

After completion of this course the student will be able to:

1. *Apply the concepts of economic dispatch and solve unit commitment problems with various constraints using conventional optimization techniques.*
2. *Able to Solve AGC problems using heuristic techniques.*
3. *Able to know the interchange of power & energy, power pools and power flow methods.*
4. *Analyzereactive power control, methods of voltage control and computer control of power systems.*

UNIT I

ECONOMIC OPERATION & UNIT COMMITMENT PROBLEM IN POWER SYSTEMS: Concept ofEconomic operation- Load forecasting - Unit commitment – Economic dispatch problem of thermal units – Gradient method- Newton's method –Introduction to UCP, constraints in Unit commitment - unit commitment problem solution by priority list scheme method and Dynamic programming Approach. Advantages of DP method over priority list scheme, forward DP approach and their flow charts solution UCP using Dynamic program method.

UNIT II

LOAD FREQUENCY CONTROL& PROPORTIONAL PLUS INTEGRAL CONTROL: Necessity of keeping frequency constant. Definition of control area, single area control, Block diagram representation of an isolated power system, steady state analysis, and Dynamic response-Uncontrolled case. Load frequency control of 2-area system: uncontrolled case and controlled case. Tie-line bias control. Proportional plus integral control of single area and its block diagram representation, steady state response, load frequency control, Economic dispatch control, optimal LF control- steady state representation, performance index and optimal parameter adjustment.

UNIT III

INTERCHANGE OF POWER BETWEEN INTER CONNECTED SYSTEM & POWER SYSTEM SECURITY & CONTINGENCY ANALYSIS: Interchange of Power & Energy: Economic interchange between interconnected utilities – Inter utility energy evaluation – Power pools – Transmission effects and issues: Limitations – Wheeling-Power system security-Contingency analysis – linear sensitivity factors – AC power flow methods – contingency selection – concentric relaxation – bounding-security constrained optimal power flow-Interior point algorithm-Bus incremental costs.

UNIT IV

REACTIVE POWER – VOLTAGE CONTROL: Reactive power control, excitation systems – modelling, static and dynamic analysis, stability compensation, generation and absorption of reactive power, relation between voltage, power and reactive power at a node, method of voltage control, tap changing transformers, tap setting of OLTC transformer and MVAR injection of switched capacitors.

UNIT V

COMPUTER CONTROL OF POWER SYSTEMS: Need of computer control of power systems, concept of energy control center (or) load dispatch center and the functions, system monitoring, data acquisition and control, system hardware configuration, SCADA and EMS functions, network topology, state estimation, security analysis and control, operating states.

Text Books:

1. O.I. Elgerd:*"Electric Energy System Theory - an Introduction",*Tata McGraw Hill, New Delhi, 2002.
2. AllenJ .Wood and Bruce.F.Wollenberg: *"Power Generation Operation and Control',*John Wiley & Sons, New York, 1996.
3. A.K.Mahalanabis, D.P.Kothari and S.I.Ahson:*"Computer Aided Power SystemAnalysis and Control",*Tata McGraw Hill publishing Ltd, 1984.

References:

1. P.Kundur:*"Power System Stability and Control",* EPRI Publications, California 1994.
2. Nagrath, I.J. and Kothari D.P:*'Modern Power System Analysis',* TMH, New Delhi, 1980.
3. D.P.Kothari&J.S.Dhillon:*Power System Optimization*, PHI,2004.

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

I M.Tech, I Semester (PE & ED)	**L**	**T**	**P**	**C**
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15BPE11 SIMULATION OF POWER ELECTRONIC SYSTEMS LAB

Objectives:

1. *To know PSPICE Coding and Simulate single phase converters with RLE load.*
2. *To write PSPICE coding and simulate single phase two & three level inverters and Buck – Boost converters.*
3. *To understand speed control of DC motor using MATLAB SIMULINK.*
4. *To know the performance of PMSM and induction motor using MATLAB SIMULINK.*

Outcomes:

After completion of this course, the student will be able to:

1. *Apply PSPICE in Simulation of Single phase semi & full converters, AC voltage and 3 phase semi & full & DC to DC converters.*
2. *Design the Single phase Two and Three level inverters.*
3. *Apply PSPICE in Simulation of Buck, Boost and Buck –Boost converters.*
4. *Design and Simulate DC & AC Drives.*

LIST OF EXPERIMENTS

Any Ten of the following experiments are to be conducted as compulsory experiments

1. PSPICE simulation of single phase Semi & full converter using R-L-E load
2. PSPICE simulation of single phase AC voltage controller using R-L-E load
3. PSPICE simulation of Three phase Semi & Full converter using R-L-E load
4. PSPICE simulation of single phase inverter with Two Level PWM control
5. PSPICE simulation of single phase inverter with Three Level PWM control
6. PSPICE simulation of Buck, Boost & Buck-Boost Converters
7. Simulation of Open Loop Control of PMSM Using MATLAB Simulink
8. Simulation of speed control of separately excited DC Motor using MATLAB Simulink
9. Simulation of induction motor with indirect vector control using MATLAB Simulink
10. Simulation of induction motor with Closed loop constant V/F control using MATLAB Simulink
11. Simulation of Four Quadrant Chopper fed DC motor drive
12. Simulation of Three Phase AC Voltage controller (Matrix Converter)

I M.Tech, I Semester (PE & ED)

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15BPE12 D.C DRIVES LAB

Objectives:

1. *To determine the performance parameters of half and fully controlled bridges with RL Loads.*
2. *To conduct experiment on closed loop speed control of PMDC motor.*
3. *To know the performance of chopper fed DC motor*
4. *To obtain speed control of four quadrant chopper fed PMDC motor.*

Outcomes:

After completion of this course, the student will be able to:

1. *Know the concept of Single phase AC to DC converters.*
2. *Design speed control of PMDC motor.*
3. *Design the concept of 4 quadrant chopper and Thyristorised drives.*
4. *Design and Simulate the operation of 3 phase full converter on R & RL loads.*

LIST OF EXPERIMENTS

Any Ten of the following experiments are to be conducted as compulsory experiments

1. Single phase half wave controlled converter fed DC motor drive with continuous and discontinuous mode
2. Single phase fully controlled converter fed DC motor drive with continuous and discontinuous mode
3. Thyristorised drive for PMDC motor with speed measurement & closed loop control
4. Speed measurement of PMDC motor with closed loop control
5. IGBT using single 4 quadrant chopper drive for PMDC motor with speed measurement and closed loop and control
6. Thyristorised drive for dc motor with closed loop control
7. Three phase input thyristorised drive 3hp dc motor with closed loop control
8. Three phase input IGBT drive for 4 quadrant chopper of 3HP dc motor with closed loop control
9. Operation of 3- phase Full controlled Converter with R-L& R-L-E load
10. Performance & speed control of D.C. drive using 3-phase full Converter
11. Operation of Single Phase Dual Converter with RL Load
12. Operation of Single Phase Full bridge controlled converter with DC Motor Load

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15BPE13 SEMINAR – I

I M.Tech, II Semester (PE & ED)

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15BPE14 ANALYSIS OF INVERTERS

Objectives:

1. *To study the operation of single phase and three phase inverters and different pulse width modulation techniques for voltage control of inverters.*
2. *To know various harmonic reduction techniques and principles of operation of current source inverter.*
3. *To understand the multilevel concept of inverters and types of multilevel inverters and their applications.*
4. *To know the operation of different types of resonant inverters.*

Outcomes:

After completion of this course, the student will be able to:

1. *Design and simulate the single phase and three phase inverters with pulse width modulation techniques for voltage control for speed control of induction motor.*
2. *Design filters circuit to minimize harmonics and know the principle of operation of current source inverter.*
3. *Design the various types of multilevel inverters.*
4. *Apply the concept of various types of resonant inverters.*

UNIT I

PULSE WIDTH MODULATED INVERTERS (SINGLE PHASE INVERTER): Introduction-Principle of operation – Performance parameters- Single phase half 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 – numerical problems, Advanced Modulation techniques for improved performance, Trapezoidal, staircase, stepped, harmonic injection and delta modulation – Advantages– Applications - numerical problems.

UNIT II

PULSE WIDTH MODULATED INVERTERS(THREE PHASE INVERTER): Three Phase inverters-analysis of 180 degree condition of 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-Variable dc link inverter –boost inverters- buck and boost inverter – inverter circuit design – Advantages –Applications - numerical problems.

UNIT III

HARMONIC REDUCTION AND CURRENT SOURCE INVERTERS: Third harmonic PWM-60 degree PWM- Phase displacement-Bipolar output voltage notches,Uni-polar output voltage notches-Transformer connections-Design of C filter to eliminate harmonics- numerical problems, Current Source inverter – inverter operation modes – load commutated inverters – comparison of current source inverter and voltage source inverters.

UNIT IV

MULTILEVEL INVERTER: Introduction –Types of Multilevel Inverters - Multilevel concept – Diode clamped, Flying capacitor & Cascade –Principle of operation – Features – Reactive power compensation, Back-to-Back Inverter – adjustable speed driver - Comparison of multilevel Inverters – Applications.

UNIT V

RESONANT INVERTERS: Introduction – Series resonant Inverters with unidirectional and Bidirectional switches – Parallel resonant Inverters – Class E resonant Inverter - Zero current switching – Resonant Converter– Zero voltage switching resonant converter – Two quadrant ZVS resonant converter – Resonant DC link Inverter.

Text Books:

1. Rashid M.H:*"Power Electronics – Circuits, Devices & Applications",* Prentice Hall of India, 3rd Edition, New Delhi, 2005.
2. P.S.Bimbra:*"Power Electronics",* Khanna Publishers, Eleventh Edition, 2003
3. M.D. Singh & K.B. Khanchandani:*"Power Electronics",* Tata Mc Graw Hill Publishing Company Limited, 2nd Edition, Fourth Print 2009

References:

1. Mohan .N, Undeland& Robbins:*"Power Electronics – Converters, Application & Design",* John Wiley & Sons, Inc,2nd Edition, Newyork, 2001.
2. P.C Sen:*"Modern Power Electronics",* Wheeler publishing Co, First Edition, New Delhi-1998.
3. Rashid M.H:*"Hand book on Power Electronics",* Academic Press,Imprint ofElesvier,California
4. http://nptel.ac.in/courses/Webcourse-contents/IIT%20Kharagpur/Power%20Electronics/New_index1.html

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15BPE15 POWER ELECTRONIC CONTROL OF AC DRIVES

Objectives:

1. *To study motor drives torque, control and its characteristics of AC and DC drives.*
2. *To design the different types of motor control and slip power recovery drives.*
3. *To know importance of power factor control and slip –Torque-power recovery systems.*
4. *To acquire knowledge about constant torque, flux weakening controllers, variable reluctance motor and brushless DC motor drives.*

Outcomes:

After completion of this course, the student will be able to:

1. *Apply the concept AC drives and speed torque characteristics.*
2. *Gain knowledge about slip regulation, speed, flux control and optimization control.*
3. *Know the concept slip power recovery drives, vector control methods and UPF.*
4. *Design and simulate the knowledge about brushless DC motor drives and reluctance servo drives.*

UNIT I

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/f operation-Induction motor characteristics in constant torque and field weakening regions

UNIT II

CONTROL OF INDUCTION MOTOR DRIVES: Scalar control-Voltage fed inverter control-Open loop volts/Hz Control-Speed control slip regulation- Speed control with torque and flux control-Current controlled voltage fed inverter drive-Current fed inverter control-Independent current and frequency control-Speed and flux control in current fed inverter drive-Volts/Hertz Control current fed-Inverter drive-Efficiency optimization control by flux program.Slip power recovery drives-Static Kramer Drive-Phasor diagram-Torque expression-Speed control of Kramer Drive-Static Scheribus Drive- Modes of operation

UNITIII

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

UNIT IV

CONTROLLERS: Flux weakening operation- Maximum speed-Direct flux weakening algorithm – Constant torque mode controller- Flux Weakening controller- Indirect flux weakening – Maximum permissible torque-Speed control scheme- Implementation strategy – Speed controller design

UNIT V

VARIABLE RELUCTANCE MOTOR DRIVE AND BRUSHLESS DC MOTOR DRIVES: Variable reluctance motor drives- Torque Production in the variable reluctance motor- Drive characteristics and control principles- Current control variable reluctance servo drive.Three phase full wave Brushless dc motor – Sinusoidal type of Brushless dc motor-Current controlled Brushless dc servo drives

Text Books:

1. R.Krishnan:*Electric Motor Drives Pearson modeling, analysis and control*, prentice hall Publication, 1st Edition, 2002.
2. B.K Bose:*Modern Power Electronics and AC drives*, 1st Edition, Pearson Publication.
3. G. K. Dubey:*Power Semiconductors Drives*, Narosa Publications, 1995.

References:

1. MD Murphy & FG Turn Bull Pergman Press:*Power Electronic Control of AC motors*, 1st Edition.
2. M.H Rashid:*Power Electronics Circuits, Devices and Application*, PHI Publications, 1995.
3. GK Dubey:*Fundamentals of Electric Drives*, Narora Publications, 1995.
4. B.K.Bose:*Power Electronics and Variable Frequency drives*, IEEE press-Standard publication, 1st Edition, 2002.

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15BPE16 POWER ELECTRONICS FOR RENEWABLE ENERGY SOURCES

Objectives:

1. *To provide knowledge about environmental impact of renewable energy resources.*
2. *To analyze and comprehend the various operating modes of wind electrical generators and solar energy systems.*
3. *To design different power converters namely AC to DC, DC to DC and AC to AC Converters for renewable energy systems.*
4. *To provide knowledge about the stand alone, grid connected and develops maximum Power point tracking Algorithms for renewable energy systems*

Outcomes:

After completion of this course, the student will be able to:

1. *Analyze the impacts of renewable energy generation on environment.*
2. *Know the importance and qualitative analysis of different renewable energy Sources.*
3. *Apply the principle of operation of electrical machines for renewable energy conversion and their performance characteristics.*
4. *Design the solar photo voltaic systems and power converters for Inversion mode and boost mode in PV system.*

UNIT I

INTRODUCTION AND QUALITATIVE STUDY OF DIFFERENT RENEWABLE ENERGY RESOURCES: Environmental aspects of electric energy conversion: impacts of renewableenergy generation on environment (cost-GHG Emission) ,Qualitative study of differentrenewable energy resources: Solar, wind, ocean, Biomass, Fuel cell, Hydrogen energysystems and hybrid renewable energy systems.

UNIT II

ELECTRICAL MACHINES FOR RENEWABLE ENERGY CONVERSION: Review of reference theory fundamentals-principle of operation and analysis: IG, PMSG,SCIG and DFIG.

UNIT III

POWER CONVERTERS AND THREE PHASE AC VOLTAGE CONTROLLERS: Solar: Block diagram of solar photo voltaic system -Principle of operation: linecommutated converters (inversion-mode) - Boost and buck-boost converters- selectionof inverter, battery sizing, and array sizingWind, AC-DC-AC converters: uncontrolled rectifiers,PWM Inverters, Grid Interactive Inverters-matrix converters.

UNIT IV

ANALYSIS OF WIND AND PV SYSTEMS AND GRID CONNECTION ISSUES: Stand alone operation of fixed and variable speed wind energy conversion systems and solar system, Grid integrated PMSG and SCIG Based WECS Grid Integrated solar system

UNIT V

HYBRID RENEWABLE ENERGY SYSTEMS: Need for Hybrid Systems- Range and type of Hybrid systems- Case studies of Wind-PVMaximumPower Point Tracking (MPPT).

Text Books:

1. Rashid .M. H:*"power electronics Hand book",* Academic press, 2001.
2. Rai. G.D:*"Non conventional energy sources",* Khanna publishes, 1993.
3. Ewald F.Fuchs, Mohammad A.S.Masoum:*power conversion of Renewable Energy Systems,* Springer, 2011.

References:

1. Rai. G.D:*"Solar energy utilization",* Khanna publishes, 1993.
2. Gray, L. Johnson:*"Wind energy system",* prentice hall linc, 1995.
3. B.H.Khan: *"Non-conventional Energy sources",* Tata McGraw-hill PublishingCompany, New Delhi.
4. http://freevideolectures.com/Course/2352/Power-System-Generation-Transmission-and-Distribution/6

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15BPE17 POWER ELECTRONICS APPLICATIONS IN POWER SYSTEMS

(Common to PE& ED and EPS)

Objectives:

1. *To acquire requisite knowledge on basic concepts of voltage regulation and power factor correction and stability aspects of Transmission lines.*
2. *To understand the different methods of employing commutation.*
3. *To analyze harmonic control, power factor improvement in different types of converters and to know working principles of various voltage regulators.*
4. *To gain adequate knowledge on switched mode power supply and to analyze HVDC converters and its control characteristics.*

Outcomes:

After completion of this course, the student will be able to:

1. *Analyze the Transmission lines with Unsymmetrical loads with and without compensation.*
2. *Apply the compensation techniques in the analysis of transmission lines.*
3. *Analyze the harmonics in different types of Converters.*
4. *Design the Switched mode power supplies andThyristorConverters used in HVDC Transmission.*

UNIT I

LOAD COMPENSATION IN POWER SYSTEMS AND UNCOMPENSATED TRANSMISSION LINES: Introduction – Voltage Regulation – Power Factor Correction – Phase Balancing and power Factor Correction of Unsymmetrical Loads - Uncompensated electrical parameters-Transmission line equation-Solution of transmission line wave equation-Surge impedance and natural loading – Uncompensated on open circuit - voltage and current profile-Uncompensated under load conditions-Maximum and stability consideration-effect of generator reactance.

UNIT II

STATIC COMPENSATION CONTROL AND COMMUTATION METHODS FOR CONTROLLED CONVERTERS: Shunt – Series Compensation, Compensation by Sectioning – Property of Static Compensation – Thyristor Controlled Reactor (TCR) – Thyristor Switched Capacitor – Saturated Reactor Compensators -Methods of employing natural commutation – Methods of employing forced commutation and implementation of forced commutation.

UNIT III

HARMONICS CONTROL & POWER FACTOR IMPROVEMENT AND VOLTAGE REGULATORS: Reactive Power Variation for Fully Controlled Converter – Half Controlled Converter – Fully Controlled Converter with controlled freewheeling -Introduction to voltage regulators – Manually Controlled voltage regulator (Conventional methods) - Static tap changer using Thyristors– Different control schemes.

UNITIV

SWITCH MODE POWER SUPLLY (SMPS): Introduction to Switch Mode Power Supply (SMPS) – Switched mode DC power supply – Fly back converter- Forward converter-Push pull Converter-Resonant DC powersupply- Switched mode AC Power supply-Resonant AC Power supply-Bidirectional power Supply.

UNIT V

HIGH VOLTAGE DC TRANSMISSION:

Analysis of HVDC Converters: Pulse number – Choice of converter configuration – Simplified analysis of Graetz circuit – Converter bridge characteristics.

Converted and HVDC system control: Principles of DC link control – Converter control characteristics – System control hierarchy – firing control – current and extinction angle control – starting and stopping of DC link power control.

Text Books:

1. Miller.T.J.E:*"Reactive Power Control in Electric Systems",* Wiley-Interscience, New York, 1982.
2. G.K.Dubey:*"Thyristorised power controllers",* New Age International Publishers, 1st Edition.
3. K.R.Padiyar: *HVDC power transmission systems – Technology & system interaction,* Published by WE limited, 1990.

References:

1. P.C.Sen:*"Power Electronics",* Tata Mc Graw Hill, 2008.
2. M.H.Rashid: *"Power Electronics: Circuits,Devices and Applications"*,Pearson Education India,3rd Edition.
3. Dr.P.S.Bimbhra:*"Power Electronics",* Khanna Publishers, 3rd Edition,2003.
4. Dr. S. N. Singh, "High Voltage DC Transmission", National Programme on Technology Enhanced Learning (NPTEL) Web Course Series.

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15BPE18 EMBEDDED SYSTEM DESIGN

(ELECTIVE-III)

Objectives:

1. *To study the 8051 micro controller architecture and addressing modes.*
2. *To know the assembly instructions and development of embedded system programming.*
3. *To acquire knowledge about embedded peripherals and interfacing.*
4. *To know the importance of CISC & RISC controllers and also know the operation of distributed embedded system.*

Outcomes:

After completion of this course, the student will be able to:

1. *Apply the concept of 8051 microcontrollers.*
2. *Know the concept of Embedded system programming and peripherals.*
3. *Design the concept of interfacing, RISC Embedded controllers.*
4. *Design and control the distributed Embedded system and controllers.*

UNIT I

THE 8051 MICROCONTROLLERS ARCHITECTURE: Architecture of 8051 microcontroller - Memory Organization - Addressing Modes - Assembly Language Instructions -Embedded system concepts – Embedded Hardware devices – Introduction to 8051 microcontroller – 8051 Derivatives

UNIT II

EMBEDDED SYSTEM PROGRAMMING: Embedded Software Tools - Assembler - Compiler - Simulator – Debugger – Incircuit Simulator – Integrator Development Environment (IDE) - Introduction to Embedded 'C' Programming - Programming in Embedded Controllers.

UNIT III

EMBEDDED PERIPHERALS &INTERFACING: Embedded Peripherals - General Purpose I/O - Timer - Counter - UART/USART-Interrupts - ADC-DAC – Parallel Port - Peripheral Interfacing with input/output devices - LED-LCD – Keyboard - ADC - DAC.

UNIT IV

RISC EMBEDDED CONTROLLERS: Comparison of CISC and RISC Controllers - Pipelining Architecture - Introduction to PIC Microcontrollers - PIC16F877 Architecture - Memory Organization - Addressing Modes - Assembly Language Instructions – EmbeddedC programming with PIC16F877.

UNIT V

DISTRIBUTED EMBEDDED SYSTEM DESIGN: Distributed Embedded System – Embedded Networking - RS232-RS485 - Inter-Integrated Circuit (I2 C) – Serial Peripheral Interface (SPI) – Universal Serial Bus (USB) - Controller Area Network (CAN) - Embedded Networking using Ethernet devices.

Text Books:

1. Kenneth J. Ayala:*"The 8051 Microcontroller Architecture Programming &Applications",* Thomson Publications.
2. Mahammedali, *"8051Microcontrolled based Embedded systems"*

References:

1. MykePredko, *"Programming & Customizing PIC Microcontrollers".*
2. ZdravkoKarakehayov, *"Embedded System Design with 8051 Microcontrollers".*

Websites:

1. www.raisonance.com
2. www.ccsinfo.com
3. www.micrchip.com
4. www.atmel.com

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15BPE19 INTELLIGENT CONTROL OF ELECTRICAL DRIVES

(ELECTIVE-III)

Objectives:

1. *To develop the BNN and ANN models*
2. *To know the concept of genetic algorithms using MATLAB*
3. *To study the operation and reasoning of fuzzy logic system*
4. *To develop the fuzzy logic controllers for DC and AC electrical drives*

Outcomes:

After completion of this course, the student will be able to:

1. *Apply the concept of about ANN and BNN models*
2. *Design the genetic algorithms using MATLAB.*
3. *Emphasize the fuzzy logic system and fuzzy logic control electrical drives.*
4. *Estimate the harmonics in PWM control, space vector PWM and speed and flux estimation of induction motor.*

UNIT I

INTRODUCTION: Approaches to intelligent control - Architecture for intelligent control - Symbolic reasoning system – rule based systems - AI approach - Knowledge representation - Expert systems.

UNIT II

ARTIFICIAL NEURAL NETWORKS: Concept of Artificial Neural Networks and its basic mathematical model – McCulloch Pitts neuron model - simple perceptron - Adaline and Madaline - Feed-forward Multilayer Perceptron - Learning and Training the neural network - Principal - Component analysis and wavelet transformations - Design of logic using all algorithms - Neural Network based controller with any application.

UNIT III

GENETIC ALGORITHM: Concept of Genetic algorithm and detail algorithmic steps - Genetic operators - Solution of typical control problems using genetic algorithm-Concept on some other search techniques like tabu search and ant-colony search techniques for solving optimization problems -Case studies: Speed control of Induction motor using MATLAB - Neural Network toolbox - simple feed-forward network programs.

UNIT IV

FUZZY LOGIC SYSTEM: Introduction to crisp sets and fuzzy sets - basic fuzzy set operation and approximate reasoning - Introduction to fuzzy logic modeling and control – Fuzzification -inferencingDefuzzification - Fuzzy knowledge and rule bases - Fuzzy modeling and control schemes for nonlinear systems - Self-organizing fuzzy logic control - Implementation of fuzzy logic controller using MATLAB fuzzy-logic toolbox -Stability analysis of fuzzy control systems.

UNIT V

FUZZY LOGIC & NEURAL NETWORK APPLICATIONS TO DRIVES:

Fuzzy logic applications: Design of Fuzzy PI controller for speed control of DC motor-Flux programming efficiency improvement of three phase induction motor-Induction motor speed control-Slip gain tuning of indirect vector control of induction motor-stator resistance estimation.

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

Text Books:

1. S.N.Sivanandam, S.Sumathi and S.N.Deepa:*"Introduction to Neural Networks using MATLAB 6.0",* Mc Graw Hill Publishing companies Limited, 3rd Edition 2008.
2. Lawrence V.Fansett:*"Fundamentals of Neural Networks: Architectures, Algorithums&Applications",* Prentice Hall, 1994.
3. S.N.Sivanandam&S.N.Deepa:*"Introduction to genetic Algorithams",*Spinger Publications 2007.

References:

1. SimopnS.Haykin:*"Neural Networks: A Comprehensive Foundation",* Macmillan,1994.
2. S.Rajasekaran, G.A.VijayalakashmiPai:*"Neural Networks, Fuzzy Logic & GeneticAlgorithams: Synthesis & Applications",* PHI, 3rd Edition 2007.
3. John Yen and Reza Langari:*Fuzzy logic Intelligence, Control, and Information*,Pearson Education, Indian Edition, 2003.

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15BPE20 MODERN RECTIFIERS AND RESONANT CONVERTERS

(ELECTIVE-III)

Objectives:

1. *To gain knowledge about 1-phase & full wave converter with continuous and discontinues mode of conduction and reduction of harmonics & minimization of THD*
2. *To know the operation of ideal rectifiers, realization of non ideal rectifiers with control of current and hysteresis*
3. *To know the concept of 1-phase converter systems incorporating ideal rectifiers , ZCS and ZVS*
4. *To understand the average model for buck, boost and buck-boost converter and design of controllers*

Outcomes:

After completion of this course, the student will be able to:

1. *Simulate and Design about 1-phase converter with continues and discontinues mode of operation and elimination of harmonics.*
2. *To Know the concept of linear and nonlinear rectifiers and its performance characteristics.*
3. *Design ZCS, ZVS and buck converter with resonant control*
4. *To identify the importance of linear system, state space model, PI controller and optimal controller.*

UNIT I

POWER SYSTEM HARMONICS & LINE COMMUTATED RECTIFIERS: Average power-RMS value of a waveform-Power factor-AC line current harmonic standards IEC 1000-IEEE 519- The Single phase full wave rectifier-Continuous Conduction Mode-Discontinuous Conduction Mode-Behaviour when C is largeMinimizing THD when C is small-Three phase rectifiers-Continuous Conduction Mode- Discontinuous Conduction Mode-Harmonic trap filters.

UNIT II

PULSE WIDTH MODULATED RECTIFIERS: Properties of Ideal rectifiers-Realization of non ideal rectifier-Control of current waveform-Average current control-Current programmed Control- Hysteresis control- Nonlinear carrier control.

UNIT III

SINGLE PHASE CONVERTER SYSTEM: Single phase converter system incorporating ideal rectifiers- Modeling losses and efficiency in CCM high quality rectifiers-Boost rectifier Example - expression for controller duty cycle-expression for DC load current-solution for converter Efficiency.

UNIT IV

RESONANT CONVERTERS: Review on Parallel and Series Resonant Switches-Soft Switching-Zero Current Switching - Zero Voltage Switching -Classification of Quasi resonant switches-Zero Current Switching of Quasi Resonant Buck converter -Zero Current Switching of Quasi Resonant Boost converter - Zero Voltage Switching of Quasi Resonant Buck converter - Zero Voltage Switching of Quasi Resonant Boost converter - Steady State analysis.

UNIT V

DYNAMIC ANLYSIS OF SWITCHING CONVERTERS: Review of linear system analysis-State Space Averaging-Basic State Space Average Model-State Space Averaged model for an ideal Buck Converter, ideal Boost Converter, ideal Buck Boost Converter, for an ideal Cuk Converter -Pulse Width Modulation-Voltage Mode PWM Scheme-Current Mode PWM Scheme - Design of Controllers - PI Controller, Variable Structure Controller, Optimal Controller for the source current shaping of PWM rectifiers.

TEXT BOOKS:

1. Robert W. Erickson &Dragon Maksimovic:*"Fundamentals of Power Electronics"*2nd Edition, 2001 Springer science and Business media.
2. Mohammed H.Rashid:Power Electronics, Pearson Education- Third Edition –first Indian reprint – 2004.
3. Mohan .N, Undeland& Robbins:*"Power Electronics – Converters, Application & Design",* John Wiley & Sons, Inc,2nd Edition, Newyork, 2001.

REFERENCES:

1. William Shepherd and Li zhang,MarceldEkkerin.C: *"Power Converters Circuits".*
2. Simon Ang and Alejandro Oliva:*"Power- Switching Converters",* Taylor & FrancisGroup.

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15BPE21 OPTIMAL CONTROL THEORY

(ELECTIVE-IV)
(Common to PE& ED and EPS)

Objectives:

1. *To define the optimal control problems, Mathematical model of a process including physical constraints and know the introductory aspects of optimal control theory*
2. *To know the fundamental concept of calculus of variation and usefulness of Euler's equation for fixed end and free end point problems.*
3. *To study the usefulness of Hamiltonian function and Pontryagin's minimum principle to solve optimal control problem using variational approach*
4. *To understand the concept of Dynamic programming and know the computational procedure for solving optimal control problems*

Outcomes:

After completion of this course, the student will be able to:

1. *Select the performance measure for typical control problems and apply principle of controllability and observability in solving linear system*
2. *Apply Euler's equation for solving optimal control problems having functional of single function and functional involving several independent functions*
3. *Solve several optimal control problems using Hamiltonian function and Pontryagin's minimum principle.*
4. *Apply Dynamic programming to solve nonlinear problems.*

UNIT I

INTRODUCTION: The Mathematical Model of a Process, Physical Constraints. The Performance Measure , the Optimal Control Problem , Forms of the Optimal Control, State Variable Representation of System – System Classification and Output Equations , Solution of State Equation – Linear Systems, Typical Control Problems, Selection of Performance Measure , Controllability and Observability.

UNIT II

THE CALCULUS OF VARIATIONS – I: Fundamental Concepts, Maxima and Minima of Functions, Fundamental Theorem of Calculus of Variations. Functional of Single Function, The Simplest Variation Problem- Euler's Equation, Fixed End Point Problem- Free End Point Problem.

UNIT III

THE CALCULUS OF VARIATIONS – II: Functional Involving Several Independent Functions – Problem with Fixed End Points – Problems with Free End Points, Constrained Extrema-Constrained Minimization of Function and Functional.

UNIT IV

VARIATIONAL APPROACH TO OPTIMALCONTROL PROBLEMS: Necessary Conditions for Optimal Control Hamaltonian Function- Boundary Conditions in Optimal Control Problems – Linear Regulator Problems – Matrix Ricalti Equation – Linear Tracking Problem.

PONTRYAGIN'S MINIMUM PRINCIPLE: State un Equality Constraints – Minimum Time Problem- Minimum Control Effort Problem- Minimum Fuel Problem – Minimum Energy Problem.

UNIT V

DYNAMIC PROGRAMMING: The Optimal Control Law, The principal of Optimality, Dynamic Programming applied to Routing Problems, An Optimal Control Systems-A recurrence Relation of Dynamic Programming – Computational Procedure for Solving Optimal Control

Problems –Discrete Linear Regulator Problems, Hamilton – Jacobian- Bellman Equation-Continuous Linear Regulator Problems.

NUMERICAL DETERMINATION OF OPTIMAL TRAJECTORIES: Two-Point Boundary-Value Problem- Method of Steepest Descent –Steepest Descent Algorithm.

Text Books:

1. Donald E. Krik:*Optimal Control Theory,* Library of Congress Cataloging in Publication Data.
2. M.Gopal:*Modern Control Systems Theory,* New age International Publishers, 5th Edition, 1984

References:

1.A.P.Sage:*Optimal System Control,* Pearson Education Canada, 1977.
2. Ogata:*Modern Control Systems Theory,* Prentice Hall, 2010.

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15BPE22 SYSTEM IDENTIFICATION AND ADAPTIVE CONTROL

(ELECTIVE-IV)

Objectives:

1. *To acquire knowledge about linear and non linear models*
2. *To understand the non parametric and parametric identification for linear and non linear systems.*
3. *To study non linear identification using neural network and fuzzy logic systems.*
4. *To know the operation of Auto tuning, self tuning regulators and adaptive control with different types of applications like heat exchanger. Ship steering control and etc.*

Outcomes:

After completion of this course, the student will be able to:

1. *Gain the knowledge about design of linear and non linear models.*
2. *Analyze the non parametric and parametric identification with different instrumental systems.*
3. *Acquire the knowledge about Wiener models*
4. *Emphasize the adaptive control and different tuning models with applications*

UNIT I

MODELS FOR INDENTIFICATION: Models of LTI systems: Linear Models-State space Models-OE model- Model sets, Structures and Identifiability-Models with Nonlinearities – Non-linear state-space models-Black box models, Fuzzy models'.

UNIT II

NON-PARAMETRIC AND PARAMETRIC IDENTIFICATON: Transient response and Correlation Analysis – Frequency response analysis – Spectral Analysis – Least Square – Recursive Least Square –Forgetting factor- Maximum Likelihood – Instrumental Variable methods.Open and closed loop identification: Approaches – Direct and indirect identification – Joint input-output identification – Non-linear system identification

UNIT III

WIENER MODELS: Power series expansions - State estimation techniques – Non linear identification using Neural Network and Fuzzy Logic.

UNIT IV

ADAPTIVE COTROL AND ADAPTATION TECHNIQUES: Introduction – Uses – Auto tuning – Self Tuning Regulators (STR) – Model Reference Adaptive Control (MRAC) – Types of STR and MRAC

UNIT V

DIFFERENT APPROACHES TO SELF TUNING REGULATORS: Different Approaches to Self Tuning Regulators-Stochastic Adaptive control – Gain Scheduling -Inverted Pendulum, Robot arm, process control application: heat exchanger, Distillation column, application to power system, Ship steering control.

Text Books:

1.Ljung,*"System Identification Theory for the User",* PHI, 1987.

2. TorstenSoderstrom, PetreStoica:*"System Identification",* prentice Hall ` International (UK) Ltd,1989.

References:

1. Astrom and Wittenmark:*"Adaptive Control",* PHI

2. William S. Levine: *"Control Hand Book".*

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I M.Tech, II Semester (PE & ED)	**L**	**T**	**P**	**C**
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15BPE23 ELECTRICAL DISTRIBUTION AND AUTOMATION

(ELECTIVE-IV)

Objectives:

1. *To understand the overall distribution network systems and system analysis.*
2. *To acquire knowledge about distribution transformer and substation.*
3. *To acquire knowledge about protective devices and various faults.*
4. *To acquire knowledge about capacitive compensation for power factor control.*

Outcomes:

After completion of this course, the student will be able to:

1. *Design the necessary accessories for distribution network.*
2. *Design the overview of distribution transformers and substations.*
3. *Design the concept of capacitive compensation for power factor control and its application.*
4. *Knowthe concept of protective devices, types of common faults and its protection.*

UNIT I

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

UNIT II

DISTRIBUTION FEEDERS AND SUBSTATIONS: Design consideration of Distribution feeders: Radial and loop types of primary feeders, voltage levels, feederloading -Design practice of the secondary distribution system.

SUBSTATIONS: Location - Rating of a Distribution Substation, service area with primary feeders. Benefits derived through optimal location of substations.

UNIT III:

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

UNIT IV

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

UNIT V

CAPACITIVE COMPENSATION FOR POWER FACTOR CONTROL: Different types of power capacitors, shunt and series capacitors, effect of shunt capacitors (Fixed and switched) power factor correction, capacitor location. Economic justification. Procedure to determine the best capacitor location.

VOLTAGE CONTROL: Equipment for voltage control, effect of series capacitors, effect of AVB/AVR, line drop compensation.

Text Books:

1. TuranGonen:"*Electric Power Distribution System Engineering"*, Mc.Graw-Hill Book Company,1986.

References:

1. A.S.Pabla: *Electric Power Distribution,* Tata Mc Graw-Hill Publishing Company, 4th Edition, 1997.

SRI VENKATESWARA COLLEGE OF ENGINEERING AND TECHNOLOGY(AUTONOMOUS)

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

I M.Tech, II Semester (PE & ED)

L	T	P	C
-	-	3	2

15BPE24 A.C. DRIVES LAB

Objectives:

1. *To know performance of three phase induction motor using AC voltage controllers and cycloconverters.*
2. *To understand operation of three phase IGBT based PWM inverter with R & RL load.*
3. *To acquire knowledge on use of PIC Microcontrollers for generation of pulses.*
4. *To understand the fundamentals of DSP and its use in motor control circuits.*

Outcomes:

After completion of this course, the student will be able to:

1. *Analyze the speed control of 3 phase slip ring induction motor.*
2. *Design the IGBT based PWM inverter with RL load.*
3. *Know the concept of PIC microcontroller based speed control of three phase induction motor.*
4. *Gain the knowledge about operation of 3 phase PWM inverters, cycloconverter and AC voltage controllers*

LIST OF EXPERIMENTS

Any Ten of the following experiments are to be conducted as compulsory experiments

1. Performance & speed control of 3 phase slip ring Induction motor by Static Rotor Resistance controller
2. Single phase cyclo converter based ac induction motor controller
3. Performance & Operation of a 3-phase A.C. Voltage controller on motor load.
4. Single phase half wave controlled AC voltage controller with resistive-inductive load
5. Single phase fully controlled AC voltage controller with resistive-inductive load
6. Single Phase IGBT based PWM Inverter on R & R-L load
7. Operation of 3-phase IGBT based PWM Inverter on R & R-L load
8. Three phase PWM Pulse generation using PIC Micro controller
9. PIC Microcontroller based speed control of three phase Induction Motor
10. DSP based V/F Control of 3 phase Induction motor
11. Simulation of three phase cycloconverter based three phase induction motor drive
12. Simulation of GTO based PWM inverter with RLE load

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I M.Tech, II Semester (PE & ED)

L	T	P	C
-	-	3	2

15BPE25 EMBEDDED SYSTEMS LAB

Objectives:

1. *To understand the fundamentals of 8051 and its use in conducting experiments motor control circuit.*
2. *To know the arithmetic operation and addressing modes.*
3. *To obtain speed control of DC motor using ALS89C51ED2.*
4. *To understand the interfacing of electro mechanic relay, stepper motor and elevator.*

Outcomes:

After completion of this course, the student will be able to:

1. *Know the concept of Arithmetic operations manipulation for 8051*
2. *Design the stack, direct and indirect addressing*
3. *Know the concept of Interfacing of LED, Electro Mechanical relay and stepper motor to 89C51*
4. *Gain the knowledge about PWM generation using Timer 1,2,3*

LIST OF EXPERIMENTS

Any Ten of the following experiments are to be conducted as compulsory experiments

1. a. Arithmetic operations manipulation for 8051
   b. Arithmetic operations with the stack for 8051.
2. a. Direct Bank Addressing.
   b. Indirect Addressing.
3. Accessing Scratchpad RAM.
4. Creating Variable Arrays.
5. Speed Control of DC Motor using ALS89C51ED2.
6. Interfacing of Button and LED to ALS89C51ED2.
7. Interfacing of an Electro Mechanical Relay.
8. Interfacing of Stepper Motor to ALS89C51ED2
9. Study on PWM generation using Timer 1, 2, 3 using ALS89C51ED2.
10. Interfacing of Keyboard and Elevator using ALS89C51ED2
11. Stack of LED 7 Segment and LCD Display
12. Interfacing of RS232 and RS485

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I M.Tech, II Semester (PE & ED)	**L**	**T**	**P**	**C**
	-	**-**	**-**	**2**

15BPE26 SEMINAR – II

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I M.Tech, II Semester (PE & ED)	**L**	**T**	**P**	**C**
	-	**-**	**-**	**2**

15BPE27 COMPREHENSIVE VIVA VOCE

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

I M.Tech, III & IV Semester (PE & ED)	**L**	**T**	**P**	**C**
	-	**-**	**-**	**12**

15BPE28 PROJECT WORK