RAJEEV GANDHI MEMORIAL

COLLEGE OF ENGINEERING AND TECHNOLOGY

AUTONOMOUS INSTITUTE

Affiliated to JNTU-Anantapur, Approved by AICTE-New Delhi, Accredited by NBA-New Delhi

NANDYAL-518 501, KURNOOL Dist., A.P.

POWER ELECTRONICS

ACADEMIC REGULATIONS,

COURSE STRUCTURE AND SYLLABI

APPLICABLE FOR STUDENTS ADMITTED INTO

M.TECH (REGULAR) FROM 2010-11

RAJEEV GANDHI MEMORIAL COLLEGE OF ENGINEERING AND TECHNOLOGY

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REGULATIONS

For pursuing Two year Master (post graduate) Degree of study in Engineering (M.Tech), offered by Rajeev Gandhi Memorial College of Engineering and Technology, Nandyal-518501 under Autonomous status and herein referred to as RGMCET (Autonomous)

All the rules specified herein approved by the Academic Council will be in force and applicable to students admitted from the Academic Year 2010-11 onwards. Any reference to "Institute" or "College" in these rules and regulations stands for Rajeev Gandhi Memorial College of Engineering and Technology (Autonomous).

All the rules and regulations, specified here after shall be read as a whole for the purpose of interpretation as and when a doubt arises , the interpretation of the Chairman, Academic Council is final. As per the requirements of statutory bodies, the Principal, Rajeev Gandhi Memorial College of Engineering and Technology shall be the Chairman, Academic Council.

I. ACADEMIC REGULATIONS 2010 FOR M.TECH (REGULAR)

(Effective for the students admitted into first year from the Academic Year 2010-2011)

THE M.TECH DEGREE OF JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY, ANANTAPUR, SHALL BE CONFERRED ON CANDIDATES WHO ARE ADMITTED TO THE M.TECH PROGRAM AT RGMCET, NANDYAL AND THEY SHALL FULFIL ALL THE REQUIREMENTS FOR THE AWARD OF THE DEGREE.

1.0 Eligibility for Admissions:

Admission to the above program shall be made subject to the eligibility, qualifications and specialization prescribed by Andhra Pradesh State Council of Higher Education (APSCHE) from time to time.

Admissions shall be made on the basis of merit rank obtained in GATE examination or PGCET conducted by any University of Andhra Pradesh designated by Govt. of A.P., or on the basis of any other order of merit prescribed by APSCHE, subject to the reservations prescribed by the Government of A.P. from time to time.

2.0 Award of M.Tech Degree:

2.1) The student shall be declared eligible for the award of the M.Tech degree, if he pursues a course of study and completes it successfully for not less than prescribed course work duration and not more than double the prescribed course work duration.

2.2) The student, who fails to fulfil all the academic requirements for the award of the degree within double the course work duration from the year of his admission, shall forfeit his seat in M.Tech course.

2.2) The minimum clear instruction days for each semester shall be 95.

3.0 Courses of Study:

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

1. Computer Science (CSE)
2. Digital Systems and Computer Electronics (ECE)

3. Embedded Systems (ECE)
4. Machine Design (ME)
5. Power Electronics (EEE)
6. Software Engineering (IT)

and any other course as approved by the appropriate authorities from time to time.

4.0 Course pattern:

4.1) The entire course of study is of four semesters. During the first and second semesters the student has to undergo course work and during the third and fourth semesters the student has to carry out project work.

4.2) The student eligible to appear for the End Examination in a subject, but absent at it or has failed in the End Examination may appear for that subject at the supplementary examination.

TABLE 1: CREDITS

	SEMESTER			
	Periods/ Week	Credits	Internal Marks	External Marks
Theory	04	04	40	60
Practical	03	02	40	60
Seminar		02	100	
Comprehensive Viva-voce		04		100
Project		12		

TABLE: 2 COURSE PATTERN

Semester	No.of Subjects	Number of Labs	Total Credits	
First	06	02	6X4=24 2X2=04	28
Second	06	02 Comprehensive Viva	6X4=24 2X2=04 1X4=04	32
Third	Seminar(3rd semester) Project Work			02
Fourth				12
Total credits				74

5.0 Attendance:

5.1) The candidate shall be deemed to have eligibility to write end semester examinations if he has secured a minimum of 75% of attendance in aggregate of all the subjects.

5.2) Condonation of shortage of attendance up to 10% i.e. 65% and above and below 75% may be given by the College academic committee consisting of Principal, Head of the Department and a senior faculty member.

5.3) Condonation of shortage of attendance shall be granted only on genuine and valid reasons on representation by the candidate with supporting evidence.

5.4) **Shortage of attendance below 65% shall in no case be condoned**.

5.5) The candidate shall not be promoted to the next semester unless he fulfils the attendance requirements of the previous 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 practicals, on the basis of Internal Evaluation and End Semester Examination.

6.1) For the theory subjects 60 marks shall be for the External End Examination, While 40 marks shall be for Internal Evaluation, based on the better of the marks secured in the two Mid Term-Examinations held, one in the middle of the Semester (I-IV units) and another immediately After the completion of instruction (V-VIII) units with four questions to be answered out of six, evaluated for 40 marks. Each question carries 10 marks. Each midterm examination shall be conducted for duration of 120 minutes. The End Examination will have 08 questions and 5 questions are to be answered and each question carries 12 marks.

6.2) For practical subjects, 60 marks shall be for the End Semester Examinations and 40 marks shall be for Internal evaluation based on the day-to-day performance. End practical examinations for M.Tech courses will be conducted with two Examiners, one of them being Laboratory Class Teacher and second Examiner shall be external from other institution.

6.3) Student has to undergo a comprehensive viva pertaining to his specialization which carries 100 marks. He has to secure 50% marks to obtain required credits. Comprehensive viva will be held at the end of II semester with HOD, senior faculty member and external Examiner from outside the institute. For this, HOD of the Department shall submit a panel of 5 Examiners, who are eminent in that field. One from the panel will be selected by the principal of the institute as external Examiner for comprehensive viva.

6.4) For Seminar100 marks shall be for Internal evaluation. The candidate has to secure a minimum of 50 marks to be declared successful. The assessment will be made by a board consisting of HOD and two Internal experts at the end of III semester.

6.5) The 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 Examination and Internal evaluation taken together.

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

7.0 Re-registration for improvement of Internal marks:

Following are the conditions to avail the benefit of improvement of internal 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 marks secured are more than 50%.

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

7.4) The candidate has to re-register for the chosen subjects and fulfil the academic requirements as and when they are offered.

7.5) For each subject, the candidate has to pay a fee equivalent to one third of the semester tuition fee and the amount is to be remitted in the form of D.D. in favour of the Principal, RGMCET payable at RGMCET Nandyal branch along with the requisition through the HOD of the respective Department.

7.6) In case of availing the Improvement of Internal marks, the Internal 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 / Dissertation work :

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

8.1) Registration of Project work: The candidate is permitted to register for the project work after satisfying the attendance requirement of all the courses (theory and practical courses of I & II Sem).

8.2) An Internal Department Committee (I.D.C) consisting of HOD, Supervisor and One Internal senior expert 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.

8.5) The 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 submitted during that period.

8.6) Three copies of the Thesis / Dissertation certified in the prescribed form by the supervisor & HOD shall be submitted to the institute.

8.7) The Department shall submit a panel of three experts for a maximum of 5 students at a time. However, the thesis / dissertation will be adjudicated by the board consists of HOD, concerned supervisor and one external Examiner from other institute nominated by the principal from a panel of Examiners submitted by the Department to the Controller of Examinations.

8.8) If the report of the board is favourable in viva voce examination, the board shall jointly report candidates work as:

1. Satisfactory

2. Not satisfactory

If the report of the viva voce is not satisfactory the candidate will retake the viva voce examination after three months. If he fails to get a satisfactory report at the second viva voce examination he will not be eligible for the award of the degree unless the candidate is permitted to revise and resubmit the thesis.

9.0 Award of Degree and Class:

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

TABLE 3: AWARD OF DIVISION

Class Awarded	% of marks to be secured	
First Class with Distinction	70% and above	From the aggregate marks secured form the 74 Credits.
First Class	Below 70% but not less than 60%	
Second Class	Below 60% but not less than 50%	

(The marks in Internal evaluation and End Examination shall be shown separately in the marks memorandum)

10.0 Supplementary Examinations:

Apart from the regular End Examinations the institute may also schedule and conduct supplementary examinations for all subjects for the benefit of students with backlogs. Such of the students writing supplementary examinations as supplementary candidates may have to write more than one examination per day.

11.0 Transcripts:

After successful completion of prerequisite credits for the award of degree a Transcript containing performance of all academic years will be issued as a final record. Duplicate transcripts will also be issued if required after the payment of requisite fee and also as per norms in vogue.

12.0 Minimum Instruction Days:

The minimum instruction days for each semester shall be 95 clear instruction days excluding the days allotted for tests/examinations and preparation holidays declared if any.

13.0 Amendment of Regulations:

The college may, from time to time, revise, amend or change the regulations, scheme of examinations and syllabi. However the academic regulations of any student will be same throughout the course of study in which the student has been admitted.

14.0 Transfers

There shall be no branch transfers after the completion of admission process.

15.0 With holding of results:

If the candidate has not paid any dues to the institute or if any case of in-discipline is pending against him, the result of the candidate will be with held and he will not be allowed for the next semester. The issue of the degree is liable to be withheld in such cases.

16.0 Transitory Regulations:

Candidates who have discontinued or have been detained for want of attendance are eligible for admission to the same or equivalent subjects as and when subjects are offered, subject to 6.5 and 2.0

17.0 Rules of Discipline:

17.1) Any attempt by any student to influence the teachers, Examiners, faculty and staff of controller of Examination for undue favours in the exams, and bribing them either for marks or attendance will be treated as malpractice cases and the student can be debarred from the college.

17.2) When The student absents himself, he is treated as to have appeared and obtained zero marks in that subject(s) and grading is done accordingly.

17.3) When the performance of the student in any subject(s) is cancelled as a punishment for indiscipline, he is awarded zero marks in that subject(s).

17.4) When the student's answer book is confiscated for any kind of attempted or suspected malpractice the decision of the Examiner is final.

18.0 General:

18.1) The Academic Regulation should be read as a whole for the purpose of any interpretation.

18.2) In the case of any doubt or ambiguity in the interpretation of the above rules, the decision of the College Academic Council is final.

18.3) The Institute may change or amend the academic regulations or syllabi at any time and the changes or amendments made shall be applicable to all the students with effect from the dates notified by the Institute.

18.4) Where the words "he", "him", "his", occur in the regulations, they include "she", "her", "hers".

RAJEEV GANDHI MEMORIAL COLLEGE OF ENGINEERING & TECHNOLOGY, NANDYAL

AUTONOMOUS

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

M.Tech - I Semester (Power Electronics) **Regulation: 2010**

S. No	Course Code	Subject	Abbreviation	Credits	Scheme Of Instruction Periods/Week			Duration Of End Exam In Hours	Scheme Of Examination Marks		
					Th	D*/T	P		END	INTERNAL	Total
THEORY:											
1	D4301101	Renewable Energy Sources	RES	4	4	0	-	3	60	40	100
2	D4302101	Analysis of Power Electronic Converters	APEC	4	4	0	-	3	60	40	100
3	D4303101	Modeling of Conventional Machines	MCM	4	4	0	-	3	60	40	100
4	D4304101	Power Electronic Control of DC Drives	PECDC	4	4	0	-	3	60	40	100
5	D4305101	Advanced Power Semi Conductor Devices & Protection	APSCD &P	4	4	0	-	3	60	40	100
6		Elective-I	E-I	4	4	0	-	3	60	40	100
PRACTICALS:											
7	D4391101	Power Converters Lab	PCL	2	-	-	3	3	60	40	100
8	D4392101	Simulation of Power Converters Lab	SPCL	2	-	-	3	3	60	40	100
TOTAL				**28**	**24**	**0**	**6**		**480**	**320**	**800**
					30						

ELECTIVE-I

Control System Design	D4306101	Digital Control Systems	D4309101
Adaptive Control Theory	D4307101	Optimal Control Theory	D4310101
Advanced Control Systems	D4308101	Modern Control Theory	D4311101

M.Tech -II Semester (Power Electronics) **Regulation: 2010**

S. No	Course Code	Subject	Abbreviation	Credits	Scheme Of Instruction Periods/Week			Duration Of End Exam In Hours	Scheme Of Examination Marks		
					Th	D*/T	P		End	Internal	Total
THEORY:											
1	D4312102	Integration of Renewable Energy Sources	IRES	4	4	-	-	3	60	40	100
2	D4313102	Modern Power Electronics	MPE	4	4	-	-	3	60	40	100
3	D4314102	Special Machines & Control	SMC	4	4	-	-	3	60	40	100
4	D4315102	Power Electronic Control of AC Drives	PECAC	4	4	-	-	3	60	40	100
5	D4316102	Power Electronic Applications to Power Systems	PEAPS	4	4	-	-	3	60	40	100
6		Elective-II	E-II	4	4	-	-	3	60	40	100
PRACTICALS:											
7	D4393102	Power Electronic Drives Lab	PEDL	2	-	-	3	3	60	40	100
8	D4394102	Power System Simulation Lab	PSSL	2	-	-	3	3	60	40	100
9	D4395102	Comprehensive Viva	CV	4	-	-	-	-	100	00	100
TOTAL				**32**	**24**	**0**	**6**		**480**	**320**	**900**
					30						

ELECTIVE-II

Micro Computer System Design	D4317102
Embedded Systems Design	D4318102
Neural Networks & its Applications	D4319102
Fuzzy control And its Applications	D4320102
Soft Computing Techniques	D4321102
DSP for Motor Drive Applications	D4322102

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DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

M.Tech – III Semester (Power Electronics) **Regulation: 2010**

S. No	Course Code	Subject	Abbreviation	Credits	Scheme Of Instruction Periods/Week			Duration Of End Exam In Hours	Scheme Of Examination Marks		
					Th	D*/T	P		End	Internal	Total
1	D4396103	SEMINAR	SEM	2	-	-	-	-	-	-	-
TOTAL				02							-

M.Tech – IV Semester (Power Electronics) **Regulation: 2010**

S. No	Course Code	Subject	Abbreviation	Credits	Scheme Of Instruction Periods/Week			Duration Of End Exam In Hours	Scheme Of Examination Marks		
					Th	D*/T	P		End	Internal	Total
1	D4397104	PROJECT WORK	PW	12	-	-	-	-	-	-	-
TOTAL				12							

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T	P	C
4	0	4

(D4301101) RENEWABLE ENERGY SOURCES

UNIT I Principles of Solar Radiation

Solar energy option- Physics of Sun- Terrestrial and Extraterrestrial Solar Radiation- Instruments for Measuring Solar Radiation-Flat Plate and Concentrating Collectors-Advanced Collectors.

UNIT II Photovoltaic Conversion

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

UNIT III Principles of Fuel Cells

Aspects of Hydrogen as Fuel-Fuel Cell-Commercial Technologies for Generation of Electricity-Practical Issues Related to Fuel Cell Stacking- Constructional Features of Proton Exchange membrane Fuel Cells - Constructional Features of Solid Oxide Fuel Cells- Advantages and Disadvantages of Fuel Cells

UNIT IV Fuel Cell Modeling

Fuel Cell Equivalent Circuit-Practical Determination of the Equivalent Model Parameters- Example of Determination of FC Parameters

UNIT V Wind Energy-I

Basic Principles of Wind Energy Conversion-Wind data & Energy estimation-Site selection-Basic components of WECS-Classification-Advantages & Disadvantages

UNIT VI Wind Energy-II

Types of Wind Machines-Analysis of Aerodynamic forces acting on blade-generating systems-Induction Generators-PMSM

UNIT VII Biomass

Introduction- Fuel from Biomass- Biogas- Biomass for Biogas -Biological Formation of Biogas-Factors Affecting Biodigestion - Characteristics of Biodigesters-Construction of Biodigesters -Generation of Electricity Using Biogas

UNIT VIII Geothermal Energy

Resources, types of wells, methods of harnessing the energy, geothermal electricity

TEXT BOOKS :

1. Integration of alternative sources of energy- Felix a. Farret, M. Godoy simoes- A John Wiley & Sons, inc., publication
2. Non-conventional energy sources- G.D. Rai

REFERENCE BOOKS :

1. Renewable Energy Resources / John Twidell and Tony Weir / E & F.N.Spon
2. Renewable Energy Resources Basic Principles and Applications / G.N.Tiwari and M.K.Ghosal / Narosa
3. Solar Energy - Principles of thermal collection and storage/ S.P. Sukhatme / TMH
4. Fuel Cell Handbook (Seventh Edition) By EG&G Technical Services, Inc.

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(D4302101) ANALYSIS OF POWER ELECTRONICS CONVERTERS

UNIT I Single Phase AC voltage Controllers

Single Phase AC Voltage Controllers with resistive, resistive-inductive and resistive-inductive-induced e.m.f loads-ac voltage controller's wit PWM control-Effects of source and load inductances –synchronous tap changers –Applications- numerical problems

UNIT II Three Phase AC Voltage Controllers

Three Phase AC Voltage controllers-Analysis of Controllers with star and delta connected resistive, resistive – inductive loads-Effects of source and load inductances–Application- numerical problems.

UNIT III Cycloconverters

Single phase to single phase cycloconverters –analysis of midpoint and bridge configurations-three phase to three phase cycloconverters-analysis of Midpoint and bridge configurations-Limitations-Advantages-Applications

UNIT IV Single phase converters

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-Application- numerical problems

UNIT V Three Phase Converters

Three Phase Converters- Half controlled and fully controlled Converters – Evaluation of input power factor and harmonic factor-Continuous and Discontinuous load current-three phase dual converters-Power factor improvements-three phase PWM-twelve pulse converters–Application- numerical problems

UNIT VI D.C to D.C Converters

Analysis of step-down and step up dc to dc converters with resistive and resistive –inductive loads-Switched mode regulators- Analysis of Buck regulators-Boost Regulators-Buck-Boost Regulators-Cuk Regulators-Condition for continuous inductor current and capacitor voltage-Comparison of regulators-Multi output boost regulators –advantages –Application- numerical problems

UNIT VII Pulse Width Modulated Inverters (Single Phase Inverter)

Principle of operation- Performance parameters- Single Phase bridge Inverters-Evaluation of output voltage and current with resistive and inductive loads-Voltage control of single phase inverters – Single PWM-Multiple PWM-Sinusoidal PWM-modified PWM-phase displacement control-Advanced Modulation techniques for improved performance , Trapezoidal, staircase ,stepped, harmonic injection and delta modulation – Advantage-–Application- numerical problems

UNIT VIII 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-harmonic reduction –current source inverters-Variable dc link inverter –boost inverters- buck and boost inverter – inverter circuit design – Advantage-–Application- numerical problems

TEXT BOOKS:

1. Power Electronics by Md.H.Rashid –Pearson Education Third Edition -First Indian reprint 2004
2. Power Electronics By P.S.Bimbhra (2004), "Power Electronics", Khanna publishers.
3. Power Electronics- Ned Mohan, Tore M.Undeland and William P.Robbins –John Wiley & Sons -2nd Edition

REFERENCE BOOKS:

1. Power Electronics By M.S.Jamil Asghar Phi Publication.
2. Power Electronics By M.D.Singh and K.B.Khanchandani (2002, TMH).
3. Vedam Subrahmanyam (1997), "Power Electronics", New age international publishers.

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ELECTRICAL & ELECTRONICS ENGINEERING

M.Tech (Power Electronics) I-Sem	**T**	**P**	**C**
	4	**0**	**4**

(D4303101) MODELING OF CONVENTIONAL MACHINES

UNIT I Basic concepts of Modeling

Basic Two- pole DC machine – primitive 2-axis machine – Voltage & Current relationship – Torque equation

UNIT II DC Machine Modeling- I

Mathematical model of separately excited DC motor and DC series motor in state variable form – Transfer function of the motor – Numerical problems

UNIT III DC Machine Modeling- II

Mathematical model of DC shunt motor and DC Compound motor in state variable form – Transfer function of the motor - Numerical problems

UNIT IV Transformations

Linear transformation- phase transformation (a, b, c to ȧ, β, o) – Active transformation (ȧ, β, o to d, q)

UNIT V Modeling of three phase Induction machine

Circuit model of a 3 phase Induction motor – Linear transformation – Phase Transformation – Transformation to a Reference frame – Two axis model for Induction motor

UNIT VI Dynamic modeling of three phase Induction Machine

Voltage and current Equation in stator reference frame – Equation rotor reference frame – Equations in a synchronously rotating frame – Torque equation – Equation in state – space form

UNIT VII Modeling of three phase Synchronous machine

Circuit model of a 3Ph Synchronous motor – Two axis representation of Synchronous Motor.

UNIT VIII Dynamic Analysis of Synchronous Machine

Voltage and current Equation in state – space variable form – Torque equation.

TEXT BOOKS:

1. Thyristor control of Electric Drives- Vedam Subramanayam
2. Generalized Machine Theory –Bimbra

REFERENCE BOOKS:

1. Analysis of electric machinery and Drive systems- Oleg wasynezul, Scott D.Sudhoff, Paul C. Krause.
2. Electric Motor Drives - Modeling, Analysis& control -R.Krishnan- Pearson Publications-1st edition -2002

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	4	**0**	**4**

(D4304101) POWER ELECTRONIC CONTROL OF DC DRIVES

UNIT 1 Controlled Bridge Rectifier (1-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.

UNIT II Controlled Bridge Rectifier (3-Φ) with DC Motor Load

Three phase semi converter and three phase full converter for continuous and discontinuous modes of operation – power and power factor – Addition of Free wheeling diode – Three phase double converter.

UNIT III 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 IV Phase Controlled DC Motor Drives

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

UNIT V Current and Speed controlled DC Motor drives

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

UNIT VI 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 VII Closed loop operation of DC motor Drives

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

UNIT-VIII Simulation of DC motor Drives

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

TEXT BOOKS:

1. Power Electronics and motor control – Shepherd, Hulley, Liang – II Edition, Cambridge University Press
2. Electric motor drives modeling, Analysis and control – R. Krishnan – I Edition, Prentice Hall India.

REFERENCE BOOKS :

1. Power Electronic Circuits, Devices and Applications – M. H. Rashid – PHI, I Edition – 1995.
2. Fundamentals of Electric Drives – G. K. Dubey – Narosa Publications – 1995.
3. Power Semiconductor drives – S.B. Dewan and A. Straughen – 1975.

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(D4305101) ADVANCED POWER SEMICONDUCTOR DEVICES AND PROTECTION

UNIT I BJTs

Introduction- 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 BJTs and darlingtons

UNIT II Power MOSFETs

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 Gate Turn-Off Thyristors

Introduction-basic structures-I-V characteristics-physics of device operation-GTO switching characteristics-snubber circuits-over protection of GTOs.

UNIT IV Insulated Gate Bipolar Transistors

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 V Emerging Devices and Circuits

Introduction-Power junction field effect transistors-field controlled Thyristor-JFET based devices versus other power devices-MOS controlled Thyristors-high voltage integrated circuits-new semiconductor materials

UNIT VI Passive Components and Electromagnetic compatibility

Introduction-design of inductor-transformer design-selection of capacitors-resistors current measurements-heat sinking circuit lay out –Electromagnetic Interference (EMI)-Sources of EMI-Electromagnetic Interference in Power Electronic Equipment

UNIT VII Noise

Noise sources in SMPS-Diode Storage Charge Noise-Noise generated due to switching-Common noises sources in SMPS-Noises Due to High frequency transformer-How the conducted noise is measured - minimizing EMI-EMI shielding-EMI standards.

UNIT VIII Protection of Devices & Circuits

Cooling & Heat sinks – Thermal modeling of powerswitching devices- snubber circuits – Reverse recovery transients – Supply and load side transients – voltage protections – current protections.

TEXT BOOKS :

1. Power Electronics-Md.H.Rashid –Pearson Education Third Edition -First Indian reprint 2004
2. Power Electronics- Ned Mohan, Tore M.Undeland and William P.Robbins –John Wiley & Sons -2nd Edition.

REFERENCE BOOKS :

1. Power Electronics Circuits-Vithayathil
2. Power Electronics Circuits-W.C. Lander

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(D4306101) CONTROL SYSTEM DESIGN

UNIT I Introduction To Design

System Performance specifications – design of Lead, Lag, Lead-Lag compensators, Using Root Locus & Bode plot.

UNIT II Classical Controller Design

Basic control action – P, PI, PD & PID controllers – characteristics – Design

UNIT III Controller Tuning

Tuning – optimal controllers setting – evaluation criteria – IAE, ISE, ITAE and ¼ decay ratio – Zeigler Nichols method – damped oscillator method – Process reaction curve method.

UNIT IV Multiloop Control System Design

Feed forward control – ratio control – cascade control – inferential control – split range control – Introduction to multivariable control.

UNIT V State Variable Design-I

Design by state feedback – output feedback – Pole assignment technique – design of state and output regulators – Design of reduced and full order observers

UNIT VI State Variable Design-II

Introduction to Kalman filter- Design – Extended Kalman filter(EKF)-Applications

UNIT VII Robust Control

Introduction to robust control – H Control – Parameter optimization

UNIT VIII Case Studies

Radar tracking – Control of Robot arm – Satellite Altitude Control – Temperature Control.

TEXT BOOKS :

1. M.Gopal, Modern control systems Engineering, Wiley Eastern Ltd., 1993.
2. Stephampoulis. A, Chemical process control, prentice hall of India, New Delhi, 1990.
3. Eckman D.P., Automatic process control, Wiley Eastern Ltd., New Delhi, 1993.

REFERENCES BOOKS:

1. S.Thompson, Control systems Engineering and Design, Longman group, UK. Ltd., 1989.
2. E.O. Doebelin, Control systems Principles and Design, John Wiley, 1990.
3. I.J. Nagrath and M.Gopal, Control systems Engineering, Wiley Eastern Ltd., 1982.

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(D4307101) ADAPTIVE CONTROL THEORY

UNIT I Modeling And Simulation

Linear Feed back – Effect of process variations – Classifications of Adaptive control - Modeling – Frequency Impulse – Step Response methods – Simulations of 1^{st} and 2^{nd} order systems.

UNIT II Identification Technique

Off-line – on line methods – Least square – Recursive least square – fixed memory – maximum likelihood – Instrumental variable – stochastic approximate method.

UNIT III MRAS & STC

Introduction – the gradient approach – MIT rule Liapunov Functions – Control policies – Pole placement control – minimum variance control – Predictive control.

UNIT IV Properties of Adaptive Systems

Introduction – nonlinear dynamics –adaptation of feedforward gain –analysis of indirect discrete time self tuners - stability of direct discrete time algorithms – averaging-application of averaging technique

UNIT V Auto-Tuning and Gain Scheduling

PID control – auto tuning technique – Transient response methods – Methods based on relay feedback – Relay oscillations – Principle and design of gain scheduling controllers – Non linear transformations – Applications of gain scheduling.

UNIT VI Robust And Self –Oscillating Systems

Introduction – robust high gain feed back control – self oscillating adaptive systems – variable structure systems – conclusion

UNIT VII Applications And Expert Control

Introduction - Industrial adaptive controllers – Process control – ship steering – Adaptive signal processing – Extremum control – expert control system – Learning systems – Introduction to Neuro-Fuzzy controllers.

UNIT VIII Practical Issues And Implementation

Introduction - controller implementation – controller design – estimator implementation - square root algorithms - prototype algorithms

REFERENCES

1. Adaptive Control, Karl.J.Astrom, Bjorn Witten mark, Pearson Education, pvt. Ltd 1995.
2. Adaptive Filtering, Prediction and control, Goodwin G.C Sin KS New Jersey, Prentice Hall inc. 1984.
3. Self tuning and Adaptive control, Harris C.J. Billings. S.A. Peter pereginius Ltd., 1984.
4. Isermann R, Digital Control System vol. I & II Narosa Publishing House, Reprint 1993.
5. Mendal JM, Discrete Technique of Parameter Estimate Marcel dekkas, New York, 1973.

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(D4308101) ADVANCED CONTROL SYSTEMS

UNIT I State Space Analysis

State Space Representation, Solution of State Equation, State Transition Matrix, Canonical Forms – Controllable Canonical Form, Observable Canonical Form, Jordan Canonical Form.

UNIT II Controllability and Observability

Tests for controllability and observability for continuous time systems – Time varying case, minimum energy control, time invariant case, Principle of Duality, Controllability and observability form Jordan canonical form and other canonical forms.

UNIT III Describing Function Analysis

Introduction to nonlinear systems, Types of nonlinearities, describing functions, describing function analysis of nonlinear control systems.

UNIT IV Phase-Plane Analysis

Introduction to phase-plane analysis, Method of Isoclines for Constructing Trajectories, singular points, phase-plane analysis of nonlinear control systems

UNIT V Stability Analysis

Stability in the sense of Lyapunov., Lyapunov's stability and Lypanov's instability theorems. Direct method of Lypanov for the Linear and Nonlinear continuous time autonomous systems

UNIT VI Control

Effect of state feedback on controllability and observability, Design of State Feedback Control through Pole placement. Full order observer and reduced order observer

UNIT VII Calculus Of Variations

Minimization of functionals of single function, Constrained minimization. Minimum principle. Control variable inequality constraints. Control and state variable inequality constraints. Euler Lagrangine Equation

UNIT VIII Optimal Control

Formulation of optimal control problem. Minimum time, Minimum energy, minimum fuel problems. State regulator problem. Output regulator problem. Tracking problem, Continuous-Time Linear Regulators

TEXT BOOKS:

1. Modern Control System Theory – by M. Gopal, New Age International Publishers, 2nd edition, 1996.
2. Control Systems Engineering by I.J. Nagarath and M.Gopal, New Age International (P) Ltd.

REFERENCE BOOKS:

1. Modern Control Engineering – by K. Ogata, Prentice Hall of India, 3rd edition, 1998
2. Digital Control and State Variable Methods – by M. Gopal, Tata Mc Graw-Hill Companies, 1997.
3. Systems and Control by Stainslaw H. Zak , Oxford Press, 2003.

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(D4309101) DIGITAL CONTROL SYSTEMS

UNIT I Sampling and Reconstruction

Introduction, sample and hold operations, sampling theorem, reconstruction of original sampled signal to continuous time signal

Z-Transforms

Introduction, Linear difference equations, pulse response, Z-transforms, Theorems of Z transforms, the inverse Z-transforms, Modified Z-transforms

UNIT II Z-Plane Analysis of Discrete Time control systems

Z-transform method for solving difference equations: pulse transform function, block diagram analysis of sampled –data systems, mapping between s-plane and z-plane; primary strips and complementary strips

UNIT III State Space Analysis

State space representation of discrete time systems, pulse transfer function matrix, solving discrete time state space equations, state transition matrix and its properties methods for computation of state transition matrix, discretization of continuous time state-space equations

UNIT IV Controllability and Observability

Concepts of controllability and observability, tests for controllability and observability, duality between controllability and observability, controllability and observability conditions for pulse transfer functions

UNIT V Stability Analysis

Stability analysis of closed loop systems in the Z-plane, Jury stability criterion test-Stability analysis by use of the bilinear transformation and routh stability criterion. Stability analysis using liapumov theorems

UNIT VI Design of Discrete Time control system by conventional methods

Design of digital control based on the frequency response methods-Bilinear transformation and design procedure in the w-plane, lead, lag and Lead-lag compensators and digital PID controllers. Design digital control through dead beat response methods.

UNIT VII State Feed back controllers and Observers

Design of state feedback controller through pole placement-Necessary and sufficient conditions, Ackerman's formula, State observers-Full order and Reduced Order observer

UNIT VIII Linear Quadratic Regulators

Min/Max principle, Linear Quadratic Regulators, Kalman Filters, State Estimation through kalman Filters, Introduction to adaptive controls

TEXT BOOKS:

1. Discrete Time Control Systems-K.Ogata Pearson Education
2. Digital Control systems and State Variables methods by M.Gopal

REFERENCE BOOKS :

1. Digital Control Engineering Kuo, Oxford University
2. Digital Control Engineering M.Gopal

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(D4310101) OPTIMAL CONTROL THEORY

UNIT I Performance Measure

Problem formulation - state variable representation of systems - performance measures for optimal control problems - selecting a performance measure

UNIT II Dynamic Programming-I

Optimal control law – principle of optimality – Application of Principle of optimality to decision making – Recurrence relation of Dynamic Programming – Imbedding Principle – computational procedure to solve optimal control problems

UNIT III Dynamic Programming-II

Discrete Linear regulator Problems – Hamilton – Jacobi Belman Equation – Continous linear regulator problems

UNIT IV Calculus of Variations

Fundamental concepts – Functional of a single function – functionals involving several independent functions – piece wise smooth extremals – constrained extrema

UNIT V Variational Approach to Optimal Control Problem

Necessary condition for optimal control – Linear regulator problems – Pontryagin's Minimum

UNIT VI Optimal Control Problem

Principle and state inequality constraints – Minimum time Problems – Minimum Control – Effort problems – Singular intervals in optimal control Problem.

UNIT VII Numerical Determination of Optimal Control

Simplex Method – golden section Method – Hill climbing – Gradient – Penalty functions methods

UNIT VIII Introduction of Stochastic Control Theory

Introduction of Stochastic Control Theory

REFERENCE BOOKS:

1. Optimal Control theory, An Introduction, Donald. E. Kirk, Prentice Hall, Inc., Englewood Cliffs, New Jersey, 1962.
2. Optimum system control, Sage A.P., Prentice Hall N.H. 1968
3. Rao S.S. Optimization theory And Application, Wiley Eastern, New Delhi, 1992.

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(D4311101) MODERN CONTROL THEORY

UNIT I Mathematical Preliminaries

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

UNIT II State Variable Analysis

Linear Continuous time model for physical systems – Existence and Uniqueness of Solutions to Continuous – Time State Equations – Solutions – Linear Time Invariant Continuous – Time State Equations – State transition matrix and it's properties

UNIT III Controllability And Observability

General concept of Controllability - General concept of Observability Controllability tests for Continuous – Time Invariant systems - Observability tests for Continuous - Time Invariant systems - Controllability and Observability of state model in Jordan Canonical form - Controllability and Observability Canonical forms of State model

UNIT IV Non Linear Systems – I

Introduction – Non Linear Systems – Types of Non – Linearities – Saturation – Dead – Zone – Backlash – Jump Phenomenon etc; - Singular Points – Introduction to Linearization of nonlinear systems, properties of Non Linear Systems – Describing function – describing function analysis of nonlinear systems- Stability analysis of Non – Linear systems through describing functions

Unit V Non Linear Systems – II

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

UNIT VI Stability Analysis

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

UNIT VII State Feedback Controllers And Observers

State Feedback Controller design through Pole Assignment – state observers: Full order and Reduced order

UNIT VIII Optimal Control

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

TEXT BOOKS:

1. Modern Control System Theory by M. Gopal – New Age International – 1984
2. Modern Control Engineering by Ogata. K – Prentice Hall – 1997

REFERENCE BOOKS :

1. Optimal control by Kirk.
2. Digital Control Engineering Kuo, Oxford University

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(D4391101) POWER CONVERTERS LAB

Choose any ten experiments from the following list

1. Single phase half controlled converter with R and R-L Load
2. Single phase full controlled converter with R and R-L Load
3. Three phase half controlled converter with R and R-L Load
4. Three phase full controlled converter with R and R-L Load
5. Single phase AC Voltage controller with R and R-L Load
6. Three phase half controlled AC Voltage controller with R and R-L Load
7. Three phase full controlled AC Voltage controller with R and R-L Load
8. Single phase cycloconverter
9. McMurray full bridge inverter
10. Single phase dual converter with R-L load
11. Simple series and parallel inverter
12. Thyristorised chopper

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(D4392101) SIMULATION OF POWER CONVERTERS LAB

NOTE: The first seven experiments are compulsory. Three experiments can be chosen from the remaining

1. Simulation of firing schemes: Ramp, Cosine, PWM
2. Simulation of Single phase fully controlled converter with R and R-L load using MATLAB/PSIM
3. Simulation of Three phase fully controlled converter with R and R-L load using MATLAB/PSIM
4. Simulation of Single phase AC Voltage controller with R and R-L load using MATLAB/PSIM
5. Simulation of Three phase full controlled AC Voltage controller with R and R-L Load using
6. MATLAB/PSIM
7. Simulation of three phase inverter in 120^0 conduction mode load connected both in star & delta
8. Simulation of three phase inverter in 180^0 conduction mode load connected both in star & delta
9. Simulation of step-down & step-up choppers
10. Simulation of buck & boost converter
11. Simulation of cuk converter
12. Simulation of z-source inverter
13. Simulation of Single phase cyclo-converter
14. PWM pulse generation through MATLAB program

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(D4312102) INTEGRATION OF RENEWABLE ENERGY SOURCES

UNIT-I Integration of alternative sources of energy

Introduction - Principles of Power Injection - Converting Technologies-Power Converters for Power Injection into the Grid - Power Flow – Instantaneous Active and Reactive power Control Approach - Integration of Multiple Renewable Energy Sources-DC-Link Integration-AC-Link Integration-HFAC-Link Integration-Islanding and Interconnection Control – DG control and power injection

UNIT-II Distributed generation

Introduction – purpose of distributed generation – sizing and siting of distributed generation – demand-side management – optimal location of distributed energy sources

UNIT-III Distributed generation (contd)

DG influence on power and energy losses – estimation of DG influence on power losses of sub transmission systems – Equivalent of sub transmission systems using experimental design – algorithm of multicriterial analysis

UNIT-IV Interconnection of alternative energy sources with the grid

Introduction - Interconnection Technologies – Synchronous Interconnection - Induction Interconnection - Inverter Interconnection - Standards and Codes for Interconnection -IEEE 1547 - National Electrical Code - UL Standards - Interconnection Examples for Alternative Energy Sources Synchronous Generator for Peak Demand Reduction – small grid connected photovoltaic system

UNIT-V Interconnection Considerations

Voltage Regulation - Integration with Area EPS Grounding - Synchronization - Isolation - Response to Voltage Disturbance - Response to Frequency Disturbance - Disconnection for Faults -Loss of Synchronism - Feeder Reclosing Coordination - DC Injection - Voltage Flicker - Harmonics - Unintentional Islanding Protection

UNIT-VI Storage Systems

Introduction - Energy Storage Parameters - Lead–Acid Batteries - Constructional Features - Battery Charge–Discharge Cycles - Operating Limits and Parameters - Maintenance of Lead–Acid Batteries - Sizing Lead–Acid Batteries for DG Applications - Ultra capacitors - Double-Layer Ultra capacitors - High-Energy Ultra capacitors - Applications of Ultra capacitors

UNIT-VII Storage Systems (contd..)

Flywheels - Advanced Performance of Flywheels - Applications of Flywheels - Design Strategies - Superconducting Magnetic Storage System - SMES System Capabilities - Developments in SMES Systems - Pumped Hydroelectric Energy Storage - Storage Capabilities of Pumped Systems - Compressed Air Energy Storage - Storage Heat - Energy Storage as an Economic Resource

UNIT-VIII Micropower system modeling with homer

Introduction - Simulation Optimization - Sensitivity Analysis - Dealing with Uncertainty - Sensitivity Analyses on Hourly Data Sets - Physical Modeling - Loads - Resources - Components - System Dispatch - Economic Modeling

TEXT BOOKS:

1. Integration of alternative sources of energy- Felix a. Farret, M. Godoy simoes- A John Wiley & Sons, inc., publication
2. Non-conventional energy sources- G.D. Rai

REFERENCE BOOKS :

1. Renewable Energy Resources / John Twidell and Tony Weir / E & F.N.Spon
2. Renewable Energy Resources Basic Principles and Applications / G.N.Tiwari and M.K.Ghosal / Narosa
3. Solar Energy - Principles of thermal collection and storage/ S.P. Sukhatme / TMH

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(D4313102) MODERN POWER ELECTRONICS

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 Resonant Converters

Resonant converters- zero current switching resonant converters – L type ZCS resonant converter- M type ZCS resonant converter – zero voltage Switching resonant converters – comparison between ZCS and ZVS resonant converters- Two quadrant ZVS resonant converters – resonant dc – link inverters- evaluation of L and C for zero current switching inverter – Numerical problems.

UNIT IV 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.

UNIT V Multilevel inverters (continued)

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 VI 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 VII AC Power Supplies

AC power supplies – classification – switched mode ac power supplies Resonant AC power supplies- bidirectional ac power supplies – multistage conversions- control circuits- applications.

UNIT VIII Power conditioners and Uninterruptible Power Supplies

Introduction- power line disturbances – power conditioners- uninterruptible power supplies- applications

TEXT BOOKS:

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

REFERENCE BOOKS:

1. Introduction to **Modern Power Electronics** - Andrzej M. Trzynadlowski - Second edition - John wiley & Sons

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(D4314102) SPECIAL MACHINES AND CONTROL

UNIT I Stepper Motors

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

UNIT II Switched Reluctance Motors

Mathematical model of Switched Reluctance Motor-Operating principle-Construction and functional Aspects-Average torque and Energy Conversion Ratio-The Commutation windings-The flux current position curve fitting, Control Techniques

UNIT III Permanent Magnet Brushless DC Motors

Modelling of Permanent Magnet Brushless DC Motor – Operating principle-Mathematical modeling of PM Brushless DC motor-PMDC Motor Drive Scheme. Torque and emf equation, Torque-speed characteristics

UNIT IV Permanent Magnet Synchronous Motors

Principle of operation, EMF, power input and torque expressions, Phasor diagram, Power Controllers, Torque speed characteristics

UNIT V Servomotors

Servomotor – Types – Constructional features – Principle of Operation – Characteristics - Control – Microprocessor based applications

UNIT VI AC Tachometers

Schematic diagram, Operating principle, numerical problems

UNIT VII Linear Motors

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

UNIT VIII Controllers for machines:

Drive concept for special machines--Microprocessors based controller for PMBLDC motor-- Self control, Vector control, Current control Schemes for PMSM

TEXT BOOKS:

1. N.Mohan, Undeland & Robbins: Power Electronics Converters, Applications & Design
2. Power Electronics Control of AC Motors-MD Murphy & FG Turn Bull Pergman Press.
3. Miller, T.J.E. "Brushless Permanent Magnet and Reluctance Motor Drives", Clarendon Press, Oxford, 1989.
4. Kenjo, T and Naganori, S "Permanent Magnet and brushless DC motors", Clarendon Press, Oxford, 1989.

REFERENCES:

1. Kenjo, T, "Stepping Motors and their Microprocessor control", Clarendon Press, Oxford, 1989.
2. Naser A and Boldea I, "Linear Electric Motors: Theory, Design and Practical Application", Prentice Hall Inc., New Jersey,1987
3. Floyd E Saner,"Servo Motor Applications", Pittman USA, 1993.

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(D4315102) POWER ELECTRONIC CONTROL OF AC 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 at stator side

Scalar control-Voltage fed inverter control-Open loop volts/Hz Control-Speed control slip regulation- Speed control with torque and flux control-Current controlled voltage fed inverter drive-Current fed inverter control-Independent current and frequency control-Speed and flux control in current fed inverter drive-Volts/Hertz Control current fed-Inverter drive-Efficiency optimization control by flux program

UNIT III Control of Induction motor at rotor Side

Slip power recovery drives-Static Kramer Drive-Phasor diagram-Torque expression-Speed control of Kramer Drive-Static Scheribus Drive- Modes of operation

UNIT IV Vector control of Induction motor Drives

Principles of Vector Control-Vector Control Methods-Direct method of Vector control-Adaptive control principles-Self tuning regulator-Model referencing control

UNIT V 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 VI 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 VII Variable Reluctance motor Drive

Variable reluctance motor drives- Torque Production in the variable reluctance motor- Drive characteristics and control principles- Current control variable reluctance servo drive.

UNIT VIII Brushless DC motor Drives

Three phase full wave Brushless dc motor – Sinusoidal type of Brushless dc motor-Current controlled Brushless dc servo drives

TEXT BOOKS

1. Electric Motor Drives Pearson modeling, analysis and control R.Krishnan – Publication -1st Edition -2002
2. Modern Power Electronics and AC drives-B.K Bose-Pearson Publication -1ST Edition
3. Power Electronic Control of AC motors- MD Murphy & FG Turn Bull Pergman Press(For Chapters II,III, V) – 1st Edition
4. Power Electronics and AC drives-B.K Bose-Prentice Hall Publication -1ST Edition

REFERENCES

1. Power Electronics Circuits , Devices and Application- M.H Rashid –PHI 1995
2. Fundamentals of Electric Drives –GK Dubey- Narora Publications -1995

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(D4316102) POWER ELECTRONIC APPLICATIONS TO POWER SYSTEMS

UNIT I Introduction

Concepts of reactive power – Load compensation – System compensation – Midpoint conditions of a symmetrical line – Passive shunt and series compensation – Synchronous condenser – Saturated reactor – Phase shifting transformer – Concept of FACTS devices.

UNIT II Static Var Compensator (SVC)

Thyristor Controlled Reactor (TCR) - Thyristor Switched Reactor (TSR) - Thyristor Switched Capacitor (TSC) - Fixed Capacitor - Thyristor Controlled Reactor (FC-TCR) - Thyristor Switched Capacitor - Thyristor Controlled Reactor (TSC -TCR) – V-I Characteristics of Static Var Compensator (SVC)

UNIT III Thyristor Controlled Series Capacitor (TCSC)

Concept of series compensation - Thyristor Controlled Series Capacitor (TCSC) controller: Basic principle – Modes of Operation – Advantages

UNIT IV Emerging Facts Controller

Static Synchronous Compensator (STATCOM): Principle of Operation – V-I Characteristic – Harmonic performance – Steady state model – SSR mitigation. SSSC: principle of operation – Control system. Unified Power Flow Controller (UPFC): Principle of Operation – Injection model. Interline Power Flow Controller (IPFC): Principle of Operation – Control structure. Evaluation of different FACTS controllers

UNIT V Sub Synchronous Resonance

NGH-SSR damping scheme – Thyristor controlled braking resistor (TCBR) – SVC mitigation of SSR – TCSC mitigation of SSR

UNIT VI Load Compensation in Power Systems

Introduction - Voltage Regulation - Power Factor Correction - Phase Balancing and Power Factor Correction of Unsymmetrical Loads - Uncompensated Transmission lines.

UNIT VII Static Compensation Control

Shunt - Series Compensation, Compensation by Sectioning - Property of Static Compensation - Thyristor Controlled Reactor (TCR) - Thyristor Switched Capacitor Saturable Reactor - Saturated Reactor Compensators.

UNIT VIII Harmonics Control & Power Factor Improvement

Reactive Power Variation for Fully controlled converter - Half controlled converter - Fully controlled converter with controlled free wheeling - Methods of employing natural commutation - Methods of employing forced commutation and implementation of forced commutation

TEXT BOOKS:

1. R. Mohan Mathur, Rajiv K. Varma, "Thyristor-based facts controllers for electrical transmission systems", Wiley-IEEE, 2002
2. K.R. Padiyar, "Facts Controllers in Power Transmission & Distribution", New Age International Publishers

REFERENCE BOOKS:

1. Enrique Acha, Claudio R. Fuerte-Esquivel, Hugo Ambriz-Perez, Cesar Angeles-Camacho, "FACTS: Modeling and Simulation in Power Networks", John Wiley & Sons Ltd., 2004.
2. S. Sivanagaraju, S.Sathyabarayana, "Electric Power Transmission and Distribution", Pearson Education, 2009.
3. Kalyan K. Sen & Mey Ling Sen, "Introduction to FACTS controllers: Theory, Modeling, and Applications", Wiley-IEEE, 2009.
4. Narain G. Hingorani, Laszlo Gyugyi, "Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems", IEEE Press Standard Publishers Distributors, 2000.
5. M.Noroozian et.al "Use of UPFC for optimal power flow control", Transactions on Power Delivery, Vol.12, No.4, oct 1997, pp 1629-1634

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(D4317102) MICRO COMPUTER SYSTEM DESIGN

UNIT I Review Of 8086 Processor

Architecture, Register organization, Addressing Modes and Instruction Set (Brief treatment only), Difference between 8086 and 8088 with rest to pin structures

UNIT II 80286 Micro Processors

Architecture, Register Organization, Addressing Modes and instruction sets of 80286 (brief treatment only)

UNIT III 80386, And 80486 Micro Processors

Architectural features, Register Organization, Memory management, Virtual 8086 mode, The Memory Paging Mechanism, Pin Definitions of 80386 and 80486 (brief treatment).

UNIT IV Pentium and Pentium Pro Processors

The Memory System, Input/output system, Branch Prediction Logic, Cache Structure, Pentium Registers, Serial Pentium pro features.

UNIT V Pentium IV and Dual Core Micro Processors

Architecture, Special Registers and Pin Structures (brief treatment only)

UNIT VI I/O Programming

Fundamentals of I/O, Considerations Programmed I/O, Interrupt I/O, Block Transfers and DMA, I/O Design Example.

UNIT VII Introduction to Multiprogramming

Process Management, Semaphores Operations, Common Procedure Sharing, Memory Management and Virtual Memory Concept of 80286 and other advanced Processors.

UNIT VIII Arithmetic Coprocessor, MMX and SIMD Technologies

Data formals for Arithmetic Coprocessor, Internal Structure of 8087 and Advanced Coprocessors, Instruction Set (brief treatment)

TEXTBOOKS:

1. Barry, B. Brey, "The Intel Microprocessors,"8th Edition Pearson Education, 2009.
2. A.K. Ray and K.M. Bhurchandi,"Advanced Microprocessor and Peripherals," TMH

REFERENCES:

1. YU-Chang, Glenn A. Gibson, "Micro Computer Systems: The 8086/8088 Family Architecture, Programming and Design" 2nd Edition, Pearson Education, 2007
2. Douglas V. Hall, "Microprocessors and Interfacing," Special Indian Edition, 2006.

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(D4318102) EMBEDDED SYSTEMS DESIGN

UNIT I Pentium Processor

Introduction to the Pentium Microprocessor, Special Pentium Registers, Pentium Memory management

UNIT II Embedded Design Life Cycle

Introduction, Product Specification, Hardware/software partitioning, Iteration and Implementation, Detailed hardware and software design, Hardware/Software integration, Product Testing and Release, Maintaining and upgrading existing products. Selection Process: Packaging the Silicon, Adequate Performance, RTOS Availability, Tool chain Availability, Other issues in the Selection process, partitioning decision: Hardware/Software Duality, Hardware Trends, ASICs and Revision Costs

UNIT III Development Environment

The Execution Environment, Memory Organization, System Startup. Special Software Techniques: Manipulating the Hardware, Interrupts and Interrupt service Routines (ISRs), Watchdog Times, Flash Memory, Design Methodology. Basic Tool Set: Host – Based Debugging, Remote Debuggers and Debug Kernels, ROM Emulator, Logic Analyzer.

UNIT IV BDM

Background Debug Mode, Joint Test Action Group (JTAG) and Nexus-ICE – Integrated Solution: Bullet Proof Run Control, Real time trac, Hardware Break points, Overlay memory, Timing Constrains, Usage Issue, Setting the Trigger.

UNIT V Testing

Why Test? When to Test? Which Test? When to Stop? Choosing Test cases, Testing Embedded Software, Performance Testing Maintenance and Testing, The Future

UNIT VI Writing Software for Embedded Systems

The compilation Process, Native Versus Cross-Compilers, Runtime Libraries, Writing a Library, Using alternative Libraries, using a standard Library, Porting Kernels, C extensions for Embedded Systems, Downloading.

UNIT VII Emulation and debugging techniques

Debugging techniques, The role of the development system, Emulation techniques: JTAG, ONCE, BDM.

UNIT VII Buffering and Other Data Structures

What is a buffer? Linear Buffers, Directional Buffers, Double Buffering, Buffer Exchange, Linked Lists, FIFOs, Circular Buffers, Buffer Under run and Overrun, Allocating Buffer Memory, Memory Leakage. Memory and Performance Trade-offs

TEXTBOOKS

1. Intel Microprocessors by Barry B Brey PHI
2. Embedded System Design – Introduction to Processes, Tools, Techniques, Arnold S Burger, CMP Books
3. Embedded Systems Design by Steve Heath, Newnes

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(D4319102) NEURAL NETWORKS & ITS APPLICATIONS

UNIT I Fundamental Concepts And Models Of Artificial Neural Systems

Structure and functions of Biological Neuron, McCulloch-Pitts Neuron Model, Neuron Modeling for Artificial Neural Systems, Models of Artificial Neural Networks: Feed forward Network and feed backward Network. Neural Processing, learning: Supervised and Unsupervised learning

UNIT II Neural network learning rules

Hebbian Learning Rule, Perceptron Learning Rule, Delta Learning Rule, Widrow-Hoff learning Rule, Correlation Learning Rule, Winner–Take-All Learning rule, OutStar Learning Rule, summary of Learning rules

UNIT III Single- layer perceptron classifiers

Classification Model, Features, and Decision Regions, Discriminant Functions, linear Machine and Minimum Distance Classification, Nonparametric training concept, Training and classification using the discrete perceptron, Single Layer Continuous Perceptron Networks for Linearly Separable Classifications, Multicategory Single Layer Perceptron Networks

UNIT IV Multilayer feed forward networks

Linearly nonseparable pattern classification, Delta Learning rule for Multiperceptron layer. Generalized Delta Learning rule, Feed forward Recall and Error Back Propagation Training: Feedforward Recall, Error Back-Propagation Training. Application of Back propagation Networks in pattern recognition & Image processing, Madalines: Architecture & Algorithms.

UNIT V Single-Layer Feedback Networks

Basic concepts of Dynamical systems, Mathematical Foundation of Discrete-Time Hop field Networks. Mathematical Foundation of Gradient-Type Hopfield Networks. Transient response of Continuous time Networks. Minimization of the Traveling salesman tour length, Solving Simultaneous Linear Equations

UNIT VI Associative memories-I

Basic concepts, linear associator, Basic concepts of Recurrent Autoassociative memory: Retrieval algorithm, Storage algorithm, Performance considerations

UNIT VII Associative memories-II

Boltzmann machines, Bidirectional Associative Memory, Associative Memory of Spatio-temporal Patterns

UNIT VIII Matching and Self-Organizing Networks

Hamming net and MAXNET, Unsupervised learning of clusters. Clustering and similarity measures, Winner-Take-All learning, Recall mode, initialization of weights, separability limitations, Counter propagation networks. Feature mapping, Self organizing feature maps, LVPS, Cluster discovery networks (ART1)

TEXT BOOKS

1. J.M.Zurada: Introduction to Artificial Neural Systems, Jaico Publishers
2. Dr. B. Yagananarayana, Artificial Neural Networks, PHI, New Delhi.

REFERENCES

1. Kishan Mehrotra, Chelkuri K. Mohan, Sanjay Ranka: Elements of Artificial Neural Networks, Penram International
2. Artificial Neural Network – By Simon Haykin, Pearson Education
3. Introduction Neural Networks Using MATLAB 6.0 - by S.N. Sivanandam, S. Sumati, S. N. Deepa,1/e, TMH, New Delhi.
4. Fundamental of Neural Networks – By Laurene Fausett

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(D4320102) FUZZY CONTROL & ITS APPLICATIONS

UNIT I Introduction to Fuzzy Sets

Crisp sets- Fuzzy sets- Operation and properties- Fuzzy relation- properties - Fuzzy tolerance and equivalence relations – value assignments

UNIT II Fuzzy-Crisp Conversions

Features of membership function- Standard forms and boundaries- Fuzzification- Membership value assignments – Intuition – Inference – Rank ordering

UNIT III Fuzzy-Crisp Conversions (contd)...

Fuzzy to crisp conversions- Lamda- cuts for Fuzzy sets- Lamda cuts for Fuzzy relations- Defuzzification methods.

UNIT IV Operations On Fuzzy Sets And Fuzzy Logic

Fuzzy Arithmetic, numbers, vectors and the extension principle – Fuzzy numbers – Internal arithmetic - Fuzzy logic- Approximate reasoning- Fuzzy tautologies, contradictions, equivalence and logical proofs- Forms of implication operator- Max-Min Composition – Max Product Composition - other Composition operation

UNIT V Fuzzy Rule Based System

Natural language- Linguistic hedges- Rule based systems- Canonical rule forms- Decomposition of compound rules- Likelihood and truth qualification- Aggregation of Fuzzy rules- Graphical techniques of inference- Fuzzy relational equations- Partitioning- Fuzzy association memories(FAM)

UNIT VI Fuzzy Control System

Simple Fuzzy logic controller- General Fuzzy logic controller-comparison

UNIT VII Fuzzy Control System Design

Fuzzy control system design - Examples

UNIT VIII Applications

Classical Fuzzy control problem- Inverted pendulum – Fuzzy Logic with Motor control – Example of Fuzzy Logic in Motor drives – Non-Linear fuzzy control – Application of Fuzzy Logic in Industry.

TEXT BOOKS

1. Dimiter Driakov etal,' An Introduction to Fuzzy Control', Narosa Publication House, 1993.
2. Klir G.J. and B.O.Yuan, 'Fuzzy sets and Fuzzy Logic: Theory and Applications', PHI, India, 1997.

REFERENCES

1. Timothy J. Ross 'Fuzzy logic with Engineering Applications' McGraw Hill.
2. Li-Xin Wang, 'A Course in Fuzzy Systems and Control', Prentice Hall PTR, 1997.
3. R.K. Yager, D.P.Filev, 'Essentials of Fuzzy Modeling and Control', John Wiley & Sons Inc, New York, 1994.

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(D4321102) SOFT COMPUTING TECHNIQUES

UNIT-I Overview of course

Brief introduction to the platforms and required background for the course. Basics of Soft Computing-Introduction to Soft Computing. The main components and characteristics of Soft Computing

UNIT-II Fuzzy Logic and Systems

Fuzzy Sets and Membership Functions- Operations on Fuzzy Sets- Fuzzification- Fuzzy Numbers -Uncertain Fuzzy Values-Fuzzy Numbers and its L-R representation-Operations on Fuzzy Numbers-Fuzzy Relations-Cartesian product-Binary Fuzzy Relations. IF-THEN fuzzy relation-n-ary Fuzzy Relations-Compositions of Fuzzy Relations-max-min composition-max-product composition

UNIT-III Fuzzy Inference Systems

Architecture of Fuzzy Inference System-Fuzzy Inference Rules and Reasoning-Defuzzification-Applications of Fuzzy Logic -Fuzzy Control Systems-Pattern Analysis and Classification-Fuzzy Expert Systems

UNIT-IV Neural Networks

Artificial Neural Networks-Models of Neuron-Architecture of Neural Networks-Feed-forward Neural Networks-Recurrent Neural Networks-Network layers-Perceptrons

UNIT-V Learning Methods for Neural Networks

Supervised Learning-Unsupervised Learning-Reinforcement Learning-Transfer Function- Back-Propagation Algorithm- Applications of Neural Networks-Neural Networks in Business-Neural networks in Medicine

UNIT-VI Genetic Algorithms - Genetic Algorithms and Evolutionary –Computation-Basics of Genetic Algorithms-Representation methods -Selection -Crossover –Mutation

UNIT-VII Applications of Genetic Algorithms

Genetic Algorithms on optimization and planning-Traveling Salesman Problem-Genetic Algorithms in Business and their role in Decision Making-Intelligent Control Using Evolutionary Computation

UNIT-VIII Hybrid Systems

Fuzzy-Evolutionary System -Neuro-Fuzzy System - Neuro-Fuzzy-Evolutionary System -Neuro-Evolutionary System

TEXT BOOKS:

1. Neuro-Fuzzy and soft computing by J S R Jang, CT Sun and E.Mizutani , PHI PVT LTD.
2. Principles of soft computing –by sivandudam and Deepa publisher –John mikey India.

REFERENCE BOOKS:

1. S. Haykins- Neural Networks: A comprehensive foundation.

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(D4422102) DSP FOR MOTOR DRIVE APPLICATIONS

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(D4393102) POWER ELECTRONIC DRIVES LAB

1. Load test on open & closed loop BLDC motor using micro 2407. For forward & reverse direction
2. Load test on open & closed loop 3 phase induction motor using micro 2812. For forward & reverse direction
3. Load test on open & closed loop 3 phase induction motor using micro 2407 with SPWM technique.
4. Load test on open & closed loop 3 phase induction motor using micro 2407 with SVPWM technique.
5. Load test on open DC Motor using micro 2407 with SPWM technique.
6. Load test on closed loop PMSM using micro 2812 with SPWM technique.
7. Load test on closed loop 3 phase induction motor using FPGA, P.3 with SPWM technique
8. Closed loop DC motor speed control with P, PI, PD & PID using MATLAB/SIMULINK
9. Speed control of 3 phase induction motor with SPWM technique using MATLAB/SIMULINK
10. Two quadrant operation of DC motor with chopper circuit using MATLAB/SIMULINK

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(D4394102) POWER SYSTEM SIMULATION LAB

Experiments using E-TAP Software

1. Load Flow Analysis
2. Short circuit Analysis
3. Motor Starting Analysis
4. Transient Stability Analysis
5. Harmonic Analysis

Experiments using POWER WORLD Software

1. Load Flow Analysis
2. Optimal Power flow & Economic Dispatch
3. Stability Study(PV&QV curves)
4. Short circuit Analysis
5. Contingency Analysis