ANNA UNIVERSITY CHENNAI :: CHENNAI 600 025

AFFILIATED INSTITUTIONS

REGULATIONS – 2008

CURRICULUM AND SYLLABI FROM

VI TO VIII SEMESTERS AND ELECTIVES FOR

B.E. ELECTRICAL AND ELECTRONICS ENGINEERING

SEMESTER VI

(Applicable to the students admitted from the Academic year 2008 – 2009 onwards)

SL. No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	EE2351	Power System Analysis	3	1	0	4
2.	EE2352	Solid State Drives	3	0	0	3
3.	EE2353	High Voltage Engineering	3	0	0	3
4.	EE2354	Microprocessors & Microcontroller	3	0	0	3
5.	EE2355	Design of Electrical Machines	3	1	0	4
6.	CS2361	Computer Networks	3	0	0	3
7.		Elective I	3	0	0	3
PRACTICAL						
1.	EE2356	Microprocessor and Micro controller Laboratory	0	0	3	2
2.	EE2357	Presentation Skills and Technical Seminar	0	0	2	1
		TOTAL	**21**	**2**	**5**	**26**

SEMESTER VII

(Applicable to the students admitted from the Academic year 2008 – 2009 onwards)

SL. No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	EE2401	Power System Operation and Control	3	0	0	3
2.	EE2402	Protection & Switchgear	3	0	0	3
3.	EE2403	Special Electrical Machines	3	0	0	3
4.	MG2351	Principles of Management	3	0	0	3
5.	CS2411	Operating Systems	3	0	0	3
6.		Elective – II	3	0	0	3
PRACTICAL						
1.	EE2404	Power System Simulation Laboratory	0	0	3	2
2.	EE2405	Comprehension	0	0	2	1
		TOTAL	**18**	**0**	**5**	**21**

SEMESTER VIII

(Applicable to the students admitted from the Academic year 2008 – 2009 onwards)

THEORY			L	T	P	C
1.	EE2451	Electric Energy Generation, Utilization and Conservation	3	0	0	3
2.		Elective – III	3	0	0	3
3.		Elective – IV	3	0	0	3
PRACTICAL						
1.	EE2452	Project	0	0	12	6
		TOTAL	**9**	**0**	**12**	**15**

LIST OF ELECTIVES - R 2008

ELECTIVE I

SL.NO	CODE NO.	COURSE TITLE	L	T	P	C
1.	EE2021	Fibre Optics and Laser Instruments	3	0	0	3
2.	CS2021	Visual Languages and Applications	3	1	0	4
3.	EE2022	Advanced Control System	3	0	0	3
4.	EE2023	Robotics & Automation	3	0	0	3
5.	GE2021	Professional Ethics in Engineering	3	0	0	3
6.	EE2027	Power System Transients	3	0	0	3

ELECTIVE II

7.	EE2024	Bio-Medical Instrumentation	3	0	0	3
8.	EE2025	Intelligent Control	3	0	0	3
9.	EE2026	Power System Dynamics	3	0	0	3
10.	CS2022	Computer Architecture	3	1	0	4
11.	GE2022	Total Quality Management	3	0	0	3

ELECTIVE III

12.	EE2028	Power Quality	3	0	0	3
13.	EE2029	System Identification and Adaptive Control	3	0	0	3
14.	EE2030	Operations Research	3	0	0	3
15.	EE2031	VLSI Design	3	0	0	3
16.	EE2032	HVDC Transmission	3	0	0	3

ELECTIVE IV

17.	GE2023	Fundamental of Nanoscience	3	0	0	3
18.	EE2033	Micro Electro Mechanical Systems	3	0	0	3
19.	EE2034	Software for Circuits Simulation	3	0	0	3
20.	EE2035	CAD of Electrical apparatus	3	0	0	3
21.	EE2036	Flexible AC Transmission Systems	3	0	0	3

EE2351 POWER SYSTEM ANALYSIS L T P C
3 1 0 4

AIM

To understand the necessity and to become familiar with the modelling of power system and components. And to apply different methods to analyse power system for the purpose of system planning and operation.

OBJECTIVES

- To model the power system under steady state operating condition. To apply efficient numerical methods to solve the power flow problem.
- To model and analyse the power systems under abnormal (or) fault conditions.
- To model and analyse the transient behaviour of power system when it is subjected to a fault.

UNIT I INTRODUCTION 9

Modern power system (or) electric energy system - Analysis for system planning and operational studies – basic components of a power system. Generator models - transformer model – transmission system model - load representation. Single line diagram – per phase and per unit representation – change of base. Simple building algorithms for the formation of Y-Bus matrix and Z-Bus matrix.

UNIT II POWER FLOW ANALYSIS 9

Importance of power flow analysis in planning and operation of power systems. Statement of power flow problem - classification of buses into P-Q buses, P-V (voltage-controlled) buses and slack bus. Development of Power flow model in complex variables form and polar variables form.

Iterative solution using Gauss-Seidel method including Q-limit check for voltage-controlled buses – algorithm and flow chart.

Iterative solution using Newton-Raphson (N-R) method (polar form) including Q-limit check and bus switching for voltage-controlled buses - Jacobian matrix elements – algorithm and flow chart.

Development of Fast Decoupled Power Flow (FDPF) model and iterative solution – algorithm and flowchart; Comparison of the three methods.

UNIT III FAULT ANALYSIS – BALANCED FAULTS 9

Importance short circuit (or) for fault analysis - basic assumptions in fault analysis of power systems. Symmetrical (or) balanced three phase faults – problem formulation – fault analysis using Z-bus matrix – algorithm and flow chart. Computations of short circuit capacity, post fault voltage and currents.

UNIT IV FAULT ANALYSIS – UNBALANCED FAULTS 9

Introduction to symmetrical components – sequence impedances – sequence networks – representation of single line to ground, line to line and double line to ground fault conditions. Unbalanced fault analysis - problem formulation – analysis using Z-bus impedance matrix – (algorithm and flow chart.).

UNIT V STABILITY ANALYSIS 9

Importance of stability analysis in power system planning and operation - classification of power system stability - angle and voltage stability – simple treatment of angle stability into small-signal and large-signal (transient) stability Single Machine Infinite Bus (SMIB) system: Development of swing equation - equal area criterion - determination of critical clearing angle and time by using modified Euler method and Runge-Kutta second order method. Algorithm and flow chart.

L = 45 T = 15 TOTAL = 60 PERIODS

TEXT BOOKS

1. Hadi Saadat, 'Power System Analysis', Tata McGraw Hill Publishing Company, New Delhi, 2002.
2. Olle. I. Elgerd, 'Electric Energy Systems Theory – An Introduction', Tata McGraw Hill Publishing Company Limited, New Delhi, Second Edition, 2003.

REFERENCES

1. P. Kundur, 'Power System Stability and Control, Tata McGraw Hill, Publications, 1994.
1. John J. Grainger and W.D. Stevenson Jr., 'Power System Analysis', McGraw Hill International Book Company, 1994.
3. I.J. Nagrath and D.P. Kothari, 'Modern Power System Analysis', Tata McGraw-Hill Publishing Company, New Delhi, 1990.
4. .K.Nagasarkar and M.S. Sukhija Oxford University Press, 2007.

EE2352 SOLID STATE DRIVES L T P C
3 0 0 3

AIM

To study and understand the operation of electric drives controlled from a power electronic converter and to introduce the design concepts of controllers.

OBJECTIVES

- To understand the stable steady-state operation and transient dynamics of a motor-load system.
- To study and analyze the operation of the converter / chopper fed dc drive and to solve simple problems.
- To study and understand the operation of both classical and modern induction motor drives.
- To understand the differences between synchronous motor drive and induction motor drive and to learn the basics of permanent magnet synchronous motor drives.
- To analyze and design the current and speed controllers for a closed loop solid-state DC motor drive and simulation using a software package

UNIT I DRIVE CHARACTERISTICS 9

Equations governing motor load dynamics - steady state stability - Multi quadrant dynamics - Acceleration, deceleration, starting and stopping - load torque characteristics of various drives.

UNIT II CONVERTER / CHOPPER FED DC MOTOR DRIVE 9

Steady state analysis of the single and three phase fully controlled converter fed separately excited D.C motor drive - Continuous and discontinuous conduction Time ratio and current limit control - 4 quadrant operation of converter.

UNIT III DESIGN OF CONTROLLERS FOR DRIVES 9

Transfer function for DC motor, load and converter – Closed loop control with current and speed feedback - Armature voltage control and field weakening mode control, Design of controllers: Current controller and speed controller - Converter selection and characteristics - Use of simulation software package.

UNIT IV INDUCTION MOTOR DRIVES 9

Stator voltage control – energy efficient drive - v/f control, constant air-gap flux – field weakening mode - voltage/current fed inverters - Block diagram of vector control - closed loop control.

UNIT V SYNCHRONOUS MOTOR DRIVES 9

V/f control and self-control of synchronous motor – Marginal angle control and power factor control - Permanent magnet synchronous motor Black diagram of closed loop control.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Gopal K.Dubey, "Power Semi conductor controlled drives " Prentice Hall Inc., New Jersey 1989.
2. Bimal K. Bose. 'Modern Power Electronics and AC Drives', PHI / Pearson Education, 2002.

REFERENCES:

1. N.K.De and S.K.Sen Electrical Drices" PHI, 2006 9th print.
2. Murphy J.M.D. and Turnbull, " Thyristor control of AC Motor" Pergamon Press Oxford 1988.
3. R. Krishnan, 'Electric Motor & Drives Modeling, Analysis and Control', Prentice Hall of India, 2001.

EE 2353 HIGH VOLTAGE ENGINEERING L T P C
3 0 0 3

AIM

To expose the students to various types of over voltage transients in power system and its effect on power system.

- Generation of over voltages in laboratory.
- Testing of power apparatus and system.

OBJECTIVES

- To understand the various types of over voltages in power system and protection methods.
- Generation of over voltages in laboratories.
- Measurement of over voltages.
- Nature of Breakdown mechanism in solid, liquid and gaseous dielectrics.
- Testing of power apparatus and insulation coordination.

UNIT I OVER VOLTAGES IN ELECTRICAL POWER SYSTEMS 6

Causes of over voltages and its effects on power system – Lightning, switching surges and temporary over voltages – protection against over voltages – Bewley's lattice diagram.

UNIT II ELECTRICAL BREAKDOWN IN GASES, SOLIDS AND LIQUIDS 10

Gaseous breakdown in uniform and non-uniform fields – Corona discharges – Vacuum breakdown – Conduction and breakdown in pure and commercial liquids – Breakdown mechanisms in solid and composite dielectrics.

UNIT III GENERATION OF HIGH VOLTAGES AND HIGH CURRENTS 10

Generation of High DC, AC, impulse voltages and currents. Tripping and control of impulse generators.

UNIT IV MEASUREMENT OF HIGH VOLTAGES AND HIGH CURRENTS 10

Measurement of High voltages and High currents – Digital techniques in high voltage measurement.

UNIT V HIGH VOLTAGE TESTING & INSULATION COORDINATION 9

High voltage testing of electrical power apparatus – Power frequency, impulse voltage and DC testing – International and Indian standards – Insulation Coordination.

TOTAL : 45 PERIODS

TEXT BOOK

1. M. S. Naidu and V. Kamaraju, 'High Voltage Engineering', Tata McGraw Hill, 3rd Edition, 2004.
2. E. Kuffel and M. Abdullah, 'High Voltage Engineering', Pergamon Press, Oxford, 1970.

REFERENCES

1. E. Kuffel and W. S. Zaengel, 'High Voltage Engineering Fundamentals', Pergamon Press, Oxford, London, 1986.
2. L. L. Alston, Oxford University Press, New Delhi, First Indian Edition, 2006.

EE2354 MICROPROCESSORS AND MICRO CONTROLLER LT P C
3 0 0 3

AIM

To introduce Microprocessor Intel 8085 and 8086 and the Micro Controller 8051

OBJECTIVES

- To study the Architecture of 8085 & 8086, 8051
- To study the addressing modes & instruction set of 8085 & 8051.
- To introduce the need & use of Interrupt structure 8085 & 8051.
- To develop skill in simple program writing for 8051 & 8085 and applications
- To introduce commonly used peripheral / interfacing ICs

UNIT I 8085 and 8086 PROCESSOR 9

Hardware Architecture pintouts - Signals – Memory interfacing – I/O ports and data transfer concepts – Timing Diagram – Interrupt structure.

UNIT II PROGRAMMING OF 8085 PROCESSOR 9

Instruction format and addressing modes – Assembly language format – Data transfer, data manipulation & control instructions – Programming: Loop structure with counting & Indexing - Look up table - Subroutine instructions - stack.

UNIT III PERIPHERAL INTERFACING 9

Study of Architecture and programming of ICs: 8255 PPI, 8259 PIC, 8251 USART, 8279 Key board display controller and 8253 Timer/ Counter – Interfacing with 8085 - A/D and D/A converter interfacing.

UNIT IV 8051 MICRO CONTROLLER 9

Functional block diagram - Instruction format and addressing modes – Timing Diagram Interrupt structure – Timer –I/O ports – Serial communication.

UNIT V MICRO CONTROLLER PROGRAMMING & APPLICATIONS 9

Data Transfer, Manipulation, Control & I/O instructions – Simple programming exercises key board and display interface – Closed loop control of servo motor- stepper motor control - Washing Machine Control.

TOTAL : 45 PERIODS

TEXT BOOKS

1. "Microprocessor and Microcontrollers", Krishna Kant Eastern Company Edition, Prentice – Hall of India, New Delhi , 2007.
2. Muhammad Ali Mazidi & Janice Gilli Mazidi, R.D.Kinely 'The 8051 Micro Controller and Embedded Systems', PHI Pearson Education, 5th Indian reprint, 2003.

REFERENCES

1. R.S. Gaonkar, 'Microprocessor Architecture Programming and Application', Wiley Eastern Ltd., New Delhi.
2. The 8088 & 8086 Microprocessors , Walter A Tribal & Avtar Singh, Pearson, 2007, Fourth Edition.

EE2355 DESIGN OF ELECTRICAL MACHINES L T P C
3 1 0 4

AIM

To expose the students to the concept of design of various types of electrical machines.

OBJECTIVES

To provide sound knowledge about constructional details and design of various electrical machines.

- To study mmf calculation and thermal rating of various types of electrical machines.
- To design armature and field systems for D.C. machines.
- To design core, yoke, windings and cooling systems of transformers.
- To design stator and rotor of induction machines.
- To design stator and rotor of synchronous machines and study their thermal behaviour.

UNIT I INTRODUCTION 9

Major considerations in Electrical Machine Design - Electrical Engineering Materials – Space factor – Choice of Specific Electrical and Magnetic loadings - Thermal considerations - Heat flow – Temperature rise - Rating of machines – Standard specifications.

UNIT II DC MACHINES 9

Output Equations – Main Dimensions - Magnetic circuit calculations – Carter's Coefficient - Net length of Iron –Real & Apparent flux densities – Selection of number of poles – Design of Armature – Design of commutator and brushes – performance prediction using design values.

UNIT III TRANSFORMERS 9

Output Equations – Main Dimensions - KVA output for single and three phase transformers – Window space factor – Overall dimensions – Operating characteristics – Regulation – No load current – Temperature rise in Transformers – Design of Tank - Methods of cooling of Transformers.

UNIT IV INDUCTION MOTORS 9

Output equation of Induction motor – Main dimensions – Length of air gap- Rules for selecting rotor slots of squirrel cage machines – Design of rotor bars & slots – Design of end rings – Design of wound rotor -– Magnetic leakage calculations – Leakage reactance of polyphase machines- Magnetizing current - Short circuit current – Circle diagram - Operating characteristics.

UNIT V SYNCHRONOUS MACHINES **9**

Output equations – choice of loadings – Design of salient pole machines – Short circuit ratio – shape of pole face – Armature design – Armature parameters – Estimation of air gap length – Design of rotor –Design of damper winding – Determination of full load field mmf – Design of field winding – Design of turbo alternators – Rotor design.

L = 45 T = 15 TOTAL = 60 PERIODS

TEXT BOOKS

1. Sawhney, A.K., 'A Course in Electrical Machine Design', Dhanpat Rai & Sons, New Delhi, 1984.
2. Sen, S.K., 'Principles of Electrical Machine Designs with Computer Programmes', Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 1987.

REFERENCES

1. A.Shanmugasundaram, G.Gangadharan, R.Palani 'Electrical Machine Design Data Book', New Age Intenational Pvt. Ltd., Reprint 2007.
2. 'Electrical Machine Design', Balbir Singh, Brite Publications, Pune.

CS2361 COMPUTER NETWORKS **L T P C**
3 0 0 3

UNIT I **9**

Introduction to networks – network architecture – network performance – Direct link networks – encoding – framing – error detection – transmission – Ethernet – Rings – FDDI - Wireless networks – Switched networks – bridges

UNIT II **9**

Internetworking – IP - ARP – Reverse Address Resolution Protocol – Dynamic Host Configuration Protocol – Internet Control Message Protocol – Routing – Routing algorithms – Addressing – Subnetting – CIDR – Inter domain routing – IPv6

UNIT III **9**

Transport Layer – User Datagram Protocol (UDP) – Transmission Control Protocol – Congestion control – Flow control – Queuing Disciplines – Congestion - Avoidance Mechanisms.

UNIT IV **9**

Data Compression – introduction to JPEG, MPEG, and MP3 – cryptography – symmetric-key – public-key – authentication – key distribution – key agreement – PGP – SSH – Transport layer security – IP Security – wireless security - Firewalls

UNIT V **9**

Domain Name System (DNS) – E-mail – World Wide Web (HTTP) – Simple Network Management Protocol – File Transfer Protocol (FTP)– Web Services - Multimedia Applications – Overlay networks

TOTAL : 45 PERIODS

TEXT BOOK:

1.Larry L. Peterson and Bruce S. Davie, "Computer Networks: A Systems Approach", Fourth Edition, Elsevier Publishers Inc., 2007.
2. Andrew S. Tanenbaum, "Computer Networks", Fourth Edition, PHI, 2003.

REFERENCES:

1. James F. Kuross and Keith W. Ross, “Computer Networking: A Top-Down Approach Featuring the Internet”, Third Edition, Addision wesley, 2004.
2. William Stallings, “Data and Computer Communication”, Sixth Edition, Pearson Education, 2000.
3. Nader F. Mir, ”Computer and communication networks”, Pearson Education, 2007.

EE2356 MICROPROCESSOR AND MICRO CONTROLLER LABORATORY L T P C
0 0 3 2

AIM

- To understand programming using instruction sets of processors.
- To study various digital & linear

8-bit Microprocessor

1. Simple arithmetic operations: Multi precision addition / subtraction / multiplication / division.
2. Programming with control instructions: Increment / Decrement, Ascending / Descending order, Maximum / Minimum of numbers,Rotate instructions Hex / ASCII / BCD code conversions.
3. A/D Interfacing.
4. D/A Interfacing.
5. Traffic light controller Interfacing
6. Steeper Motor Interfacing
7. Simple experiments using 8251, 8279, 8254.

16-bit Microprocessor

8. Simple arithmetic operations: Multi Precision addition / substraction/ multiplication / division.

8-bit Microcontroller

9. Demonstration of basic instructions with 8051 Micro controller execution, including:
    a. Conditional jumps, looping
    b. Calling subroutines.
    c. Stack parameter testing
10. Interfacing Keyboard and Display
11. Steepter motor Interfacing\
    a. D/A Interfacing
    b. Traffic light controller Interfacing
    c. 8051 based Serial Port Communication.

TOTAL : 45 PERIODS

REQUIREMENT FOR A BATCH OF 30 STUDENTS

S.No.	Description of Equipment	IC number/code	Quantity required
1.	8085 Microprocessor Trainer with Power supply	-	15
2.	8051 Micro controller Trainer Kit with power supply	-	15
3.	8086 Microprocessor Trainer Kit	-	10
4.	8255 Interface board	-	5
5.	8251 Interface board	-	5
6.	8259 Interface board	-	5
7.	8279 Keyboard/Display Interface Board	-	5
8.	8254 timer counter	-	5
9.	ADC and DAC card	-	5
10.	Stepper motor with Controller	-	5
11.	Traffic Light Control System	-	5
12.	Regulated power supply	-	10
13.	Universal ADD-ON modules	-	5
14.	8 Digit Multiplexed Display Card	-	5
15.	Multimeter	-	5
16.	C R O	-	2

EE2357 PRESENTATION SKILLS AND TECHNICAL SEMINAR L T P C
0 0 2 1

OBJECTIVE

During the seminar session each student is expected to prepare and present a topic on engineering/ technology, for a duration of about 8 to 10 minutes. In a session of three periods per week, 15 students are expected to present the seminar. A faculty guide is to be allotted and he / she will guide and monitor the progress of the student and maintain attendance also.

Students are encouraged to use various teaching aids such as over head projectors, power point presentation and demonstrative models. This will enable them to gain confidence in facing the placement interviews.

EE2401 POWER SYSTEM OPERATION AND CONTROL L T P C
3 0 0 3

AIM: To understand the day to day operation of power system and the control actions to be implemented on the system to meet the minute-to-minute variation of system load demand.

OBJECTIVES:

- To have an overview of power system operation and control.
- To model power-frequency dynamics and to design power-frequency controller.
- To model reactive power-voltage interaction and the control actions to be implemented for maintaining the voltage profile against varying system load.

UNIT I INTRODUCTION 9

System load – variation - load characteristics - load curves and load-duration curve (daily, weekly and annual) - load factor - diversity factor. Importance of load forecasting and simple techniques of forecasting. An overview of power system operation and control and the role of computers in the implementation. (Qualitative treatment with block diagram).

UNIT II REAL POWER - FREQUENCY CONTROL 9

Basics of speed governing mechanism and modeling - speed-load characteristics – load sharing between two synchronous machines in parallel. Control area concept LFC control of a single-area system. Static and dynamic analysis of uncontrolled and controlled cases. Integration of economic dispatch control with LFC. Two-area system – modeling - static analysis of uncontrolled case - tie line with frequency bias control of two-area system - state variable model.

UNIT III REACTIVE POWER–VOLTAGE CONTROL 9

Basics of reactive power control. Excitation systems – modeling. 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 transformer. System level control using generator voltage magnitude setting, tap setting of OLTC transformer and MVAR injection of switched capacitors to maintain acceptable voltage profile and to minimize transmission loss.

UNIT IV COMMITMENT AND ECONOMIC DISPATCH 9

Statement of economic dispatch problem – cost of generation – incremental cost curve - co-ordination equations without loss and with loss, solution by direct method and λ-iteration method. (No derivation of loss coefficients).

Statement of Unit Commitment problem – constraints; spinning reserve, thermal unit constraints, hydro constraints, fuel constraints and other constraints. Solution methods - Priority-list methods - forward dynamic programming approach. Numerical problems only in priority-list method using full-load average production cost.

UNIT V COMPUTER CONTROL OF POWER SYSTEMS 9

Need of computer control of power systems. Concept of energy control centre (or) load dispatch centre and the functions - system monitoring - data acquisition and control. System hardware configuration – SCADA and EMS functions. Network topology - state estimation - security analysis and control. Various operating states (Normal, alert, emergency, in-extremis and restorative). State transition diagram showing various state transitions and control strategies.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Allen. J. Wood and Bruce F. Wollenberg, 'Power Generation, Operation and Control', John Wiley & Sons, Inc., 2003.
2. Chakrabarti & Halder, "Power System Analysis: Operation and Control", Prentice Hall of India, 2004 Edition.

REFERENCES

1. D.P. Kothari and I.J. Nagrath, 'Modern Power System Analysis', Third Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2003. (For Chapters 1, 2 & 3)
2. L.L. Grigsby, 'The Electric Power Engineering, Hand Book', CRC Press & IEEE Press, 2001.
3. Hadi Saadat, "Power System Analysis", (For the chapters 1, 2, 3 and 4)11^{th} Reprint 2007.
4. P.Kundur, 'Power System Stability and Control' MC Craw Hill Publisher, USA, 1994.
5. Olle.I.Elgerd, 'Electric Energy Systems theory An introduction' Tata McGraw Hill Publishing Company Ltd. New Delhi, Second Edition 2003.

EE2402 PROTECTION AND SWITCHGEAR L T P C
3 0 0 3

AIM: To introduce the students to the various abnormal operating conditions in power system and describe the apparatus and system protection schemes. Also to describe the phenomena of current interruption to study the various switchgears.

OBJECTIVES:

- To discuss the causes of abnormal operating conditions (faults, lightning and switching surges) of the apparatus and system.
- To understand the characteristics and functions of relays and protection schemes.
- To understand the problems associated with circuit interruption by a circuit breaker.

UNIT I INTRODUCTION 9

Importance of protective schemes for electrical apparatus and power system. Qualitative review of faults and fault currents - relay terminology – definitions - and essential qualities of protection.

Protection against over voltages due to lightning and switching - arcing grounds - Peterson Coil - ground wires - surge absorber and diverters

Power System earthing – neutral Earthing - basic ideas of insulation coordination.

UNIT II OPERATING PRINCIPLES AND RELAY CHARACTERISTICS 9

Electromagnetic relays – over current, directional and non-directional, distance, negative sequence, differential and under frequency relays – Introduction to static relays.

UNIT III APPARATUS PROTECTION 9

Main considerations in apparatus protection - transformer, generator and motor protection - protection of busbars. Transmission line protection - zones of protection. CTs and PTs and their applications in protection schemes.

UNIT IV THEORY OF CIRCUIT INTERRUPTION 9

Physics of arc phenomena and arc interruption. DC and AC circuit breaking - restriking voltage and recovery voltage - rate of rise of recovery voltage - resistance switching - current chopping - interruption of capacitive current.

UNIT V CIRCUIT BREAKERS **9**

Types of circuit breakers – air blast, air break, oil, SF_6 and vacuum circuit breakers – comparative merits of different circuit breakers – testing of circuit breakers.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. M.L. Soni, P.V. Gupta, V.S. Bhatnagar, A. Chakrabarti, 'A Text Book on Power System Engineering', Dhanpat Rai & Co., 1998. (For All Chapters 1, 2, 3, 4 and 5).
2. R.K.Rajput, A Tex book of Power System Engineering. Laxmi Publications, First Edition Reprint 2007.

REFERENCES

1. Sunil S. Rao, 'Switchgear and Protection', Khanna publishers, New Delhi, 1986.
2. C.L. Wadhwa, 'Electrical Power Systems', Newage International (P) Ltd., 2000.
3. B. Ravindranath, and N. Chander, 'Power System Protection & Switchgear', Wiley Eastern Ltd., 1977.
4. Badri Ram, Vishwakarma, 'Power System Protection and Switchgear', Tata McGraw Hill, 2001.
5. Y.G. Paithankar and S.R. Bhide, 'Fundamentals of Power System Protection', Prentice Hall of India Pvt. Ltd., New Delhi–110001, 2003.

EE 2403 SPECIAL ELECTRICAL MACHINES L T P C
3 0 0 3

AIM

To expose the students to the construction, principle of operation and performance of special electrical machines as an extension to the study of basic electrical machines.

OBJECTIVES

To impart knowledge on

- Construction, principle of operation and performance of synchronous reluctance motors.
- Construction, principle of operation, control and performance of stepping motors.
- Construction, principle of operation, control and performance of switched reluctance motors.
- Construction, principle of operation, control and performance of permanent magnet brushless D.C. motors.
- Construction, principle of operation and performance of permanent magnet synchronous motors.

UNIT I SYNCHRONOUS RELUCTANCE MOTORS **9**

Constructional features – Types – Axial and Radial flux motors – Operating principles – Variable Reluctance and Hybrid Motors – SYNREL Motors – Voltage and Torque Equations - Phasor diagram - Characteristics.

UNIT II STEPPING MOTORS **9**

Constructional features – Principle of operation – Variable reluctance motor – Hybrid motor – Single and multi stack configurations – Torque equations – Modes of excitations – Characteristics – Drive circuits – Microprocessor control of stepping motors – Closed loop control.

UNIT III SWITCHED RELUCTANCE MOTORS **9**

Constructional features – Rotary and Linear SRMs - Principle of operation – Torque production – Steady state performance prediction- Analytical method -Power Converters and their controllers – Methods of Rotor position sensing – Sensorless operation – Closed loop control of SRM - Characteristics.

UNIT IV PERMANENT MAGNET BRUSHLESS D.C. MOTORS 9

Permanent Magnet materials – Magnetic Characteristics – Permeance coefficient - Principle of operation – Types – Magnetic circuit analysis – EMF and torque equations – Commutation - Power controllers – Motor characteristics and control.

UNIT V PERMANENT MAGNET SYNCHRONOUS MOTORS 9

Principle of operation – Ideal PMSM – EMF and Torque equations – Armature reaction MMF – Synchronous Reactance – Sinewave motor with practical windings - Phasor diagram – Torque/speed characteristics - Power controllers - Converter Volt-ampere requirements.

TOTAL : 45 PERIODS

TEXT BOOKS

1. T.J.E. Miller, 'Brushless Permanent Magnet and Reluctance Motor Drives', Clarendon Press, Oxford, 1989.
2. T. Kenjo, 'Stepping Motors and Their Microprocessor Controls', Clarendon Press London, 1984.

REFERENCES

1. R.Krishnan, 'Switched Reluctance Motor Drives – Modeling, Simulation, Analysis, Design and Application', CRC Press, New York, 2001.
2. P.P. Aearnley, 'Stepping Motors – A Guide to Motor Theory and Practice', Peter Perengrinus, London, 1982.
3. T. Kenjo and S. Nagamori, 'Permanent Magnet and Brushless DC Motors', Clarendon Press, London, 1988.

MG2351 PRINCIPLES OF MANAGEMENT L T P C
3 0 0 3

UNIT I OVERVIEW OF MANAGEMENT 9

Definition - Management - Role of managers - Evolution of Management thought - Organization and the environmental factors – Trends and Challenges of Management in Global Scenario.

UNIT II PLANNING 9

Nature and purpose of planning - Planning process - Types of plans – Objectives - - Managing by objective (MBO) Strategies - Types of strategies - Policies - Decision Making - Types of decision - Decision Making Process - Rational Decision Making Process - Decision Making under different conditions.

UNIT III ORGANIZING 9

Nature and purpose of organizing - Organization structure - Formal and informal groups / organization - Line and Staff authority - Departmentation - Span of control - Centralization and Decentralization - Delegation of authority - Staffing - Selection and Recruitment - Orientation - Career Development - Career stages – Training - - Performance Appraisal.

UNIT IV DIRECTING 9

Creativity and Innovation - Motivation and Satisfaction - Motivation Theories - Leadership Styles - Leadership theories - Communication - Barriers to effective communication - Organization Culture - Elements and types of culture - Managing cultural diversity.

UNIT V CONTROLLING 9

Process of controlling - Types of control - Budgetary and non-budgetary control techniques - Managing Productivity - Cost Control - Purchase Control - Maintenance Control - Quality Control - Planning operations.

TOTAL= 45 PERIODS

TEXT BOOKS:

1. Stephen P. Robbins and Mary Coulter, 'Management', Prentice Hall of India, 8th edition.
2. Charles W L Hill, Steven L McShane, 'Principles of Management', Mcgraw Hill Education, Special Indian Edition, 2007.

REFERENCES:

1. Hellriegel, Slocum & Jackson, ' Management - A Competency Based Approach', Thomson South Western, 10th edition, 2007.
2. Harold Koontz, Heinz Weihrich and Mark V Cannice, 'Management - A global & Entrepreneurial Perspective', Tata Mcgraw Hill, 12th edition, 2007.
3. Andrew J. Dubrin, 'Essentials of Management', Thomson Southwestern, 7th edition, 2007.

CS2411 OPERATING SYSTEMS L T P C

3 0 0 3

AIM: To learn the various aspects of operating systems such as process management, memory management, file systems, and I/O management

UNIT I PROCESSES AND THREADS 9

Introduction to operating systems – review of computer organization – operating system structures – system calls – system programs – system structure – virtual machines. Processes: Process concept – Process scheduling – Operations on processes – Cooperating processes – Interprocess communication – Communication in client-server systems. Case study: IPC in Linux. Threads: Multi-threading models – Threading issues. Case Study: Pthreads library

UNIT II PROCESS SCHEDULING AND SYNCHRONIZATION 10

CPU Scheduling: Scheduling criteria – Scheduling algorithms – Multiple-processor scheduling – Real time scheduling – Algorithm Evaluation. Case study: Process scheduling in Linux. Process Synchronization: The critical-section problem – Synchronization hardware – Semaphores – Classic problems of synchronization – critical regions – Monitors. Deadlock: System model – Deadlock characterization – Methods for handling deadlocks – Deadlock prevention – Deadlock avoidance – Deadlock detection – Recovery from deadlock.

UNIT III STORAGE MANAGEMENT 9

Memory Management: Background – Swapping – Contiguous memory allocation – Paging – Segmentation – Segmentation with paging. Virtual Memory:Background – Demand paging – Process creation – Page replacement –Allocation of frames – Thrashing. Case Study: Memory management in Linux

UNIT IV FILE SYSTEMS 9

File-System Interface: File concept – Access methods – Directory structure –File-system mounting – Protection. File-System Implementation : Directory implementation – Allocation methods – Free-space management – efficiency and performance – recovery – log-structured file systems. Case studies: File system in Linux – file system in Windows XP

UNIT V I/O SYSTEMS **8**

I/O Systems – I/O Hardware – Application I/O interface – kernel I/O subsystem – streams – performance. Mass-Storage Structure: Disk scheduling – Disk management – Swap-space management – RAID – disk attachment – stable storage – tertiary storage. Case study: I/O in Linux

TOTAL : 45 PERIODS

TEXT BOOKS

1. Silberschatz, Galvin, and Gagne, "Operating System Concepts", Sixth Edition, Wiley India Pvt Ltd, 2003.
2. D. M. Dhamdhere, "Operating Systems: A concepts based approach", Second Edition, Tata McGraw-Hill Publishing Company Ltd., 2006.

REFERENCES

1. Andrew S. Tanenbaum, "Modern Operating Systems", Second Edition, Pearson Education/PHI, 2001.
2. Harvey M. Deital, "Operating Systems", Third Edition, Pearson Education, 2004.

EE2404 POWER SYSTEM SIMULATION LABORATORY **L T P C**
0 0 3 2

AIM

To acquire software development skills and experience in the usage of standard packages necessary for analysis and simulation of power system required for its planning, operation and control.

OBJECTIVES

i. To develop simple C programs for the following basic requirements:
   a) Formation of bus admittance and impedance matrices and network solution.
   b) Power flow solution of small systems using simple method, Gauss-Seidel P.F. method.
   c) Unit Commitment and Economic Dispatch.

ii. To acquire experience in the usage of standard packages for the following analysis / simulation / control functions.
   a) Steady-state analysis of large system using NRPF and FDPF methods.
   b) Quasi steady-state (Fault) analysis for balanced and unbalanced faults.
   c) Transient stability simulation of multimachine power system.
   d) Simulation of Load-Frequency Dynamics and control of power system.

1. Computation of Parameters and Modelling of Transmission Lines
2. Formation of Bus Admittance and Impedance Matrices and Solution of Networks.
3. Load Flow Analysis - I : Solution of Load Flow And Related Problems Using Gauss-Seidel Method
4. Load Flow Analysis - II: Solution of Load Flow and Related Problems Using Newton-Raphson and Fast-Decoupled Methods
5. Fault Analysis

6. Transient and Small Signal Stability Analysis: Single-Machine Infinite Bus System

7. Transient Stability Analysis of Multimachine Power Systems

8. Electromagnetic Transients in Power Systems

9. Load – Frequency Dynamics of Single- Area and Two-Area Power Systems

10. Economic Dispatch in Power Systems.

TOTAL : 45 PERIODS

Detailed Syllabus

1. COMPUTATION OF PARAMETERS AND MODELLING OF TRANSMISSION LINES

Aim

(i) To determine the positive sequence line parameters L and C per phase per kilometer of a three phase single and double circuit transmission lines for different conductor arrangements.

(ii) To understand modelling and performance of short, medium and long lines.

Exercises

1.1 Computation of series inductance and shunt capacitance per phase per km of a three phase line with flat horizontal spacing for single stranded and bundle conductor configuration.

1.2 Computation of series inductance and shunt capacitance per phase per km of a three phase double circuit transmission line with vertical conductor arrangement with bundle conductor.

1.3 Computation of voltage, current, power factor, regulation and efficiency at the receiving end of a three phase Transmission line when the voltage and power at the sending end are given. Use Π model.

1.4 Computation of receiving end voltage of a long transmission for a given sending end voltage and when the line is open circuited at receiving. Also compute the shunt reactor compensation to limit the no load receiving end voltage to specified value.

1.5 Determination of the voltage profile along the long transmission line for the following cases of loading at receiving end (i) no load (ii) rated load (iii) surge impedance loading and (iv) receiving end short circuited.

2. FORMATION OF BUS ADMITTANCE AND IMPEDANCE MATRICES AND SOLUTION OF NETWORKS

Aim

To understand the formation of network matrices, the bus admittance matrix **Y** and the bus impedance matrix **Z** of a power network, to effect certain required changes on these matrices and to obtain network solution using these matrices.

Exercises

2.1 Write a program in C language for formation of bus admittance matrix **Y** of a power network using the "Two-Rule Method", given the data pertaining to the transmission lines, transformers and shunt elements. Run the program for a sample 6 bus system and compare the results with that obtained using a standard software.

2.2 Modify the program developed in 2.1 for the following:

(i) To obtain modified **Y** matrix for the outage of a transmission line, a Transformer and a shunt element.

(ii) To obtain network solution **V** given the current injection vector **I**

(iii) To obtain full **Z** matrix or certain specified columns of **Z** matrix.

Verify the correctness of the modified program using 6 bus sample system

* 2.3 Write a program in C language for forming bus impedance matrix **Z** using the "Building Algorithm".

* Optional (not mandatory)

EXPERIMENT 3

LOAD FLOW ANALYSIS - I : SOLUTION OF LOAD FLOW AND RELATED PROBLEMS USING GAUSS-SEIDEL METHOD

Aim

(i) To understand, the basic aspects of steady state analysis of power systems that are required for effective planning and operation of power systems.

(ii) To understand, in particular, the mathematical formulation of load flow model in complex form and a simple method of solving load flow problems of small sized system using Gauss-Seidel iterative algorithm

Exercises

3.1 Write a program in c language for iteratively solving load flow equations using Gauss-Seidel method with provision for acceleration factor and for dealing with P-V buses. Run the program for a sample 6 bus system (Base case) and compare the results with that obtained using a standard software.

3.2 Solve the "Base case" in 3.1 for different values of acceleration factor, draw the convergence characteristics "Iteration taken for convergence versus acceleration factor" and determine the best acceleration factor for the system under study.

3.3 Solve the "Base Case" in 3.1 for the following changed conditions and comment on the results obtained, namely voltage magnitude of the load buses and transmission losses:

(i) Dropping all shunt capacitors connected to network
(ii) Changing the voltage setting of generators V_{gi} over the range 1.00 to 1.05
(iii) Changing the tap setting of the transformers, a_i, over the range 0.85 to 1.1

3.4 Resolve the base case in 3.1 after shifting generation from one generator bus to another generator bus and comment on the MW loading of lines and transformers.

4. LOAD FLOW ANALYSIS – I: SOLUTION OF LOAD FLOW AND RELATED PROBLEMS USING NEWTON-RAPHSON AND FAST DECOUPLED METHODS

Aim

(i) To understand the following for medium and large scale power systems:

(a) Mathematical formulation of the load flow problem in real variable form
(b) Newton-Raphson method of load flow (NRLF) solution
(c) Fast Decoupled method of load flow (FDLF) solution

(ii) To become proficient in the usage of software for practical problem solving in the areas of power system planning and operation.

(iii) To become proficient in the usage of the software in solving problems using Newton-Raphson and Fast Decoupled load flow methods.

Exercises

4.1 Solve the load flow problem (Base case) of a sample 6 bus system using Gauss-Seidel, Fast Decoupled and Newton-Raphson Load Flow programs for a mismatch convergence tolerance of 0.01 MW, plot the convergence characteristics and compare the convergence rate of the three methods.

4.2 Obtain an optimal (minimum transmission loss) load flow solution for the Base case loading of 6 bus sample system by trial and error approach through repeated load flow solutions using Fast Decoupled Load Flow package for different combinations of generator voltage settings, transformer tap settings, and reactive power of shunt elements.

4.3 Carry out contingency analysis on the optimal state obtained in 4.2 for outage of a transmission line using FDLF or NRLF package.

4.4 Obtain load flow solutions using FDLF or NRLF package on the optimal state obtained in 4.2 but with reduced power factor (increased Q load) load and comment on the system voltage profile and transmission loss.

4.5 Determine the maximum loadability of a 2 bus system using analytical solution as well as numerical solution using FDLF package. Draw the P-V curve of the system.

4.6 For the base case operating state of the 6 bus system in 4.1 draw the P-V curve for the weakest load bus. Also obtain the voltage Stability Margin (MW Index) at different operating states of the system.

4.7 For the optimal operating state of 6 bus system obtained in 4.2 determine the Available Transfer Capability (ATC) between a given “source bus” and a given “s

5. FAULT ANALYSIS

Aim

To become familiar with modelling and analysis of power systems under faulted condition and to compute the fault level, post-fault voltages and currents for different types of faults, both symmetric and unsymmetric.

Exercises

5.1 Calculate the fault current, post fault voltage and fault current through the branches for a three phase to ground fault in a small power system and also study the effect of neighbouring system. Check the results using available software.

5.2 Obtain the fault current, fault MVA, Post-fault bus voltages and fault current distribution for single line to ground fault, line-to-line fault and double line to ground fault for a small power system, using the available software. Also check the fault current and fault MVA by hand calculation.

5.3 Carryout fault analysis for a sample power system for LLLG, LG, LL and LLG faults and prepare the report.

6. TRANSIENT AND SMALL-SIGNAL STABILITY ANALYSIS: SINGLE MACHINE-INFINITE BUS SYSTEM

Aim

To become familiar with various aspects of the transient and small signal stability analysis of Single-Machine Infinite Bus (SMIB) system.

Exercises

For a typical power system comprising a generating, step-up transformer, double-circuit transmission line connected to infinite bus:

Transient Stability Analysis

6.1 Hand calculation of the initial conditions necessary for the classical model of the synchronous machine.

6.2 Hand computation of critical clearing angle and time for the fault using equal area criterion.

6.3 Simulation of typical disturbance sequence: fault application, fault clearance by opening of one circuit using the software available and checking stability by plotting the swing curve.

6.4 Determination of critical clearing angle and time for the above fault sequence through trial and error method using the software and checking with the hand computed value.

6.5 Repetition of the above for different fault locations and assessing the fault severity with respect to the location of fault

6.6 Determination of the steady-state and transient stability margins.

Small-signal Stability Analysis:

6.7 Familiarity with linearised swing equation and characteristic equation and its roots, damped frequency of oscillation in Hz, damping ratio and undamped natural frequency.

6.8 Force-free time response for an initial condition using the available software.

6.9 Effect of positive, negative and zero damping.

7. TRANSIENT STABILITY ANALYSIS OF MULTIMACHINE POWER SYSTEMS

Aim
To become familiar with modelling aspects of synchronous machines and network, state-of-the-art algorithm for simplified transient stability simulation, system behaviour when subjected to large disturbances in the presence of synchronous machine controllers and to become proficient in the usage of the software to tackle real life problems encountered in the areas of power system planning and operation.

Exercises
For typical multi-machine power system:

7.1 Simulation of typical disturbance sequence: fault application, fault clearance by opening of a line using the software available and assessing stability with and without controllers.

7.2 Determination of critical clearing angle and time for the above fault sequence through trial and error method using the software.

7.3 Determination of transient stability margins.

7.4 Simulation of full load rejection with and without governor.

7.5 Simulation of loss of generation with and without governor.

7.6 Simulation of loss of excitation (optional).

7.7 Simulation of under frequency load shedding scheme (optional).

8. ELECTROMAGNETIC TRANSIENTS IN POWER SYSTEMS

Aim
To study and understand the electromagnetic transient phenomena in power systems caused due to switching and faults by using Electromagnetic Transients Program (EMTP) and to become proficient in the usage of EMTP to address problems in the areas of over voltage protection and mitigation and insulation coordination of EHV systems.

Exercises

Using the EMTP software or equivalent

Simulation of single-phase energisation of the load through single-phase pi-model of a transmission line and understanding the effect of source inductance.

8.1 Simulation of three-phase energisation of the load through three-phase pi-model of a transmission line and understanding the effect of pole discrepancy of a circuit breaker.

8.2 Simulation of energisation of an open-ended single-phase distributed parameter transmission line and understanding the travelling wave effects.

8.3 Simulation of a three-phase load energisation through a three-phase distributed parameter line with simultaneous and asynchronous closing of circuit breaker and studying the effects.

8.4 Study of transients due to single line-to-ground fault.

8.5 Computation of transient recovery voltage.

9. LOAD-FREQUENCY DYNAMICS OF SINGLE-AREA AND TWO-AREA POWER SYSTEMS

Aim

To become familiar with the modelling and analysis of load-frequency and tie-line flow dynamics of a power system with load-frequency controller (LFC) under different control modes and to design improved controllers to obtain the best system response.

Exercises

9.1 Given the data for a Single-Area power system, simulate the load-frequency dynamics (only governor control) of this area for a step load disturbance of small magnitude, plot the time response of frequency deviation and the corresponding change in turbine power. Check the value of steady state frequency deviation obtained from simulation with that obtained by hand calculation.

9.2 Carry out the simulation of load-frequency dynamics of the Single-Area power system in 9.1 with Load-frequency controller (Integral controller) for different values of K_I (gain of the controller) and choose the best value of K_I to give an "optimal" response with regard to peak over shoot, settling time, steady-state error and Mean-Sum-Squared-Error.

9.3 Given the data for a two-area (identical areas) power system, simulate the load-frequency dynamics (only governor control) of this system for a step load disturbance in one area and plot time response of frequency deviation, turbine power deviation and tie-line power deviation. Compare the steady-state frequency deviation obtained with that obtained in the case of single-area system.

9.4 Carry out the simulation of load-frequency dynamics of two-area system in 9.3 for the following control modes:

(i) Flat tie-line control
(ii) Flat frequency control
(iii) Frequency bias tie-line control

and for the frequency bias Tie-line control mode, determine the optimal values of gain and frequency bias factor required to get the "best" time response.

9.5 Given the data for a two-area (unequal areas) power system, determine the best controller parameters; gains and bias factors to give an optimal response for frequency deviation and tie-line deviations with regard to peak overshoot, settling time, steady-state error and Mean-Sum-Squared-Error.

10. ECONOMIC DISPATCH IN POWER SYSTEMS

Aim

(i) To understand the basics of the problem of Economic Dispatch (ED) of optimally adjusting the generation schedules of thermal generating units to meet the system load which are required for unit commitment and economic operation of power systems.

(ii) To understand the development of coordination equations (the mathematical model for ED) without and with losses and operating constraints and solution of these

equations using direct and iterative methods

Exercises

10.1. Write a program in 'C' language to solve economic dispatch problem of a power system with only thermal units. Take production cost function as quadratic and neglect transmission loss.

10.2. Write a program in 'C' language to solve economic dispatch problem of a power system. Take production cost as quadratic and include transmission loss using loss co-efficient. Use λ-iteration algorithm for solving the co-ordination equations.

10.3. Determine using the program developed in exercise 10.1 the economic generation schedule of each unit and incremental cost of received power for a sample power system, for a given load cycle.

10.4. Determine using the program developed in exercise 10.2 the economic generation schedule of each unit, incremental cost of received power and transmission loss for a sample system, for the given load levels.

10.5. Apply the software module developed in 10.1 to obtain an optimum unit commitment schedule for a few load levels.

REQUIREMENT FOR A BATCH OF 30 STUDENTS

S.No.	Description of Equipment	Quantity required
1.	Personal computers (Pentium-IV, 80GB, 512 MBRAM)	25
2.	Printer laser	1
3.	Dotmatrix	1
4.	Server (Pentium IV, 80GB, 1GBRAM) (High Speed Processor)	1
5.	Software: E.M.T.P/ETAP/CYME/MIPOWER /any power system simulation software	5 licenses
6.	Compliers: C, C++, VB, VC++	25 users

EE 2405 **COMPREHENSION** **L T P C**
0 0 2 1

AIM:
To encourage the students to comprehend the knowledge acquired from the first Semester to Sixth Semester of B.E Degree Course through periodic exercise.

EE2451 ELECTRIC ENERGY GENERATION AND UTILISATION AND CONSERVATION **L T P C 3 0 0 3**

AIM To expose students to the main aspects of generation, utilization and conservation.

OBJECTIVES

To impart knowledge on

- Generation of electrical power by conventional and non–conventional methods.
- Electrical energy conservation, energy auditing and power quality.
- Principle and design of illumination systems and methods of heating and welding.
- Electric traction systems and their performance.
- Industrial applications of electric drives.

UNIT I POWER GENERATION **9**

Review of conventional methods – thermal, hydro and nuclear based power generation. Non-conventional methods of power generation – fuel cells - tidal waves – wind – geothermal – solar - bio-mass - municipal waste. Cogeneration. Effect of distributed generation on power system operation.

UNIT II ECONOMIC ASPECTS OF GENERATION **9**

Economic aspects of power generation – load and load duration curves – number and size of units – cost of electrical energy – tariff. Economics of power factor improvement – power capacitors – power quality.

Importance of electrical energy conservation – methods – energy efficient equipments. Introduction to energy auditing.

UNIT III ILLUMINATION **9**

Importance of lighting – properties of good lighting scheme – laws of illumination – photometry - types of lamps – lighting calculations – basic design of illumination schemes for residential, commercial, street lighting, and sports ground - energy efficiency lamps.

UNIT IV INDUSTRIAL HEATING AND WELDING **9**

Role electric heating for industrial applications – resistance heating – induction heating – dielectric heating - electric arc furnaces.

Brief introduction to electric welding – welding generator, welding transformer and the characteristics.

UNIT V ELECTRIC TRACTION **9**

Merits of electric traction – requirements of electric traction system – supply systems – mechanics of train movement – traction motors and control – braking – recent trends in electric traction.

TOTAL : 45 PERIODS

TEXT BOOKS

1. C.L. Wadhwa, ‘Generation, Distribution and Utilization of Electrical Energy’, New Age International Pvt. Ltd, 2003.
2. B.R. Gupta, ‘Generation of Electrical Energy’, Eurasia Publishing House (P) Ltd, New Delhi, 2003.

REFERENCES

1. H. Partab, ‘Art and Science of Utilisation of Electrical Energy’, Dhanpat Rai and Co, New Delhi, 2004.
2. E. Openshaw Taylor, ‘Utilization of Electrical Energy in SI Units’, Orient Longman Pvt. Ltd, 2003.

3. J.B. Gupta, 'Utilization of Electric Power and Electric Traction', S.K.Kataria and Sons, 2002.

EE2021 FIBRE OPTICS AND LASER INSTRUMENTS L T P C
3 0 0 3

AIM

To contribute to the knowledge of Fibre optics and Laser Instrumentation and its Industrial and Medical Application.

OBJECTIVES

- To expose the students to the basic concepts of optical fibres and their properties.
- To provide adequate knowledge about the Industrial applications of optical fibres.
- To expose the students to the Laser fundamentals.
- To provide adequate knowledge about Industrial application of lasers.
- To provide adequate knowledge about holography and Medical applications of Lasers.

UNIT I OPTICAL FIBRES AND THEIR PROPERTIES 9

Principles of light propagation through a fibre - Different types of fibres and their properties, fibre characteristics – Absorption losses – Scattering losses – Dispersion – Connectors and splicers – Fibre termination – Optical sources – Optical detectors.

UNIT II INDUSTRIAL APPLICATION OF OPTICAL FIBRES 9

Fibre optic sensors – Fibre optic instrumentation system – Different types of modulators – Interferometric method of measurement of length – Moire fringes – Measurement of pressure, temperature, current, voltage, liquid level and strain.

UNIT III LASER FUNDAMENTALS 9

Fundamental characteristics of lasers – Three level and four level lasers – Properties of laser – Laser modes – Resonator configuration – Q-switching and mode locking – Cavity damping – Types of lasers – Gas lasers, solid lasers, liquid lasers, semiconductor lasers.

UNIT IV INDUSTRIAL APPLICATION OF LASERS 9

Laser for measurement of distance, length, velocity, acceleration, current, voltage and Atmospheric effect – Material processing – Laser heating, welding, melting and trimming of material – Removal and vaporization.

UNIT V HOLOGRAM AND MEDICAL APPLICATIONS 9

Holography – Basic principle - Methods – Holographic interferometry and application, Holography for non-destructive testing – Holographic components – Medical applications of lasers, laser and tissue interactive – Laser instruments for surgery, removal of tumors of vocal cards, brain surgery, plastic surgery, gynaecology and oncology.

TOTAL : 45 PERIODS

TEXT BOOKS

1. J.M. Senior, 'Optical Fibre Communication – Principles and Practice', Prentice Hall of India, 1985.
2. J. Wilson and J.F.B. Hawkes, 'Introduction to Opto Electronics', Prentice Hall of India, 2001.

REFERENCES

1. G. Keiser, 'Optical Fibre Communication', McGraw Hill, 1995.
2. M. Arumugam, 'Optical Fibre Communication and Sensors', Anuradha Agencies, 2002.
3. John F. Read, 'Industrial Applications of Lasers', Academic Press, 1978.

4. Monte Ross, 'Laser Applications', McGraw Hill, 1968

CS2021 VISUAL LANGUAGES AND APPLICATIONS L T P C
3 1 0 4

AIM

To study the principles and techniques of windows programming using MFC, procedures, resources, controls and database programming through the visual languages, Visual C++ and Visual Basic.

OBJECTIVES

i. To study about the concepts of windows programming models, MFC applications, drawing with the GDI, getting inputs from Mouse and the Keyboard.

ii. To study the concepts of Menu basics, menu magic and classic controls of the windows programming using VC++.

iii. To study the concept of Document/View Architecture with single & multiple document interface, toolbars, status bars and File I/O Serialization.

iv. To study about the integrated development programming event driven programming, variables, constants, procedures and basic ActiveX controls in visual basic.

v. To understand the database and the database management system, visual data manager, data bound controls and ADO controls in VB.

UNIT I FUNDAMENTALS OF WINDOWS AND MFC 9

Messages - Windows programming - SDK style - Hungarian notation and windows data types - SDK programming in perspective.The benefits of C++ and MFC - MFC design philosophy - Document/View architecture - MFC class hierarchy - AFX functions. Application object - Frame window object - Message map.

Drawing the lines – Curves – Ellipse – Polygons and other shapes. GDI pens – Brushes - GDI fonts - Deleting GDI objects and deselecting GDI objects. Getting input from the mouse: Client & Non-client - Area mouse messages - Mouse wheel - Cursor. Getting input from the keyboard: Input focus - Keystroke messages - Virtual key codes - Character & dead key messages.

UNIT II RESOURCES AND CONTROLS 9

Creating a menu – Loading and displaying a menu – Responding to menu commands – Command ranges - Updating the items in menu, update ranges – Keyboard accelerators. Creating menus programmatically - Modifying menus programmatically - The system menu - Owner draw menus – Cascading menus - Context menus.

The C button class – C list box class – C static class - The font view application – C edit class – C combo box class – C scrollbar class. Model dialog boxes – Modeless dialog boxes.

UNIT III DOCUMENT / VIEW ARCHITECTURE 9

The inexistence function revisited – Document object – View object – Frame window object – Dynamic object creation. SDI document template - Command routing. Synchronizing multiple views of a document – Mid squares application – Supporting multiple document types – Alternatives to MDI. Splitter Windows: Dynamic splitter window – Static splitter windows.

Creating & initializing a toolbar - Controlling the toolbar's visibility – Creating & initializing a status bar - Creating custom status bar panes – Status bar support in appwizard. Opening, closing and creating the files - Reading & Writing – C file derivatives – Serialization basics - Writing serializable classes.

UNIT IV FUNDAMENTALS OF VISUAL BASIC 10

Menu bar – Tool bar – Project explorer – Toolbox – Properties window – Form designer – Form layout – Intermediate window. Designing the user interface: Aligning the controls – Running the application – Visual development and event driven programming.
Variables: Declaration – Types – Converting variable types – User defined data types - Lifetime of a variable. Constants - Arrays – Types of arrays. Procedures: Subroutines – Functions – Calling procedures. Text box controls – List box & Combo box controls – Scroll bar and slider controls – File controls.

UNIT V DATABASE PROGRAMMING WITH VB 8

Record sets – Data control – Data control properties, methods. Visual data manager: Specifying indices with the visual data manager – Entering data with the visual data manager. Data bound list control – Data bound combo box – Data bound grid control. Mapping databases: Database object – Table def object, Query def object.
Programming the active database objects – ADO object model – Establishing a connection - Executing SQL statements – Cursor types and locking mechanism – Manipulating the record set object – Simple record editing and updating.

L = 45 T = 15 TOTAL = 60 PERIODS

TEXT BOOKS

1. Jeff Prosise, 'Programming Windows With MFC', Second Edition, WP Publishers & Distributors [P] Ltd, Reprinted 2002.
2. Evangelos Petroutsos, 'Mastering Visual Basic 6.0', BPB Publications, 2002.

REFENENCES

1. Herbert Schildt, 'MFC Programming From the Ground Up', Second Edition, Tata McGraw Hill, reprinted 2002.
2. John Paul Muller, 'Visual C++ 6 From the Ground Up Second Edition', Tata McGraw Hill, Reprinted 2002.
3. Curtis Smith & Micheal Amundsen, 'Teach Yourself Database Programming with Visual Basic 6 in 21 days', Techmedia Pub, 1999.

EE2022 ADVANCED CONTROL SYSTEM L T P C
3 0 0 3

AIM

To gain knowledge in state variable analysis, non-linear systems and optimal control.

OBJECTIVES

- To study the state variable analysis
- To provide adequate knowledge in the phase plane analysis.
- To give a basic knowledge in describing function analysis.
- To analyze the stability of the systems using different techniques.
- To study the design of optimal controller.

UNIT I STATE VARIABLE ANALYSIS 9

Concept of state – State Variable and State Model – State models for linear and continuous time systems – Solution of state and output equation – controllability and observability - Pole Placement – State observer Design of Control Systems with observers.

UNIT II PHASE PLANE ANALYSIS 9

Features of linear and non-linear systems - Common physical non-linearities – Methods of linearising non-linear systems - Concept of phase portraits – Singular points – Limit cycles – Construction of phase portraits – Phase plane analysis of linear and non-linear systems – Isocline method.

UNIT III DESCRIBING FUNCTION ANALYSIS 9

Basic concepts, derivation of describing functions for common non-linearities – Describing function analysis of non-linear systems – Conditions for stability – Stability of oscillations.

UNIT IV STABILITY ANALYSIS 9

Introduction – Liapunov's stability concept – Liapunov's direct method – Lure's transformation – Aizerman's and Kalman's conjecture – Popov's criterion – Circle criterion.

UNIT V OPTIMAL CONTROL 9

Introduction -Decoupling - Time varying optimal control – LQR steady state optimal control – Optimal estimation – Multivariable control design.

TOTAL : 45 PERIODS

TEXT BOOKS

1. I.J. Nagrath and M. Gopal, 'Control Systems Engineering', New Age International Publishers, 2003.
2. Ashish Tewari, 'Modern control Design with Matlab and Simulink', John Wiley, New Delhi, 2002.

REFERENCES

1. George J. Thaler, 'Automatic Control Systems', Jaico Publishers, 1993.
2. M.Gopal, Modern control system theory, New Age International Publishers, 2002.
3. Gene F. Franklin, J. David Powell and Abbasemami-Naeini, " Feedback Control of Dynamic Systems", Fourth edition, Pearson Education, Low price edition. 2002.

EE2023 ROBOTICS AND AUTOMATION L T P C

3 0 0 3

AIM

To provide comprehensive knowledge of robotics in the design, analysis and control point of view.

OBJECTIVES

i. To study the various parts of robots and fields of robotics.
ii. To study the various kinematics and inverse kinematics of robots.
iii. To study the Euler, Lagrangian formulation of Robot dynamics.
iv. To study the trajectory planning for robot.
v. To study the control of robots for some specific applications.

UNIT I BASIC CONCEPTS 9

Definition and origin of robotics – different types of robotics – various generations of robots – degrees of freedom – Asimov's laws of robotics – dynamic stabilization of robots.

UNIT II POWER SOURCES AND SENSORS 9

Hydraulic, pneumatic and electric drives – determination of HP of motor and gearing ratio – variable speed arrangements – path determination – micro machines in robotics – machine vision – ranging – laser – acoustic – magnetic, fiber optic and tactile sensors.

UNIT III MANIPULATORS, ACTUATORS AND GRIPPERS 9

Construction of manipulators – manipulator dynamics and force control – electronic and pneumatic manipulator control circuits – end effectors – U various types of grippers – design considerations.

UNIT IV KINEMATICS AND PATH PLANNING 9

Solution of inverse kinematics problem – multiple solution jacobian work envelop – hill climbing techniques – robot programming languages

UNIT V CASE STUDIES 9

Mutiple robots – machine interface – robots in manufacturing and non- manufacturing applications – robot cell design – selection of robot.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Mikell P. Weiss G.M., Nagel R.N., Odraj N.G., Industrial Robotics, McGraw-Hill Singapore, 1996.
2. Ghosh, Control in Robotics and Automation: Sensor Based Integration, Allied Publishers, Chennai, 1998.

REFERENCES

1. Deb.S.R., Robotics technology and flexible Automation, John Wiley, USA 1992.
2. Asfahl C.R., Robots and manufacturing Automation, John Wiley, USA 1992.
3. Klafter R.D., Chimielewski T.A., Negin M., Robotic Engineering – An integrated approach, Prentice Hall of India, New Delhi, 1994.
4. Mc Kerrow P.J. Introduction to Robotics, Addison Wesley, USA, 1991.
5. Issac Asimov I Robot, Ballantine Books, New York, 1986.

GE2021 PROFESSIONAL ETHICS IN ENGINEERING L T P C
3 0 0 3

UNIT I ENGINEERING ETHICS 9

Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Professions and Professionalism – Professional Ideals and Virtues – Uses of Ethical Theories

UNIT II ENGINEERING AS SOCIAL EXPERIMENTATION 9

Engineering as Experimentation – Engineers as responsible Experimenters – Research Ethics - Codes of Ethics – Industrial Standards - A Balanced Outlook on Law – The Challenger Case Study

UNIT III ENGINEER'S RESPONSIBILITY FOR SAFETY 9

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis – Reducing Risk – The Government Regulator's Approach to Risk - Chernobyl Case Studies and Bhopal

UNIT IV RESPONSIBILITIES AND RIGHTS 9

Collegiality and Loyalty – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) - Discrimination

UNIT V GLOBAL ISSUES **9**

Multinational Corporations – Business Ethics - Environmental Ethics – Computer Ethics - Role in Technological Development – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Honesty – Moral Leadership – Sample Code of Conduct

TOTAL : 45 PERIODS

TEXT BOOKS

1. Mike Martin and Roland Schinzinger, “Ethics in Engineering”, McGraw Hill, New York (2005).
2. Charles E Harris, Michael S Pritchard and Michael J Rabins, “Engineering Ethics – Concepts and Cases”, Thompson Learning, (2000).

REFERENCES

1. Charles D Fleddermann, “Engineering Ethics”, Prentice Hall, New Mexico, (1999).
2. John R Boatright, “Ethics and the Conduct of Business”, Pearson Education, (2003)
3. Edmund G Seebauer and Robert L Barry, “Fundamentals of Ethics for Scientists and Engineers”, Oxford University Press, (2001)
4. Prof. (Col) P S Bajaj and Dr. Raj Agrawal, “Business Ethics – An Indian Perspective”, Biztantra, New Delhi, (2004)
5. David Ermann and Michele S Shauf, “Computers, Ethics and Society”, Oxford University Press, (2003)

EE2027 POWER SYSTEM TRANSIENTS **L T P C**
3 0 0 3

AIM

To review the over voltages (or) surges due to the phenomena of switching operations and lighting discharge. Also to study propagation, reflection and refraction of these surges on the equipments their impact on the power system grid.

OBJECTIVES

- To study the generation of switching transients and their control using circuit – theoretical concept.
- To study the mechanism of lighting strokes and the production of lighting surges.
- To study the propagation, reflection and refraction of travelling waves.
- To study the impact of voltage transients caused by faults, circuit breaker action, load rejection on integrated power system.

UNIT I INTRODUCTION AND SURVEY **9**

Review and importance of the study of transients - causes for transients.
RL circuit transient with sine wave excitation - double frequency transients - basic transforms of the RLC circuit transients.
Different types of power system transients - effect of transients on power systems – role of the study of transients in system planning.

UNIT II SWITCHING TRANSIENTS **9**

Over voltages due to switching transients - resistance switching and the equivalent circuit for interrupting the resistor current - load switching and equivalent circuit - waveforms for transient voltage across the load and the switch - normal and abnormal switching transients. Current suppression - current chopping - effective equivalent circuit. Capacitance switching - effect of source regulation - capacitance switching with a restrike, with multiple restrikes. Illustration for multiple restriking transients - ferro resonance.

UNIT III LIGHTNING TRANSIENTS 9

Review of the theories in the formation of clouds and charge formation - rate of charging of thunder clouds – mechanism of lightning discharges and characteristics of lightning strokes – model for lightning stroke - factors contributing to good line design - protection using ground wires - tower footing resistance - Interaction between lightning and power system.

UNIT IV TRAVELING WAVES ON TRANSMISSION LINE COMPUTATION OF TRANSIENTS 9

Computation of transients - transient response of systems with series and shunt lumped parameters and distributed lines. Traveling wave concept - step response - Bewely's lattice diagram - standing waves and natural frequencies - reflection and refraction of travelling waves.

UNIT V TRANSIENTS IN INTEGRATED POWER SYSTEM 9

The short line and kilometric fault - distribution of voltages in a power system - Line dropping and load rejection - voltage transients on closing and reclosing lines - over voltage induced by faults - switching surges on integrated system. Qualitative application of EMTP for transient computation.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Allan Greenwood, 'Electrical Transients in Power Systems', Wiley Interscience, New York, 2nd edition 1991.
2. R.D.Begamudre, 'Extra High Voltage AC Transmission Engineering', Wiley Eastern Limited, 1986.

REFERENCES

1. M.S.Naidu and V.Kamaraju, 'High Voltage Engineering', Tata McGraw Hill, 2nd edition, 2000.

EE2024 BIO–MEDICAL INSTRUMENTATION L T P C
3 0 0 3

AIM

The course is designed to make the student acquire an adequate knowledge of the physiological systems of the human body and relate them to the parameters that have clinical importance. The fundamental principles of equipment that are actually in use at the present day are introduced.

OBJECTIVES

i. To provide an acquaintance of the physiology of the heart, lung, blood circulation and circulation respiration. Biomedical applications of different transducers used.
ii. To introduce the student to the various sensing and measurement devices of electrical origin. To provide awareness of electrical safety of medical equipments
iii. To provide the latest ideas on devices of non-electrical devices.
iv. To bring out the important and modern methods of imaging techniques.
v. To provide latest knowledge of medical assistance / techniques and therapeutic equipments.

UNIT I PHYSIOLOGY AND TRANSDUCERS 9

Cell and its structure – Resting and Action Potential – Nervous system: Functional organisation of the nervous system – Structure of nervous system, neurons - synapse – transmitters and neural communication – Cardiovascular system – respiratory system – Basic components of a biomedical system - Transducers – selection criteria – Piezo electric, ultrasonic transducers - Temperature measurements - Fibre optic temperature sensors.

UNIT II ELECTRO – PHYSIOLOGICAL MEASUREMENTS 9

Electrodes –Limb electrodes –floating electrodes – pregelled disposable electrodes - Micro, needle and surface electrodes – Amplifiers: Preamplifiers, differential amplifiers, chopper amplifiers – Isolation amplifier.

ECG – EEG – EMG – ERG – Lead systems and recording methods – Typical waveforms.

Electrical safety in medical environment: shock hazards – leakage current-Instruments for checking safety parameters of biomedical equipments

UNIT III NON-ELECTRICAL PARAMETER MEASUREMENTS 9

Measurement of blood pressure – Cardiac output – Heart rate – Heart sound – Pulmonary function measurements – spirometer – Photo Plethysmography, Body Plethysmography – Blood Gas analysers : pH of blood –measurement of blood pCO_2, pO_2, finger-tip oxymeter - ESR, GSR measurements .

UNIT IV MEDICAL IMAGING 9

Radio graphic and fluoroscopic techniques – Computer tomography – MRI – Ultrasonography – Endoscopy – Thermography – Different types of biotelemetry systems and patient monitoring – Introduction to Biometric systems

UNIT V ASSISTING AND THERAPEUTIC EQUIPMENTS 9

Pacemakers – Defibrillators – Ventilators – Nerve and muscle stimulators – Diathermy – Heart – Lung machine – Audio meters – Dialysers – Lithotripsy

TOTAL : 45 PERIODS

TEXT BOOKS

1. R.S.Khandpur, ‘Hand Book of Bio-Medical instrumentation’, Tata McGraw Hill Publishing Co Ltd., 2003.
2. Leslie Cromwell, Fred J.Weibell, Erich A.Pfeiffer, ‘Bio-Medical Instrumentation and Measurements’, II edition, Pearson Education, 2002 / PHI.

REFERENCES

1. M.Arumugam, ‘Bio-Medical Instrumentation’, Anuradha Agencies, 2003.
2. L.A. Geddes and L.E.Baker, ‘Principles of Applied Bio-Medical Instrumentation’, John Wiley & Sons, 1975.
3. J.Webster, ‘Medical Instrumentation’, John Wiley & Sons, 1995.
4. C.Rajarao and S.K. Guha, ‘Principles of Medical Electronics and Bio-medical Instrumentation’, Universities press (India) Ltd, Orient Longman ltd, 2000.

EE2025 INTELLIGENT CONTROL L T P C

3 0 0 3

UNIT I INTRODUCTION 9

Approaches to intelligent control. Architecture for intelligent control. Symbolic reasoning system, rule-based systems, the AI approach. Knowledge representation. Expert systems.

UNIT II ARTIFICIAL NEURAL NETWORKS 9

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. Data Processing: Scaling, Fourier transformation, principal-component analysis and wavelet transformations. Hopfield network, Self-organizing network and Recurrent network. Neural Network based controller

UNIT III GENETIC ALGORITHM 9

Basic concept of Genetic algorithm and detail algorithmic steps, adjustment of free parameters. 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.

UNIT IV FUZZY LOGIC SYSTEM 9

Introduction to crisp sets and fuzzy sets, basic fuzzy set operation and approximate reasoning. Introduction to fuzzy logic modeling and control. Fuzzification, inferencing and defuzzification. Fuzzy knowledge and rule bases. Fuzzy modeling and control schemes for nonlinear systems. Self-organizing fuzzy logic control. Fuzzy logic control for nonlinear time-delay system.

UNIT V APPLICATIONS 9

GA application to power system optimisation problem, Case studies: Identification and control of linear and nonlinear dynamic systems using Matlab-Neural Network toolbox. Stability analysis of Neural-Network interconnection systems. Implementation of fuzzy logic controller using Matlab fuzzy-logic toolbox. Stability analysis of fuzzy control systems.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Padhy.N.P.(2005), Artificial Intelligence and Intelligent System, Oxford University Press.
2. KOSKO,B. "Neural Networks And Fuzzy Systems", Prentice-Hall of India Pvt. Ltd., 1994.

REFERENCES

1. Jacek.M.Zurada, "Introduction to Artificial Neural Systems", Jaico Publishing House, 1999.
2. KLIR G.J. & FOLGER T.A. "Fuzzy sets, uncertainty and Information", Prentice-Hall of India Pvt. Ltd., 1993.
3. Zimmerman H.J. "Fuzzy set theory-and its Applications"-Kluwer Academic Publishers, 1994.
4. Driankov, Hellendroon, "Introduction to Fuzzy Control", Narosa Publishers.
5. Goldberg D.E. (1989) Genetic algorithms in Search, Optimization and Machine learning, Addison Wesley.

EE2026 POWER SYSTEM DYNAMICS L T P C
3 0 0 3

AIM

To understand the concept of modelling the power system and the components for simulating the transient and dynamic behaviour of power system meant for the stability studies.

OBJECTIVES

- To review the modeling of synchronous machine, the excitation system and speed-governing controllers.
- To study small signal stability analysis of a single-machine infinite bus system with excitation system and power system stabilizer.
- To study transient stability simulation of multimachine power system.

UNIT I INTRODUCTION **9**

Basics of system dynamics – numerical techniques – introduction to software packages to study the responses. Concept and importance of power system stability in the operation and design distinctionbetween transient and dynamic stability - complexity of stability problem in large system – necessity for reduced models - stability of interconnected systems.

UNIT II SYNCHRONOUS MACHINE MODELLING **9**

Synchronous machine - flux linkage equations - Park's transformation - per unit conversion - normalizing the equations - equivalent circuit - current space model - flux linkage state space model. Sub-transient and transient inductances - time constants.
Simplified models (one axis and constant flux linkage) - steady state equations and phasor diagrams.

UNIT III MACHINE CONTROLLERS **9**

Exciter and voltage regulators - function and types of excitation systems - typical excitation system configuration - block diagram and state space representation of IEEE type 1 excitation system - saturation function - stabilizing circuit.
Function of speed governing systems - block diagram and state space representation of IEEE mechanical hydraulic governor and electrical hydraulic governors for hydro turbines and steam turbines.

UNIT IV TRANSIENT STABILITY **9**

State equation for multimachine system with one axis model and simulation – modelling of multimachine power system with one axis machine model including excitation system and speed governing system and simulation using R-K method of fourth order (Gill's technique) for transient stability analysis - power system stabilizer. For all simulations, the algorithm and flow chart have to be discussed.

UNIT V DYNAMIC STABILITY **9**

System response to small disturbances - linear model of the unregulated synchronous machine and its modes of oscillation - regulated synchronous machine - distribution of power impact - linearization of the load equation for the one machine problem – simplified linear model - effect of excitation on dynamic stability - approximate system representation - supplementary stabilizing signals - dynamic performance measure - small signal performance measures.

TOTAL : 45 PERIODS

TEXT BOOKS

1. P.M. Anderson and A.A.Fouad, 'Power System Control and Stability', Galgotia Publications, New Delhi, 2003.
2. P. Kundur, 'Power System Stability and Control', McGraw Hill Inc., USA, 1994.

REFERENCES

1. M.A.Pai and W.Sauer, 'Power System Dynamics and Stability', Pearson Education Asia, India, 2002.
2. James A.Momoh, Mohamed.E. EI-Hawary." Electric Systems, Dynamics and stability with Artificial Intelligence applications", Marcel Dekker, USA First Edition 2000.

CS2022 COMPUTER ARCHITECTURE L T P C
3 1 0 4

UNIT I INSTRUCTION SET ARCHITECTURE 9

Introduction to computer architecture - Review of digital design – Instructions and addressing – procedures and data – assembly language programs – instruction set variations

UNIT II ARITHMETIC/LOGIC UNIT 9

Number representation – design of adders – design of simple ALUs – design of Multipliers and dividers – design of floating point arithmetic unit

UNIT III DATA PATH AND CONTROL 9

Instruction execution steps – control unit synthesis – microprogramming – pipelining – pipeline performance

UNIT IV MEMORY SYSTEM 9

Main Memory concepts – types of memory – cache memory organization – secondary storage – virtual memory – paging

UNIT V I/O AND INTERFACES 9

I/O devices – I/O programming – polling – interrupts – DMA – buses – links – interfacing – context switching – threads and multithreading

L = 45 T = 15 TOTAL = 60 PERIODS

TEXT BOOKS:

1. B. Parhami, “Computer Architecture”, Oxford University Press, 2005.
2. Carl Hamacher, Zvonko Vranesic and Safwat Zaky, “Computer Organization”, Fifth Edition, Tata McGraw Hill, 2002.

REFERENCES:

1. David A. Patterson and John L. Hennessy, “Computer Organization and Design: The Hardware/Software interface”, Third Edition, Elsevier, 2004.
2. William Stallings, “Computer Organization and Architecture – Designing for Performance”, Seventh Edition, Pearson Education, 2006.
3. Miles Murdocca “Computers Architecture and Organization An Integrated approach”, Wiley India pvt Ltd, 2007
4. John D. Carpinelli, “Computer systems organization and Architecture”, Pearson Education, 2001.

GE2022 TOTAL QUALITY MANAGEMENT L T P C
3 0 0 3

UNIT I INTRODUCTION 9

Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of manufacturing and service quality - Basic concepts of TQM - Definition of TQM – TQM Framework - Contributions of Deming, Juran and Crosby – Barriers to TQM.

UNIT II TQM PRINCIPLES 9

Leadership – Strategic quality planning, Quality statements - Customer focus – Customer orientation, Customer satisfaction, Customer complaints, Customer retention - Employee involvement – Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement – PDSA cycle, 5s, Kaizen - Supplier partnership – Partnering, Supplier selection, Supplier Rating.

UNIT III TQM TOOLS & TECHNIQUES I **9**

The seven traditional tools of quality – New management tools – Six-sigma: Concepts, methodology, applications to manufacturing, service sector including IT – Bench marking – Reason to bench mark, Bench marking process – FMEA – Stages, Types.

UNIT IV TQM TOOLS & TECHNIQUES II **9**

Quality circles – Quality Function Deployment (QFD) – Taguchi quality loss function – TPM – Concepts, improvement needs – Cost of Quality – Performance measures.

UNIT V QUALITY SYSTEMS **9**

Need for ISO 9000- ISO 9000-2000 Quality System – Elements, Documentation, Quality auditing- QS 9000 – ISO 14000 – Concepts, Requirements and Benefits – Case studies of TQM implementation in manufacturing and service sectors including IT.

TOTAL : 45 PERIODS

TEXT BOOK

1. Dale H.Besterfiled, et at., "Total Quality Management", Pearson Education Asia, Third Edition, Indian Reprint (2006).

REFERENCES

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", (6th Edition), South-Western (Thomson Learning), 2005.
2. Oakland, J.S. "TQM – Text with Cases", Butterworth – Heinemann Ltd., Oxford, Third Edition (2003).
3. Suganthi,L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd. (2006)
4. Janakiraman,B and Gopal, R.K, "Total Quality Management – Text and Cases", Prentice Hall (India) Pvt. Ltd. (2006)

EE2028 **POWER QUALITY** **L T P C**
3 0 0 3

AIM:

To study the various issues affecting power quality, their production, monitoring and suppression.

OBJECTIVES:

- To study the production of voltages sags, overvoltages and harmonics and methods
- of control.
- To study various methods of power quality monitoring.

UNIT I INTRODUCTION TO POWER QUALITY **9**

Terms and definitions: Overloading - under voltage - over voltage. Concepts of transients - short duration variations such as interruption - long duration variation such as sustained interruption. Sags and swells - voltage sag - voltage swell - voltage imbalance - voltage fluctuation - power frequency variations. International standards of power quality. Computer Business Equipment Manufacturers Associations (CBEMA) curve.

UNIT II VOLTAGE SAGS AND INTERRUPTIONS 9

Sources of sags and interruptions - estimating voltage sag performance. Thevenin's equivalent source - analysis and calculation of various faulted condition. Voltage sag due to induction motor starting. Estimation of the sag severity - mitigation of voltage sags, active series compensators. Static transfer switches and fast transfer switches.

UNIT III OVERVOLTAGES 9

Sources of over voltages - Capacitor switching – lightning - ferro resonance. Mitigation of voltage swells - surge arresters - low pass filters - power conditioners. Lightning protection – shielding - line arresters - protection of transformers and cables. An introduction to computer analysis tools for transients, PSCAD and EMTP.

UNIT IV HARMONICS 9

Harmonic sources from commercial and industrial loads, locating harmonic sources. Power system response characteristics - Harmonics Vs transients. Effect of harmonics - harmonic distortion - voltage and current distortion - harmonic indices - inter harmonics – resonance. Harmonic distortion evaluation - devices for controlling harmonic distortion - passive and active filters. IEEE and IEC standards.

UNIT V POWER QUALITY MONITORING 9

Monitoring considerations - monitoring and diagnostic techniques for various power quality problems - modeling of power quality (harmonics and voltage sag) problems by mathematical simulation tools - power line disturbance analyzer – Quality measurement equipment - harmonic / spectrum analyzer - flicker meters - disturbance analyzer. Applications of expert systems for power quality monitoring.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Roger. C. Dugan, Mark. F. McGranagham, Surya Santoso, H.Wayne Beaty, 'Electrical Power Systems Quality' McGraw Hill,2003.(For Chapters1,2,3, 4 and 5)

REFERENCES

1. G.T. Heydt, 'Electric Power Quality', 2nd Edition. (West Lafayette, IN, Stars in a Circle Publications, 1994). (For Chapter 1, 2, 3 and 5)
2. M.H.J Bollen, 'Understanding Power Quality Problems: Voltage Sags and Interruptions', (New York: IEEE Press, 1999). (For Chapters 1, 2, 3 and 5)
3. J. Arrillaga, N.R. Watson, S. Chen, 'Power System Quality Assessment', (New York: Wiley, 1999). (For Chapters 1, 2, 3, 4 and 5)
4. PSCAD User Manual.

EE2029 SYSTEM IDENTIFICATION AND ADAPTIVE CONTROL L T P C
3 0 0 3

UNIT I PARAMETRIC METHODS 5

Nonparametric methods: Transient analysis-frequency analysis-Correlation analysis-Spectral analysis.

UNIT II PARAMETRIC METHODS 10

Linar Regression: The Lease square esimate-best liner unbiased etimation under linear constraints- updating the Parameter estimates for linear regression models-Predcion error methods: Description of Prediction error methods-Optimal Predictio –

relationships between Prediction error methods and other identification methods-theoretical analysis.
Instrumental variable methods: description of nstrumental variable methods-theoretical analysis-covariance matrix of IV estimates- Comparison of optimal IV predicion error methods.

UNIT III RECURSIVE IDENTIFICATION METHODS 10

The recursive lest squares method-the recursive Instrumentl varible method-the recursive prediction error method-model validatio and model structure etermination.
Indenification of systems operating in closed loop: Identifiability considerations-direct indentification-Indirect indentification-joint input – output identification.

UNIT IV ADAPTIVE CONTROL SCHEMES 10

Introduction – users- Definitions-auto tuning-types of adaptive control-gain scheduling controller-model reference adaptive control schemes – self tunning controller. MRAC and STC : Approaches – The Gradient approach – Lyapunov functions – Passivity theory – pole placement method Minimum variance control – Predictive control.

UNIT V ISSUES IN ADAPIVE CONTROL AND APPLICATION 10

Stability – Convergence – Robustness – Application of adaptive conrol.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Soderstorm.T and Petre stioca, System Identification, Prentice Hall International (UK) Ltd. 1989.
2. Karl J.Astrom and Bjorn Wittenmark, Adaptive Conrol, Pearson Education, 2nd Editon, 2001.

REFERENCES

1. Ljung,L.System Identification: Theory for the user, Pretice Hall, Englewood cliffs, 1987.
2. Sastry S. and Bodson M., daptive control – stability, Convergence ad Robustness, Prentice Hall inc., New Jersey, 12989.

EE2030 OPERATIONS RESEARCH L T P C
3 0 0 3

AIM:

To introduce the Linear Programming methods, Algorithms, LC PM and PERT.

OBJECTIVES:

- To study various LP methods.
- To study Algorithms methods.
- To study case studies using CPM and PERT

UNIT I INTRODUCTION 9

Role of Operations Research - Operations Research Models and techniques. LP model and technique – formulation and graphical Solution – graphical sensitivity Analysis. The Simplex Algorithm – the two phase method – degeneracy – alterative optima – unbounded and/or Infeasible Solution – redundancies.

UNIT II PROBLEM FORMULATION 9

Definitions of the Dual Problem – Primal-dual Relationship – Economic Interpretation of Duality – Dual Simplex Method – Primal Dual Computation – Post Optimal or Sensitivity Analysis – Changes Affecting Feasibility – Changes Affecting Optimality – Revised Simplex Method – LP Packages.

UNIT III ALGORITHMS AND MODELS 9

Definition of Transportation Model – The Transportation Algorithm – Determination of the Starting Solution – Iterative Computations of an Algorithm – The Assignment Model – The Hungarian Method – The Transshipment Model – Inter Programming Problem – Cutting Plane Algorithm.

UNIT IV NETWORK SOLUTIONS 9

Scope of Network Applications – Network Solution – Minimal Spanning Tree Algorithm – Shortest Route Problem – Examples – Shortest Route Algorithm – Maximal Flow Model – Minimal cost Capacitated Flow Problems.

UNIT V CASE STUDIES USING CPM AND PERT 9

Network Diagram Representation – Critical Path Method – Time Estimates – Crashing – Time Charts – PERT and CPM for Project Scheduling – Resource Planning - Case Studies.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Hamdy A. Taha, "Operation Research – An Introduction" ,7th Edition Person Education / Prentice Hall of India Edition, Asia, 2002. (For All Chapters 1, 2, 3, 4 and 5)
2. Srinivasn, "Operations Research: Principles and applications", Prentice Hall of India, 2007 New Edition, (For All Chapters).

REFERENCES

1. Ronald. L. Rardin ,"Optimization in Operation Research", Pearson Education, Asia, 2002.
2. JIT.S Chandran, Mahendran P.Kawatra Ki Ho Kim ,"Essential of Linear Programming", Vikas Publishing House Pvt. Ltd., New Delhi, 1994.
3. Hiller F.S, Liberman G.J ,"Introduction to Operation Research", 7th Edition, McGraw Hill, 2001. (For all Chapters 1, 2, 3, 4 and 5)
4. R.Panneer Selvam ,"Operations Research", Prentice Hall of India, 2002. (For All Chapters).
5. P.C.Tulsin,"Quantitative Technique : Theory and Problem", Pearson Education, 2002.
6. Ravindran, Phillips, Solberg ,"Operation Research Principles and Practice", Second Edition, John Wiley, 1987.

EE2031 VLSI DESIGN L T P C
3 0 0 3

AIM

Tounderstand th basic concepts of VLSI and CMOS design.

OBJECTIVES

- To give clear idea about the basics of VLSI design and its importance.
- To know about the operating principles of MOS transistor.
- To study about construction of NMOS, CMOS and Bi-CMOS based logic gates.
- To understand the functioning of programmable and Reprogrammable devices.
- To learn about the programming of Programmable device using Hardware description Language.

UNIT I BASIC MOS TRANSISTOR **9**

Enhancement mode & Depletion mode – Fabrication (NMOS, PMOS, CMOS, BiCMOS) Technology – NMOS transistor current equation – second order effects – MOS Transistor Model.

UNIT II NMOS & CMOS INVERTER AND GATES **9**

NMOS & CMOS inverter – Determination of pull up / pull down ratios – stick diagram – lambda based rules – super buffers – BiCMOS & steering logic.

UNIT III SUB SYSTEM DESIGN & LAYOUT **9**

Structured design of combinational circuits – Dynamic CMOS & clocking – Tally circuits – (NAND-NAND, NOR-NOR and AOI logic) – EXOR structure – Multiplexer structures – Barrel shifter.

UNIT IV DESIGN OF COMBINATIONAL ELEMENTS & REGULAR ARRAYLOGIC **9**

NMOS PLA – Programmable Logic Devices - Finite State Machine PLA – Introduction to FPGA, CPLD.

UNIT V VHDL PROGRAMMING **9**

RTL Design – Detructured level Design -combinational logic – Types – Operators – Packages – Sequential circuit – Sub programs – Test benches. (Examples: address, counters, flipflops, FSM, Multiplexers / Demltiplexers).

TOTAL : 45 PERIODS

TEXT BOOKS

1. D.A.Pucknell, K.Eshraghian, 'Basic VLSI Design', 3rd Edition, Prentice Hall of India, New Delhi, 2003.
2. Eugene D.Fabricius, 'Introduction to VLSI Design', Tata McGraw Hill, 1990.

REFERENCES

1. N.H.Weste, 'Principles of CMOS VLSI Design', Pearson Education, India, 2002.
2. Charles H.Roth, 'Fundamentals of Logic Design', Jaico Publishing House, 1992.
3. Zainalatsedin Navabi, 'VHDL Analysis and Modelling of Digital Systems', 2n Edition, Tata McGraw Hill, 1998.
4. Douglas Perry, 'VHDL Programming By Example', Tata McGraw Hill, 3rdEdition.2007.
5. Parag K.Lala, 'Digitl System Design using PLD', BS Publications, 2003.

EE 2032 HIGH VOLTAGE DIRECT CURRENT TRANSMISSION L T P C
3 0 0 3

AIM

To develop the skills in the area of HVDC power transmission with the analysis of HVDC converters, harmonics and design of filters.

OBJECTIVE

- To understand the concept, planning of DC power transmission and comparison with AC power transmission.
- To analyze HVDC converters.
- To study about compounding and regulation.
- To analyze harmonics and design of filters.
- To learn about HVDC cables and simulation tools.

UNIT I INTRODUCTION **9**

Introduction of DC Power transmission technology – Comparison of AC and DC transmission – Application of DC transmission – Description of DC transmission system – Planning for HVDC transmission – Modern trends in DC transmission.

UNIT II ANALYSIS OF HVDC CONVERTERS **9**

Pulse number – Choice of converter configuration – Simplified analysis of Graetz circuit – Converter bridge characteristics – Characteristics of a twelve pulse converter – Detailed analysis of converters.

UNIT III COMPOUNDING AND REGULATIONS **9**

General – Required regulation – Inverter compounding – Uncompounded inverter – Rectifier compounding – Transmission characteristics with the rectifier and inverter compounding – Communication link – Current regulation from the inverter side – Transformer tap changing

UNIT IV HARMONICS AND FILTERS **9**

Introduction – Generation of harmonics – Design of AC filters and DC filters – Interference with neighbouring communication lines.

UNIT V HVDC CABLES AND SIMULATION OF HVDC SYSTEMS **9**

Introduction of DC cables – Basic physical phenomenon arising in DC insulation – Practical dielectrics – Dielectric stress consideration – Economics of DC cables compared with AC cables. Introduction to system simulation – Philosophy and tools – HVDC system simulation – Modeling of HVDC systems for digital dynamic simulation.

TOTAL : 45 PERIODS

TEXT BOOK

1. Padiyar, K. R., “HVDC power transmission system”, Wiley Eastern Limited, New Delhi 1990. First edition.
2. Edward Wilson Kimbark, “Direct Current Transmission”, Vol. I, Wiley interscience, New York, London, Sydney, 1971.

REFERENCES

1. Colin Adamson and Hingorani N G, “High Voltage Direct Current Power Transmission”, Garraway Limited, London, 1960.
2. Arrillaga, J., “High Voltage Direct Current Transmission”, Peter Pregrinus, London, 1983.
3. Rakosh Das Begamudre, “Extra High Voltage AC Transmission Engineering”, New Age Interantional (P) Ltd., New Delhi, 1990.

GE2023 FUNDAMENTAL OF NANOSCIENCE **L T P C**
3 0 0 3

UNIT I INTRODUCTION **9**

Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering-Classifications of nanostructured materials- nano particles- quantum dots, nanowires-ultra-thinfilms-multilayered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties. Introduction to properties and motivation for study (qualitative only).

UNIT II PREPARATION METHODS **10**

Bottom-up Synthesis-Top-down Approach: Precipitation, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE.

UNIT III PATTERNING AND LITHOGRAPHY FOR NANOSCALE DEVICES 7

Introduction to optical/UV electron beam and X-ray Lithography systems and processes, Wet etching, dry (Plasma /reactive ion) etching, Etch resists-dip pen lithography

UNIT IV PREPARATION ENVIRONMENTS 9

Clean rooms: specifications and design, air and water purity, requirements for particular processes, Vibration free environments: Services and facilities required. Working practices, sample cleaning, Chemical purification, chemical and biological contamination, Safety issues, flammable and toxic hazards, biohazards.

UNIT V CHARECTERISATION TECHNIQUES 10

X-ray diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques- AFM, SPM, STM, SNOM, ESCA, SIMS-Nanoindentation

TOTAL : 45 PERIODS

TEXT BOOKS

1. A.S. Edelstein and R.C. Cammearata, eds., Nanomaterials: Synthesis, Properties and Applications, (Institute of Physics Publishing, Bristol and Philadelphia, 1996)
2. N John Dinardo, Nanoscale charecterisation of surfaces & Interfaces, Second edition, Weinheim Cambridge, Wiley-VCH, 2000

REFERENCES

1. G Timp (Editor), Nanotechnology, AIP press/Springer, 1999
2. Akhlesh Lakhtakia (Editor) The Hand Book of Nano Technology, “Nanometer Structure”, Theory, Modeling and Simulations. Prentice-Hall of India (P) Ltd, New Delhi, 2007.

EE 2033 MICRO ELECTRO MECHANICAL SYSTENS L T P C
3 0 0 3

AIM

The aim of this course is to educate the student to understand the fundamentals of Micro Electro Mechanical Systems (MEMS)

OBJECTIVES

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

- integrate the knowledge of semiconductors and solid mechanics to fabricate MEMS devices.
- understand the rudiments of Microfabrication techniques.
- identify and understand the various sensors and actutators
- different materials used for MEMS
- applications of MEMS to disciplines beyond Electrical and Mechanical engineering.

UNIT I INTRODUCTION 9

Intrinsic Characteristics of MEMS – Energy Domains and Transducers- Sensors and Actuators – Introduction to Microfabrication - Silicon based MEMS processes – New Materials – Review of Electrical and Mechanical concepts in MEMS – Semiconductor devices – Stress and strain analysis – Flexural beam bending- Torsional deflection.

UNIT II SENSORS AND ACTUATORS-I **9**

Electrostatic sensors – Parallel plate capacitors – Applications – Interdigitated Finger capacitor – Comb drive devices – Thermal Sensing and Actuation – Thermal expansion – Thermal couples – Thermal resistors – Applications – Magnetic Actuators – Micromagnetic components – Case studies of MEMS in magnetic actuators.

UNIT III SENSORS AND ACTUATORS-II **9**

Piezoresistive sensors – Piezoresistive sensor materials - Stress analysis of mechanical elements – Applications to Inertia, Pressure, Tactile and Flow sensors – Piezoelectric sensors and actuators – piezoelectric effects – piezoelectric materials – Applications to Inertia , Acoustic, Tactile and Flow sensors.

UNIT IV MICROMACHINING **9**

Silicon Anisotropic Etching – Anisotrophic Wet Etching – Dry Etching of Silicon – Plasma Etching – Deep Reaction Ion Etching (DRIE) – Isotropic Wet Etching – Gas Phase Etchants – Case studies - Basic surface micromachining processes – Structural and Sacrificial Materials – Acceleration of sacrificial Etch – Striction and Antistriction methods – Assembly of 3D MEMS – Foundry process.

UNIT V POLYMER AND OPTICAL MEMS **9**

Polymers in MEMS– Polimide - SU-8 - Liquid Crystal Polymer (LCP) – PDMS – PMMA – Parylene – Fluorocarbon - Application to Acceleration, Pressure, Flow and Tactile sensors- Optical MEMS – Lenses and Mirrors – Actuators for Active Optical MEMS.

TOTAL : 45 PERIODS

TEXT BOOKS.

1. Chang Liu, 'Foundations of MEMS', Pearson Education Inc., 2006.
2.. James J.Allen, micro electro mechanical system design, CRC Press published in 2005

REFERENCES

1. Nadim Maluf, " An introduction to Micro electro mechanical system design", Artech House, 2000.
2. Mohamed Gad-el-Hak, editor, " The MEMS Handbook", CRC press Baco Raton, 2000
3. Tai Ran Hsu, "MEMS & Micro systems Design and Manufacture" Tata McGraw Hill, New Delhi, 2002.
4. Julian w. Gardner, Vijay k. varadan, Osama O.Awadelkarim,micro sensors mems and smart devices, John Wiley & son LTD,2002

EE2034 SOFTWARE FOR CIRCUIT SIMULATION L T P C
3 0 0 3

UNIT I INTRODUCTION **9**

Importance of simulation – General purpose circuit analysis – programs – Method of analysis of power electronic systems – Review of modeling of power electronic components and systems.

UNIT II ADVANCED TECHNIQUES IN SIMULATION **9**

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 PSPICE : **9**

Introduction – Pspice overview – DC circuit Analysis –AC circuit analysis – Transient and the time domain – Fourier Series and Harmonic components – An introduction to Pspice devices BJT, FET, MOSFET and is model – Amplifiers and Oscillators – Nor linear Devices.

UNIT IV MATLAB **9**

Introduction - function description – Data types – Tool boxes – Graphical Display: Import and Export of data – Programs for solution of state equations.

UNIT V SIMULINK **9**

Introduction – Graphical user Interface – Selection of objects – Blocks – lines Simulation - Application programs.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Rajagopalan.V 'Computer aided analysis of power electronic systems' Marcell Dekker 1987.

REFERENCES

1. John Keown 'Microsim Pspice and circuit analysis" Prentice hall Inc, 1998.
2. Orcad Pspice User manual, Orcad Corporation, 2006.
3. Matlab / Simulink manual, Maths Work 2007.

EE 2035 COMPUTER AIDED DESIGN OF ELECTRICAL APPARATUS **L T P C**
3 0 0 3

AIM

To introduce the basics of Computer Aided Design technology for the design of Electrical Machines.

OBJECTIVE

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

- Learn the importance of computer aided design method.
- Understand the basic electromagnetic field equations and the problem formulation for CAD applications.
- Become familiar with Finite Element Method as applicable for Electrical Engineering.
- Know the organization of a typical CAD package.
- Apply Finite Element Method for the design of different Electrical apparatus.

UNIT I INTRODUCTION **8**

Conventional design procedures – Limitations – Need for field analysis based design – Review of Basic principles of energy conversion – Development of Torque/Force.

UNIT II MATHEMATICAL FORMULATION OF FIELD PROBLEMS **9**

Electromagnetic Field Equations – Magnetic Vector/Scalar potential – Electrical vector /Scalar potential – Stored energy in Electric and Magnetic fields – Capacitance - Inductance- Laplace and Poisson's Equations – Energy functional.

UNIT III PHILOSOPHY OF FEM **10**

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 **9**

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

UNIT V DESIGN APPLICATIONS 9

Voltage Stress in Insulators – Capacitance calculation - Design of Solenoid Actuator – Inductance and force calculation – Torque calculation in Switched Reluctance Motor.

TOTAL : 45 PERIODS

TEXT BOOKS

1. S.J Salon, 'Finite Element Analysis of Electrical Machines', Kluwer Academic Publishers, London, 1995.
2. Nicola Bianchi, 'Electrical Machine Analysis using Finite Elements', CRC Taylor& Francis, 2005.

REFERENCES

1. Joao Pedro, A. Bastos and Nelson Sadowski, 'Electromagnetic Modeling by Finite Element Methods', Marcell Dekker Inc., 2003.
2. P.P.Silvester and Ferrari, 'Finite Elements for Electrical Engineers', Cambridge University Press, 1983.
3. D.A.Lowther and P.P Silvester, 'Computer Aided Design in Magnetics', Springer Verlag, New York, 1986.
4. S.R.H.Hoole, 'Computer Aided Analysis and Design of Electromagnetic Devices', Elsevier, New York, 1989.
5. User Manuals of MAGNET, MAXWELL & ANSYS Softwares.

EE2036 FLEXIBLE AC TRANSMISSION SYSTEMS L T P C
3 0 0 3

AIM: To enhance the transmission capability of transmission system by shunt and series compensation using static controllers.

OBJECTIVES:

- To understand the concept of flexible AC transmission and the associated problems.
- To review the static devices for series and shunt control.
- To study the operation of controllers for enhancing the transmission capability.

UNIT I INTRODUCTION 9

The concept of flexible AC transmission - reactive power control in electrical power transmission lines -uncompensated transmission line – series and shunt compensation. Overview of FACTS devices - Static Var Compensator (SVC) – Thyristor Switched Series capacitor (TCSC) – Unified Power Flow controller (UPFC) - Integrated Power Flow Controller (IPFC).

UNIT II STATIC VAR COMPENSATOR (SVC) AND APPLICATIONS 9

Voltage control by SVC – advantages of slope in dynamic characteristics – influence of SVC on system voltage. Applications - enhancement of transient stability – steady state power transfer – enhancement of power system damping – prevention of voltage instability.

UNIT III THYRISTOR CONTROLLED SERIES CAPACITOR(TCSC)AND APPLICATIONS 9

Operation of the TCSC - different modes of operation – modeling of TCSC – variable reactance model – modeling for stability studies. Applications - improvement of the system stability limit – enhancement of system damping – voltage collapse prevention.

UNIT IV EMERGING FACTS CONTROLLERS **9**

Static Synchronous Compensator (STATCOM) – operating principle – V-I characteristics – Unified Power Flow Controller (UPFC) – Principle of operation - modes of operation – applications – modeling of UPFC for power flow studies.

UNIT V CO-ORDINATION OF FACTS CONTROLLERS **9**

FACTs Controller interactions – SVC–SVC interaction - co-ordination of multiple controllers using linear control techniques – Quantitative treatment of control coordination.

TOTAL : 45 PERIODS

TEXT BOOK:

1. Mohan Mathur, R., Rajiv. K. Varma, “Thyristor – Based Facts Controllers for Electrical Transmission Systems”, IEEE press and John Wiley & Sons, Inc.

REFERENCES:

1. A.T.John, “Flexible AC Transmission System”, Institution of Electrical and Electronic Engineers (IEEE), 1999.
2. Narain G.Hingorani, Laszio. Gyugyl, “Understanding FACTS Concepts and Technology of Flexible AC Transmission System”, Standard Publishers, Delhi 2001.