

MEDI - 101 ADVANCED MATHEMATICS

UNIT I

Solution of Partial Differential Equation (PDE) by separation of variable method, numerical solution of PDE (Laplace, Poisson's, Parabola) using finite difference methods.

UNIT II

FT, DFT, Wavelet transform, Haar transform, their properties and applications.

UNIT III

Probability, compound probability and discrete random variable. Binomial, Normal and Poisson's distributions, Sampling distribution, elementary concept of estimation and theory of hypothesis, recurrence relations.

UNIT IV

Stochastic process, Markov process transition probability transition probability matrix, just and higher order Markov process, Markov chain.

UNIT V

Queuing system, transient and steady state, traffic intensity, distribution queuing system, concepts of queuing models (M/M/1: Infinity/ Infinity/ FC FS), (M/M/1: N/ Infinity/ FC FS), (M/M/S: Infinity/ Infinity/ FC FS)

Reference Books:

1. Higher Engineering Mathematics by B.V. Ramana, Tata Mc Hill.
2. Advance Engineering Mathematics by Ervin Kreszig, Wiley Eastern Edd.
3. Applied Numerical Methods with MATLAB by Steven C Chapra, TMH.
4. Introductory Methods of Numerical Analysis by S.S. Shastri,
5. Introduction of Numerical Analysis by Forberg
6. Numerical Solution of Differential Equation by M. K. Jain
7. Numerical Mathematical Analysis By James B. Scarborough
8. Fourier Transforms by J. N. Sheddon
9. Fuzzy Logic in Engineering by T. J. Ross
10. Fuzzy Sets Theory & its Applications by H. J. Zimmersoms

MEDI - 102 ADVANCE CONTROL SYSTEM

UNIT I

Review of basic control systems; Modelling of dynamics in state space; Eigen-values and eigen-vectors; Modal transformation; State transition matrix and its computation; Solution of closed loop dynamics in state space.

UNIT II

State feedback; Response due to step reference input; State solution with examples; Stabilisability and pole placement; Stabilisability of higher order systems.

UNIT III

Controllability and observability; Minimal polynomial; Stability in the sense of Lyapunov, Routh-Hurwitz stability analysis; Nyquist stability analysis; Jury's stability test.

UNIT IV

Types of nonlinear elements – ideal relay, saturation, ideal relay with dead zone, saturation with dead zone, hysteresis; Describing function; Determination of describing functions of these nonlinear elements; Stability analysis of closed loop systems having nonlinear element and a linear transfer function block in the forward block, by using Nyquist method; Limit cycles; Phase plane trajectory of linear second order systems; Concepts; Phase plane trajectory of the closed loop systems having nonlinear element and a linear transfer function block in the forward block.

UNIT V

Discretisation of continuous-time state dynamics, pole placement via state feedback, stabilisability of discrete-time state dynamics, multi-rate sampling and corresponding response of closed loop state dynamics.

References:

1. Digital Control Systems – B. C. Kuo, Oxford University Press, 1992.
2. Discrete-time Control Systems – K. Ogata, Prentice-Hall, 1987.
3. Analysis and Design of Nonlinear Feedback Control Systems – George J. Thaler and Marvin P. Pastel, McGraw-Hill, New York, 1962.
4. State Functions and Linear Systems – Donald G. Schultz and James L. Melsa, McGraw-Hill Education, 1967.
5. Linear System Theory and Design – Chi-Tsong Chen, Oxford University Press, New York, 1999.

MEDI - 103 DIGITAL INSTRUMENTATION & TECHNIQUES

UNIT I

Principles and Design of Digital Instruments : Digital voltmeters, Electronic counters, Frequency synthesizers, Wave analyzers, Spectrum analyzers, Sweep waveform generators and pulse generators, Lock-in amplifiers, Q-meters, High frequency impedance bridges, Ground loops, Electromagnetic and static pick-up, Interference, Shielding and grounding, Floating voltage measurements; Common signals and their effects.

UNIT II

Digital transducers: Construction –Operation and features of digital transducers – Digital displacement transducer –Frequency domain transducers – Digital encoder- Magnetic encoder- Digital pots and tachometers- Transducer oscillators – Rotational displacement transducer- Introduction to fibre optic transducers- Eddy current transducers – Photo resistor-Pyro electric radiation detectors.

UNIT- III

Sweep generators, Sweep modes, Storage oscilloscopes types, Erasing methods, Sampling oscilloscopes synchronous and random sampling, Time domain reflectometry, Logic state analyzers and their applications.

UNIT – IV

Display devices- Classification of displays- LED's in direct and indirect band gap materials- Typical uses of LED's- Liquid Crystal Displays- Theory of LCD operation-Typical uses of LCD's, Solid state CRT Displays., TFT, Plasma & Vapour Displays.

Recorders:- Strip chart recorders - Galvanometric recorders- Null type recorder-Circular chart recorder-X-Y recorder-UV recorder- Magnetic recorder-Direct recording- FM recording-Digital data recorders- Digital memory waveform recorder(DWR)- Electro mechanical recorders. Servo magnetic.

UNIT- V

Data Acquisition system, Introduction, Principles, design and need for data acquisition systems, Digital to Analog converters, Analog to Digital Converter, Logarithmic types of ADCs, Typical study of monolithic DACs and ADCs, Evolution of PLCs- architecture and Hardware – Functional blocks – symbols-PLC programming – relay logic – Ladder diagram –Timers – counters. Common Instrument Interfaces – RS422A, RS485A, USB, GPIB, I²C, HART, CAN, DeviceNet, BACNet, SCPI. Microprocessor & PC based data acquisition systems.

Text Books:

T. S. Rathore, Digital Measurement Techniques, 2nd ed., Narosa Publishing House, New Delhi,

B.M. Oliver and J.M. Cage, ELECTRONIC MEASUREMENTS AND INSTRUMENTATION Kogakusha-McGraw Hill.

D.G. Hoeschele 'A to D and D to A conversion techniques' Wiley

B.S. Sonde, Transducers and display systems, Tata McGraw Hill, New Delhi 1979.

H. R. Taylor, *Data Acquisition for Sensor Systems*, Chapman & Hall, London, 1992

MEDI - 104 INDUSTRIAL & PROCESS INSTRUMENTATION

UNIT-I

Instrumentation in Hazardous locations: Area, material & temperature classification. Explosion proof enclosures, intrinsic safety, pressurization, non incendive systems. Combustible gas detectors. Enclosure classification - IP & NEMA standards.

UNIT-II

Temperature measurement: Temperature scales, ITS90, temperature calibrators and simulators, thermowell. Different types of thermometers: liquid in glass, bimetal, filled system, thermocouple, RTD, thermistors, IC temperature sensors, radiation thermometers, temperature switches, thermostats.

UNIT-III

Level measurement: Review of different level measurement methods and application considerations. Various level measurement devices: gauge glass, float & displacer type level sensors, D/P type level sensors, capacitive level sensors, ultrasonic & microwave level sensors, tape level gauges, servo level gauges, hydrostatic tank gauging systems, conductivity level sensors, radiation level sensors, vibrating level switches.

UNIT-IV

Flow measurement: Fluid properties, turbulent & laminar flow, Reynolds number, velocity profile, flow conditioners, influence of pressure & temperature on volume flow-rate, flow computers, totalization, flow calibration.

Different flow measurement techniques: differential pressure flowmeters, variable area flowmeters, magnetic flowmeter, mass flowmeter - Coriolis & thermal types, vortex shedding flowmeter, positive displacement flowmeter, turbine flowmeter, ultrasonic flowmeter, target flowmeter, insertion flowmeter, open channel flow measurement, , Criteria for selection of flowmeters.

UNIT-V

Smart transmitters - features & advantages, HART protocol.
Overview of sensor- actuator networks, field bus.

Some Suggested Textbooks/ Reference books:

1. H.N. Norton ,“Handbook of Transducers”
2. Principle of industrial Instrumentation – Patranabis
3. E.O. Doebelin ,“Measurement Systems Applications and Design”
4. DVS Murthy , “Transducers and Instrumentation”
5. Nakra and Chaudhary, “Instrumentation Measurement and Analysis”
6. Process Measurement and analysis - B.G. Liptak (Vol-I)
7. Electronic Instruments and Measurement - A. K. Sawhney
8. Instrumentation by D.S.Kumar.

MEDI - 105 ACTIVE & PASSIVE NETWORK SYNTHESIS

Unit - I

Introduction to circuit elements

R,L,C and their characteristics in terms of linearity & time dependant nature, voltage & current sources controlled & uncontrolled sources KCL and KVL analysis, Nodal & mesh analysis, analysis of magnetically coupled circuits, Transient analysis :- Transients in RL, RC & RLC Circuits, initial conditions, time constants.

Unit- II

Driving point synthesis, Camer & Foster methods. Transfer function synthesis (Bolt Duffion method)

Unit – III Filter approximations

Filter characteristics- Butterworth, Chebyshev & Bessel filters

Unit-IV Active filter classifications

Realisation using VCVS, NIC, INIC & impedance converter & inverter network using op-amps & discrete components, Tunable filters. Sensitivity analysis for op-amp based filters using R-C networks

Unit-V Computer Techniques

Design of active and passive filters using Spice, Microcap EDA tools.

Recommended Text:

RC Network Synthesis – Huelsman - S. K. Mitra

Network Synthesis – Van Valkenberg

Passive and Active Network Analysis and Synthesis, Budak, Aram, Waveland

Lindquist: Active Network Design: Steward and Sons 1977