RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL

New Scheme Based On AICTE Flexible Curricula

Electrical Engineering, V-Semester

EE501 Electrical Machine-II

Unit-I

D.C. Machine-I

Basic construction of DC machines; types of DC machines and method of excitation; lap and wave windings; Emf equation; armature reaction and methods of limiting armature reaction; Commutation process and methods for improving commutation; Basic performance of DC generators and their performance characteristics; Metadyne and Amplidyne; permanent magnet DC motors; Brush less dc motors.

Unit-II

D.C. Machine-II

Basic operation of DC motors; Torque equation; Operating characteristics of DC motors, Starting of DC motors- 2point, 3 point and 4 point starters; speed control of DC motors; losses and efficiency of DC machines; testing of DC machines, direct testing, Swinburne's test and Hopkinson's test. Application of DC machines.

Unit-III

Synchronous Machine-I

Construction; types of prime movers; excitation system including brushless excitation; polyphase distributive winding, integral slot and fractional slot windings; emf equation, generation of harmonics and their elimination; armature reaction; synchronous reactance and impedance, equivalent circuit of alternator, relation between generated voltage and terminal voltage, voltage regulation of alternators using synchronous impedance, mmf, zpf and new A.S.A method.

Unit-IV

Synchronous Machine-II

Salient pole machines; two reaction theory equivalent circuit model and phasor diagram; determination of XdandXqby slip test; SCR and its significance; regulation of salient pole alternator, power angle equation and characteristics; synchronizing of alternator with infinite busbar,; parallel operation and load sharing; synchronizing current, synchronizing power and synchronising torque coefficient; synchro scopes and phase sequence indicator; effect of varying excitation and mechanical torque.

Unit-V

Synchronous machine-III

Synchronous motor operation, starting and stopping of synchronous motor, pull in torque, motor under load power and torque, reluctance torque, effect of excitation, effect of armature reaction, power factor adjustment, V curves, inverted V curves, synchronous motors as power factor correcting device, super synchronous and sub synchronous motors, hunting and damper winding efficiency and losses. Analysis of short circuit oscillogram, determination of various transient, sub transient and steady reactances and time constants, expression of transient and sub transient reactances in terms of self and mutual inductances of various winding, short circuit current, equivalent circuit. Single phase synchronous motors- hysteresis motor, reluctance motor. Repulsion motor, stepper motor, switched reluctance

REFERENCE BOOKS

1. M.G. Say, Performance & design of AC machines, CBS publishers & distributors, Delhi, 3rd edition
2. A.E. Clayton & N.N. Nancock, The Performance & design of DC machines CBS publications & distributors, Delhi, 3rd edition
3. P.S. Bhimbra, Electrical Machinery, Khanna Pub.
4. P.S. Bhimbra, Generalized theory of Electrical Machines, Khanna publishers, Delhi,
5. Ashfaq Husain, Electric Machines, Dhanpat Rai, New Delhi
6. I.J. Nagrath& D.P. Kothari, Electric Machines, Tata McGraw Hill , New Delhi,
7. Syed A. Nasar, Electric Machines & Power Systems, Volume I , Tata McGraw Hill, New Delhi
8. M.G. Say, Performance & design of AC machines, CBS publishers & distributors, Delhi, 3rd edition
9. M.G. Say, Performance & design of AC machines, CBS publishers & distributors, Delhi, 3rd edition
10. A.E. Clayton & N.N. Nancock, The Performance & design of DC machines CBS publications & distributors, Delhi, 3rd edition
11. P.S. Bhimbra, Electrical Machinery, Khanna Pub.
12. P.S. Bhimbra, Generalized theory of Electrical Machines, Khanna publishers, Delhi,
13. Ashfaq Husain, Electric Machines, Dhanpat Rai, New Delhi
14. I.J. Nagrath& D.P. Kothari, Electric Machines, Tata McGraw Hill , New Delhi,
15. Syed A. Nasar, Electric Machines & Power Systems, Volume I , Tata McGraw Hill, New Delhi
16. A.E. Fitzerald, C. Kingsley & S.D. Umans , Electric Machinery Tata McGraw Hill ,New Delhi ,5thedition

Experiment List

1. To plot magnetisation characteristic of a separately excited DC generator
2. To perform load test on DC generators.
3. To perform load test on DC series and shunt motor
4. To perform Swinburn's test on a DC machine and find out its efficiency under full load condition.
5. To conduct Hopkinson's test on a pair of DC shunt machine.
6. To perform OCC and SCC test on an alternator and determine its regulation.
7. To determine regulation of alternator using mmf and zpf methods.
8. To synchronise alternator with infinite bus bar.
9. To plot V and inverted V curves for a synchronous motor
10. To find $X_d$and $X_q$of salient pole synchronous machine by slip test.
11. To Determine negative sequence and zero sequence reactance of an alternator.
12. To determine subtransient direct axis and quadrature axis synchronous reactances of salient pole machine.

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL

New Scheme Based On AICTE Flexible Curricula

Electrical Engineering, V-Semester

EE 502 Power Electronics

UNIT-I

Advantages and application of power electronic devices characteristics, Symbol & application of power diodes, power transistors, GTO, Triac, Diac, Power MOSFET, IGBT, LASCR, Fast recovery diode, schottey diode MCTs. Principle of operation of SCR, Two transistor analogy, brief idea of construction of SCR, Static characteristics of SCR, Condition of turn on & off of SCR Gate characteristics, Method for turning on of SCR, Turnoff methods, different commutation techniques (Class A,B,C,D,E, & F Commutation) firing of SCR, Resistance firing Ckt, Resistance capacitance firing circuit, UJT firing cut, and ramp triggering, firing for 3-Φ circuit. SCR rating & protection of SCR over voltage, Over current, Superior firing, Design of snubber circuit and protection of gate of SCR, heating, cooling & mounting of SCR series and parallel operation of SCR, String efficiency & problem associated with series and parallel operation of SCR.

UNIT-II

Operation and analysis of single phase (Half wave & Full Wave) and multiphase (Three Phase)uncontrolled and controlled rectifier circuit with resistive, resistive & inductive load (continuous & non continuous conduction, FW small & very large inductive loads) and RLE loads. Estimation of average load voltage and load current for above rectifier circuits active and reactive power input. Effect of freewheeling diode and source inductance on performance of these rectifier circuits . Comparison of mid-point & Bridge rectifier circuits.

UNIT-III

Series and parallel inverter, Voltage source & current source inverter, Single phase and three phase bridge inverter, Self-cumulated inverters,, Mc- murray& MC murray bed ford inverters, Voltage control of single phase and three phase bridge inverter, Harmonics & their reduction techniques.

UNIT-IV

Principle of chopper operation, Various control strategies in chopper, Step up & step-up/step down choppers, chopper configuration (Type A,B, C,D, & E), Steady state analysis of chopper circuits, Current & voltage commutation of chopper circuits Jones & Morgens chopper.

UNIT-V

Single phase (midpoint & bridge configuration) and three phase cyclo convertor configuration and operating principles. AC voltage controllers (using SCRs &Traics) single phase full wave controller with R and RL load, Estimation of RMS load voltage, RMS load current and input power factor, three phase AC voltage controller (Without analysis) Dual converter Switched mode voltage regulator buck, Boost, Buch & Boost, Ck regulators.

LIST OF EXPERIMENTS (EXPANDABLE)

1- VI Characteristics Of SCR
2- VI Characteristics Of DIAC
3- VI Characteristics Of BJT
4- Characteristics Of TRIAC
5- VI Characteristics Of MOSFET
6- Transfer Characteristics Of MOSFET
7- Output Characteristics Of IGBT
8- Transfer Characteristics Of IGBT
9- 9 - Single Phase SCR Half Controlled Converter With R Load
10- 1φ Scr Fully Controlled Converter With R-Load
11- Study Of 3φ SCR Half Controlled Converter
12- Study Of 3φ SCR Fully Controlled Converter
13- Study Of Classes Of Commutation A,B,C,D,E,F.

REFERENCE BOOKS

1- M.H. Rashid, Power Electronics Circuits, Devices and Applications, Pearson 2 Education, Singapore, 1993.
2- M Ramsmoorthy, An Introduction to transistor and their application, Affiliated East-West Press.
3- P.C. Sen, Power Electonics, TMH.
4- M.D. Singh, K.B. Khanchandani, Power Electronics, TMH, Delhi, 2001.
5- Chakravarti A., Fundamental of Power Electronics and Drives, Dhanpat Ray & Co.,
6- Dr. P.S. Bhimbhra, Power Electonics, Khanna Pub.

Vedam Subramanyam, Power Electronics New Age International Revised II ed. 2006.

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL

New Scheme Based On AICTE Flexible Curricula

Electrical Engineering, V-Semester

Departmental Elective EE- 503 (A) Electrical Power Generation & Economy

Unit-I

Introduction: Energy sources and their availability, Principle types of power plants, their special features and applications, Present status and future trends. Hydro Electric Power Plants: Essentials, Classifications, Hydroelectric survey, Rainfall run-off, Hydrograph, Flow duration curve, Mass curve, Storage capacity, Site selection, Plant layout, various components, Types of turbines, Governor and speed regulation, Pumped storage, Small scale hydro–electric plants (mini and micro).

Unit-II

Thermal Power Plant: General developing trends, Essentials, Plant layout, Coal–its storage, Preparation, Handling, Feeding and burning, Cooling towers, Ash handling, Water treatment plant, High pressure boilers and steam turbines, Components of thermal power plant.

Unit-III

Non-Conventional Power Generation: Geothermal power plants, Electricity from biomass, Direct energy conversion systems (Solar and Wind), Thermo-electric conversion system, Fuel cells, Magneto-Hydro dynamic system..

Unit-IV

Gas Turbine Power Plants: Field of use, Components, Plant layout, Comparison with steam power plants, combined steam and gas power plants. Nuclear Power Plant: Nuclear fuels, Nuclear energy, Main components of nuclear power plant, Nuclear reactors types and applications, Radiation shielding, Radioactive and waste disposal safety aspect..

Unit-V

Power Plant Economics: Cost of electrical energy, Selection of type of generation and generation equipment, Performance and operating characteristics of power plants, Economic scheduling principle, Load curves, Effect of load on power plant design, Load forecasting, electric tariffs, Peak load pricing.

REFERENCE BOOKS

1. Deshpande, M.V., Power Plant Engineering, Tata McGraw Hill (2004).
2. Gupta, B.R., Generation of Electrical Energy, S. Chand (1998).
3. Deshpande, M.V., Electrical Power System Design, McGraw Hill (2004).

Wood, A.J. and Wollenberg, B.F., Power Generation and Control, John Wiley (2004).

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL

New Scheme Based On AICTE Flexible Curricula

Electrical Engineering, V-Semester

Departmental Elective EE- 503 (B) Applied Instrumentation

Unit-I

Introduction to measurement: Definition, application and types of measurement System Introduction to CRO, Different parts of CRO, Its Block diagram, Electrostatic focusing, Electrostatic deflection, post deflection acceleration, Screen for CRTs, Graticule, Vertical & Horizontal deflection system, Time base circuit, Oscilloscope probes and transducers, Attenuators, Application of CROs, Lissajous patterns, Special purpose CROsMulti input, Dual trace, Dual beam, Sampling, Storage (Analog & Digital) Oscilloscopes.

Unit-II

R, L, C Measurement: Bridges: Measurement of resistance using Measurement of inductance and capacitance by A.C. bridges: Maxwell's bridge, Anderson bridge, Schering bridge, Hay'sbridge, Wein's bridge, Shielding and grounding, Q meter.

Unit-III

NonElectrical Quantities (Transducer): Classification of Transducers, Strain gauge, Displacement Transducer Linear Variable Differential Transformer (LVDT) and Rotary Variable Differential Transformer (RVDT), Temperature Transducer Resistance Temperature Detector (RTD), Thermistor, Thermocouple, Piezoelectric transducer, Photo emissive, Photo conductive, Photo voltaic, Photodiode, Photo Transistor, Nuclear Radiation Detector.

Unit-IV

Digital instruments: Advantages of digital instruments, Over analog instruments, DA, AD conversion, Digital voltmeter, Ramp type DVM, Integrating DVM, successive approximation DVM,frequency meter. Display devices: Digital display system and indicators like CRT, LED, LCD, Nixies, Electro luminescent, Incandescent, Electrophoretic image display, Liquid vapour display dotmatrix display, Analog recorders, XY recorders. Instruments used in computer controlled instrumentation RS 232C and IEEE 488, GPIB electric interface.

Unit-V

Signal generator: Function generator, sweep frequency generator, Pulse and square wave generator, Wave Analysers, Harmonic Distortion Analyser, Spectrum Analyser, frequency counter.

References Books:

1. John P. Bentley : Principles of measurement systems, Longman 1983
2. Johnson C.D: Process control instrumentation technology, 4/e, PHI, 1995
3. D.Patranabis : Principles of Industrial Instrumentation, Tata McGraw Hill Publishing Ltd. New Delhi, 1999
4. Sheingold D. H.: Transducer interfacing hand book – a guide to analog signal

conditioning, analog devices Inc masschusetts, 1980.
5. Anderson N A : Instrumentation for process measurement and control :Chilton book company 1980.
6. H. S. Kalsi: Electronics Instrumentation, TMH.
7. K. Sawhney: Instrumentation and Measurements, Dhanpat Rai and Co.
8. Helfric and Cooper: Modern Electronic Instrumentation and Measurement Techniques; Pearson.

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New Scheme Based On AICTE Flexible Curricula

Electrical Engineering, V-Semester

Departmental Elective EE- 503 (C) Electrical Engg. Material

Unit-I

Conducting Material: Classification and main properties, High resistivity alloy: ConstantMangann,Nichrome, Electrochemical, properties of copper, Aluminum, steel tungsten, Molybdenum,Platinum, Tantalum, Niobium, Mercurry, Nickel, Titanum, Carbon, Lead, thermal, Bitmetals,thermocouple,materials, specific resistance, conductance, variation of resistance with temperature, super conductors.

Unit-II

Semi-Conductor Materials: General conception, variation of electrical conductivity, Elementshaving semiconductor properties, general application, hall effect, energy levels, conduction insemiconductors, Intrinsic conduction, impurity conduction, P and N type impurities, electrical change,Neutrality, Drift, Mobility current flow in semiconductors P-N junction formation by alloying, Elasing(forward and reverse) of P-n junction, Reverse separation current, Zener effect, Junction,capacitance, hall defects and hall coefficient.

Unit-III

Magnetic Materials: Details of magnetic materials, reduction between B.H. and , soft and hardmagnetic materials. Di-magnetic, Para magnetic and Ferromagnetic materials, electrical sheet steel,cast iron. Permanent magnetic materials. Dynamic and static hysteresis loop. Hysteresis loss, eddycurrent loss, Magnetisation, magnetic susceptibility, coercive force, core temperature, rectangularhysteresis loop, Magnet rest square loop core materials, iron silicon, Iron alloys

Unit-IV

Insulating Materials: General electrical mechanical and chemical properties of insulatingmaterial, Electrical characteristics volume and surface resistivity complex permitivity loss, anddielectric loss, equivalent circuits of an imperfect dielectric polarization and polarizability classification of dielectric.

Unit-V

Mechanical Properties: Classification insulating materials on the basis of temperature rise. Generalproperties of transformer oil, commonly used varnishes, solidifying insulating materials, resins,bituminous waxes, drying oils, Fibrous insulating materials, wood, paper and cardboard, insulatingtextiles, varnished adhesive tapes, inorganic fibrous material and other insulating materials, such asmica, ceramic, bakelite, ebonite, glass, PVC, rubber, other plastic molded materials.

REFERENCE BOOKS

1. TTTI Madras; Electrical Engineering Materials; TMH.
2. Electrical Engineering Material s & Devices; John Allison ;TMH
3. Materials for Electrical Engineering: B.M. Tareev
4. Anderson; Di-Electrics :
5. Kortisky; Electrical Engineering Materials:
6. Indulkar and S. Thruvengadem; Electrical Engineering Materials; S. Chand
7. Dekkor AK; Electrical Engineering Materials; PHI

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL

New Scheme Based On AICTE Flexible Curricula

Electrical Engineering, V-Semester

Open Elective EE- 504 (A) Industrial Electronics

Unit-I

Power supply, rectifiers (half wave, full wave), performance parameters of power supplies, filters (capacitor,inductor, inductor-capacitor, pi filter), bleeder resistor, voltage multipliers .Regulated power supplies (series and shunt voltage regulators, fixed and adjustable voltage regulators,current regulator), switched regulator (SMPS), comparison of linear and switched power supply, switchmode converter (flyback, buck, boost, buk-boost, cuk converters).

Unit-II

Silicon controlled rectifies (SCR), constructional features, principle of operation, SCR terminology, turn-onmethods, turn-off methods, triggering methods of SCR circuits, types of commutation, comparison ofthyristors and transistors, thermal characteristics of SCR, causes of damage to SCR, SCR overvoltageprotection circuit, Line commutated converters (half wave rectifier withinductive and resistive load, single phase and three phase full wave rectifiers).

Unit-III

Other members of SCR familyTriacs, Diacs, Quadracs, recovery characteristics, fast recovery diodes, power diodes, power transistor,power MOSFET, Insulated gate bipolar transistor (IGBT), loss of power in semiconductor devices,comparison between power MOSFET, power transistor and power IGBT.

Unit-IV

Applications of OP-AMPBasics of OP-AMP, relaxation oscillator, window comparator, Op-comp as rectangular to triangular pulseconverter and vice- versa, Wien bridge oscillator, function generator, frequency response of OP-AMP,simplified circuit diagram of OP-AMP, power supplies using OP-AMP, filters (low-pass, high pass) using OP-AMP

Unit-V

Programmable Logic Controller (PLC)Functions, applications, advantages and disadvantages of PLC over conventional relay controllers,comparison of PLC with process control computer system, factors to be considered in selecting PLC,functional block diagram of PLC, microprocessor in PLC, memory, input and output modules (interfacecards), sequence of operations in a PLC, status of PLC, event driven device, ladder logic language, simpleprocess control applications of PLC, Programming examples..

REFERENCE BOOKS

1. Bishwanath Paul: Industrial Electronics and control, PHI Learning.
2. Rashid: Power Electronics- Circuits, devices and applications, Pearson Education.
3. Singh and Khanchandani: Power Electronics, TMH
4. Bhimbra: Power Electronics, Khanna Publishers.
5. Moorthi: Power Electronics, Oxford University Press.
6. Webb: Programmable Logic Controllers- Principles and Applications, PHI Learning.

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL

New Scheme Based On AICTE Flexible Curricula

Electrical Engineering, V-Semester

Open Elective EE- 504 (B) Signal and system

COURSE OBJECTIVE

This course introduces students about the signals and systems mathematically and understands how to perform mathematical operations on them.

COURSE CONTENT

Classification of signals and systems: Continuous time signals (CT signals), Discrete time signals (DT signals) - Step, ramp, pulse, impulse, sinusoidal and exponential signals, basic operations on signals, classifications of CT and DT signals- Periodic and aperiodic signals, energy and power signals, random signals, CT systems and DT systems, basic properties of systems, basic properties of systems, linear time invariant systems and properties.

Analysis of continuous time signals: Time and frequency domain analysis, Fourier series analysis, spectrum of CT signals, Fourier transform and Laplace transform, region of convergence, wavelet transform.

Linear time invariant continuous time systems: Differential equations representation, block diagram representation, state variable representation and matrix representation of systems, impulse response, step response, frequency response, relizability of systems, analog filters.

Analysis of discrete time signals: Convolution sum and properties, sampling of CT signals and aliasing, DTFT and properties, Z transform and properties, inverse Z transform.

Linear time invariant discrete time systems: Difference equations, block diagram representation, impulse response, analysis of DT LTI systems using DTFT and Z transform, state variable equations and matrix representation of systems, Digital filters.

COURSE OUTCOME

Student after successful completion of course must possess an Understanding of various signals and systems properties and be able to identify whether a given system exhibits these properties and its implication for practical systems.

EVALUATION

Evaluation will be continuous an integral part of the class as well through external assessment.

REFERENCES

1. Alan V. Oppenheim, Alan S. Willsky, S Hamid Nawab, ‘Signals and Systems’, 2nd edition 2015 Pearson New International Edition
2. A. Anand Kumar, Signals and Systems, PHI, III edition, 2015
3. Mahmood Nahvi, Signals and Systems, McGraw Hill
4. Simon Haykins and Barry Van Veen, Signals and Systems, Wiley India
5. A. Nagoor Kani; ‘Signals and Systems’ McGraw Hill
6. Robert A. Gabel and Richard A.Roberts, Signals & Linear Systems, Wiley.
7. Rodger E. Ziemer, William H. Tranter, D. Ronald Fannin. Signals & systems, Pearson Education.

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL

New Scheme Based On AICTE Flexible Curricula

Electrical Engineering, V-Semester

Open Elective EE- 504 (C) Digital Control System

COURSE CONTENTS

UNIT I

Introduction to Discrete Time Control System Basic building blocks of Discrete time Control system, Sampling Theorem, Z transform and Inverse Z transform for applications for solving differential equations, Mapping between the S-plane and the Z plane, Impulse sampling and Data Hold.

UNIT II

Pulse Transfer Function and Digital PID Controllers The pulse transfer function, pulse transfer function of Closed Loop systems, Pulse transfer function of Digital PID controller, Velocity & Position forms of Digital PID Controller, Realization of Digital Controllers, Deadbeat response and ringing of poles

UNIT III

Design of Discrete Time Control System by conventional methods Stability analysis in Z-plane, Jury stability criterion, bilinear transformations, Design based on the root locus method, Digital Controller Design using Analytical Design Method.

UNIT IV

State Space Analysis of Discrete Time Control System State space representation of discrete time systems, Solution of discrete time state space equations, Pulse transfer function matrix, Eigen Values, Eigen Vectors and Matrix Diagonalization, Discretization of continuous time state space equations, Similarity transformations.

UNIT V

Pole Placement and Observer Design Concept of Controllability and Observability, Useful transformations in state space analysis and design, Stability improvement by state feedback, Design via pole placement, State observers. Optimal Control Quadratic Optimal Control and Quadratic performance index, Optimal state regulator through the matrix riccati equations, Steady State Quadratic Optimal Control.

Reference Books:

1. Discrete Time Control systems by K. Ogata, Prentice Hall, Second Edition.

2. Digital Control and State Variable Methods by M. Gopal, Tata McGraw Hill.

3. B. C. Kuo, Digital Control Systems, Oxford University Press, 2/e, Indian Edition

4. Digital control of Dynamic Systems by G.F.Franklin, J.David Powell, Michael Workman 3rd Edition, Addison Wesley .

5. Digital Control Engineering by M. Gopal, Wiley Eastern Ltd.

6. Digital Control by Kannan Moudgalya, John Wiley and Sons.

7. Digital Control Systems by Contantine H. Houpis and Gary B. Lamont, Second Edition, McGraw-Hill International.

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New Scheme Based On AICTE Flexible Curricula

Electrical Engineering, V-Semester

EE506 MATLAB

MATLAB

Basic simulation Mechanism and Simulation Tools, Starting and Ending MATLAB, MATLAB Desktop, Help Browser, Types of Files, Command Input Assistance, Operators and Special Characters, Variables and Arrays, Handling Arrays, Useful Built-in Functions, Control Structures, Input/Output Commands, File Handling

Introduction to Plotting

The plot command, Formatting and Labeling a Plot, Multiple Plots, Adding Legend, Sub Plots, Plotting Complex Data, 2-D and 3-D Plots, Plotting a Function, Plot Editor, Interactive Plotting using Plotting Tool

Programming in MATLAB

MATLAB Editor, MATLAB Programming, Debugging MATLAB Programs, MATLAB Debugger, Functions and Function Files, Differential Equation Solver, Symbolic Mathematics, Programming Examples

Basic Electrical and Networks Applications

Analysis of Electrical Networks – Experiments based on Solution of Series-Parallel Circuits, Solution of system with linear equations - Experiments based on mesh and nodal analysis, Experiments for Validation of Network Theorems, Solution of Network Problems.

REFERENCE BOOKS

1. “Modelling And Simulation Using Matlab- Simulink”,2011Dr Shailendra Jain, Willey India.
2. “MatlabProgramming”,Rudra prasad.