Jorhat Institute of Science and Technology

5th Semester B.E (ETC & PEI)

AUTOMATIC CONTROL SYSTEMS

L-3 T-1 P-4

Theory : 100
Sessional : 50
Practical:50

1) **INTRODUCTION :** Concept of automatic control systems-classifications- open loop and closed loop systems, linear and non linear systems, continuous and discrete time systems, SISO and MIMO systems, time-invariant and time varying systems, servo systems and automatic regulating systems, adaptive control systems.
2) **MATHEMATICAL MODELLING OF PHYSICAL SYSTEMS:** Differential equations and transfer function - mathematical model of electrical- mechanical and electro mechanical systems-Analogous systems. Block diagram representation of physical systems- BD reduction techniques-Signal flow graph(SFG)- definition, terminology, SFG representation of physical systems, Mason's Gain formula-BD reduction using SFG techniques
3) **TIME RESPONSE:** Time response – Time domain specifications – Types of test input signals – Ist and IInd order system response – Error coefficients – Generalized error series – Steady state error – P, PI, PID modes of feed back control.
4) **FREQUENCY RESPONSE ANALYSIS:** Frequency Response - Bode Plot, Polar Plot, Nyquist Plot - Correlation between frequency domain and time domain specifications-Frequency Domain specifications from the plots - Constant M and N Circles - Nichol's Chart.
5) **STABILITY ANALYSIS:** Characteristics equation – Location of roots in S-plane for stability – Routh Hurwitz criterion – Root locus method – Angle and magnitude conditions, construction of complete root locus, stability analysis -Effect of addition of pole, zero – Relative Stability -Gain margin and phase margin – Nyquist stability criterion.
6) **COMPENSATOR DESIGN:** Performance criteria – Lag, lead and lag-lead networks – Compensator design using Root locus and Bode plots methods.
7) **STATE VARIABLE METHOD OF SYSTEM ANALYSIS**: Concept of state and state variables-State model-State-space representation of physical systems-BD representation-state transition matrix and its properties-Relation between state equation and transfer function-Solution of state equation-Characteristic equation-Eigen values & eigen vectors-Concept of controllability and observability of linear systems.
8) **CONTROL SYSTEM COMPONENTS**: Potentiometer, Synchros, DC and AC servomotors, Rotating amplifier, Stepper motor, Tachogenerators.

Text/ Ref. Books:

1) Ogata K-Modern Control Engineering (PHI).
2) Nagrath I J&Gopal M-Control System Engg.
3) Kuo B C-Automatic Control Systems (PHI).
4) Distefano-Feedback and Control Systems(Schaum Series) McGrow Hill
5) S. Ghosh –Control Systems (Pearson Education).
6) M.Gopal – Control Systems –Principles & Design (TMH)

COMPUTER ARCHITECTURE AND ORGANISATION

L-3 T-1 P-0

Theory : 100
Sessional : 50

UNIT 1: **Introduction:** Block Diagram of Computer System, Instruction Execution Model.

UNIT 2: **General System Architecture:** Store program control concept, Flynn's classification of computers (SISD, MISD, MIMD), Multilevel viewpoint of a machine: digital logic, micro architecture, ISA, operating system, high level language; structured organization; CPU, caches, main memory, secondary memory units and I/O, Performance metrices; MIPS, MFLOPS.

UNIT 3: **Instruction Set Architecture:** Instruction set based classification of processors (CISC and RISC architecture and their comparison); addressing modes; register, immediate, direct, indirect, indexed; Operations in instruction set; Arithmetic and Logical, Data Transfer, Control Flow; Instruction set formats (fixed, variable, hybrid); Language of the machine: 8085/8086; Assembly language programming (simulation using MSAM).

UNIT 4: **Basic non pipelined CPU Architecture:** CPU Architecture types (accumulator, register, stack, memory/register) detailed data path of a typical register based CPU, Fetch-Decode-Execution cycle (typically 3 to 5 stage); microinstruction sequencing, implementation of control unit, DMA, Interrupt and DMA mechanisms and controllers, Enhancing performance with pipelining.

UNIT 5: **Memory Hierarchy & I/O Techniques:** The need for a memory hierarchy (Locality of reference principle, Memory hierarchy in practice; Cache main and secondary memory. Memory parameters access/cycle time, cost per bit); Main Memory (Semiconductor RAM & ROM organization, memory expansion, Static & Dynamic memory types); Cache memory (Associative & direct mapped cache organizations, performance). Memory management unit (MMU), memory interleaving.

UNIT 6: **Introduction to parallelism:** Goals of parallelism (Exploitation of concurrency, throughput enhancement); Amdahl's law; instruction level parallelism (pipelining, super scaling-basic features); Processor level parallelism (Multiprocessor systems overview).

UNIT 7: **Computer Organizations: Processors Architectures:** Introduction to Vector processors, Array processors, Multiprocessors, Multiprocessors Architectures: Functional structures- loosely coupled and tightly coupled, multiprocessor interconnected networks, process definition, inter-process communication mechanisms, system deadlock and preventions, multiprocessor scheduling algorithms, parallel algorithms for multiprocessor- synchronous and asynchronous.

Text Books/ Reference:

1. Computer Organization and Design, by David A. Patterson and John L. Hennessy, Morgan 1997, Kauffmann.
2. Computer Architecture and Organization, 3rd Ed., by John P. Hayes, TMH.
1. Operating Systems Internals and Design Principles by William Stalling, Prentice Hall.
2. Computer Organization 5th Ed., by Carl Hamacher, Zvonko Vranesic, 2002, Safwat Zaky.
3. Mano M.M., Computer System Architecture, PHI (EEE).
4. Structured Computer Organization by A.S. Tanenbaum, 4th Ed., PHI.

ELECTROMAGNETIC FIELD THEORY

L-3 T-1 P-0

Theory : 100

Sessional : 50

1. **Vector Analysis :** Scalar & vector field; Vector algebra; Vector calculus – gradient, divergence and curl of a vector; Cartesian , Cylindrical and Spherical systems of vectors; Transformation between vectors; Line & surface integral; Divergence theorem; Stokes theorem and Green's theorem.
2. **Static Electric Fields:** Fundamental postulates of Electrostatics, Coulomb's Law, electric field & field intensity, electric flux & flux density, Gauss's law with application, boundary conditions, capacitance & capacitors, electrostatic energy, Laplace's & Poisson's equations, uniqueness of electrostatic solutions, method of images, solution of boundary value problems in different coordinate systems. Steady Electric Current: Current density and ohm's law, EMF and Kirchoff's voltage law, continuity equation and Kirchoff's current law, Power dissipation and Joule's law, Boundary conditions.
3. **Static Magnetic Fields**: Fundamental Postulates, Vector magnetic potential, Biot-Savart Law and Application; Ampere's circuital law; Magnetic dipole, Behavior of magnetic materials, Boundary conditions, Inductances and inductors, Energy in magnetic field..
4. **Time varying Fields & Maxwell's Equation**: Faraday's law of electromagnetic induction, Maxwell's equations, Eelectromagnetic boundary conditions, Wave equations and their solutions, Time harmonic fields.
5. **Electromagnetic Waves**: Plane wave in lossless media, Plane waves in lossy media, Poynting vector and power flow in electro magnetic field, Wave polarization, Retarded potential; Standing wave ratio; Plane wave reflection from a media interface.
6. **Antennas and Radiating systems**: Fundamentals of radiation, radiation field of an elemental dipole, antenna pattern and antenna parameters, thin linear wire antennas, loop antennas, basics of antenna arrays, aperture antennas.

Text/Reference Books :

1) Introduction to Electrodynamics - J. Griffiths (PHI)
2) Engineering Electromagnetics – W.H.Hayt (TMH)
3) Fields and Waves in Communication Electronics - S. Ramo, J. R. Whinnery and T. V. Duzer (John Wiley)
4) Elements of Electromagnetic Fields – S.P Seth (Dhan Pat Rai)
5) Electromagnetics – Joseph A Edminister (Schaum's Series)
6) Basic Electromagnetics with Applications – N.N.Rao (PHI)
7) Field and Wave Electromagnetics - David K. Cheng (Pearson)
8) Introduction to Electromagnetic Field and Waves – Dale Carson & Paul
9) Antennas- J. D. Kraus (McGraw-Hill)

MATHEMATICS-V

L-3 T-1 P-0

Theory : 100
Sessional : 50

Group A: Numerical Analysis (40 Marks)

1. **Interpolation**: Finite difference. Newton Grogory forwards and backward interpolation, Newton's and Lagranges formulae for unequal intervals, Stirling ande Bessels interpolation formulae.

2. **Numerical differentiation and Integration:** Numerical differentiation , Trapezoidal and Simpson's rule for Numerical Integration

3. **Solution of Ordinary differential equations**; Taylor's series, Range- Kuta (4^{th} Order) and Milne's predicator-corrector method.

4. **Solution of Transcendental and Polynomial Equations**: Bisection Jule-Fabi and Newton- Rap son's methods.

5. **Solution of simultaneous linear equations:** Gauss elimination and Gauss- Seidal Iterative method.

GROUP B: Linear Algebra and Complex Variables (60 Marks)

1. Definition and examples of vector space, Vector subspace, Basis and dimension of vector space, Theorems, Quotient space.
2. Linear transformation, Representation of Linear transformations by matrices, Kernel and image of Linear transformation, Linear functional, Rank and nullity of linear transformation, Linear operator, Eigen values and Eigen vectors of linear operator.
3. Normal linear space and Banch spaces, Continuous linear transformations, Inner product, Hilbert space, Orthogonal components, Orthogonal sets.
4. Functions of Complex Variables, Elementary functions, Analytic functions. Cauchy-Rieman equations. Harmonic functions and their applications to two dimensional problems.
5. Conformal transformation, complex line integral, Cauchy- Goursat theorem, Cauchy Integral formula, Liouville's theorem, Taylor's and Laurent's series, singularities, Residue theorem and applications.

ELECTRICAL AND ELECTRONIC MEASUREMENT-I

L-3 T-1 P-2

Theory:100
Sessional : 50

Practical-25

1. **INTRODUCTION:** Concept of measurement, basic characteristics of measuring devices, error analysis, standards and calibration, performance characteristics of instrumentation system, system performance measurement, systems linearity and distortion.
2. **ANALOG INSTRUMENTS**: Construction, principle of operation, scale shape, uses, errors and compensation of Moving coil, Moving iron, Electrodynamic, Rectifier, Thermocouple and Electrostatic instruments for Current, Voltage and Power measurement. Induction Type energy mete, Energy meter errors, adjustment and testing
3. **SPECIAL TYPE OF METERS:** Construction and working principle of Frequency meter, Synchroscope, Power factor meter and Megger.
4. **CATHOD RAY OSCILLOSCOPE:** Block diagram representation ; Cathode ray tube ; Vertical and Horizontal deflection systems ; Delay line ; Multiple trace ; CRO probe & transducers ; Measurement of voltage, current, phase & frequency by CRO ; Storage Oscilloscope.
5. **ELECTRONIC INSTRUMENTS:** (a) Electronic Voltmeters: Advantage & disadvantages of using electronic voltmeters ; Different stages in AC & DC electronic voltmeters ; Balanced bridge voltmeter ; Principle and circuit diagrams for average responding, peak responding & RMS responding voltmeters.(b) Digital Voltmeters: Classification of digital voltmeters ; Principle, block diagram and signal wave form of ramp type, stair case ramp type and integrating type digital voltmeters. (c) Electronic Multimeters, Q-meter.
6. **SIGNALGENERATORS & ANALYZERS:** Sine wave generators, Frequency synthesized signal generators, Sweep frequency generators; **Signal Analyzers -** Measurement Technique, Wave Analyzers, Harmonic distortion analyzer, Spectrum analyzer.
7. **RECORDERS:** Different types of recorders ; Construction, working principle and circuit diagrams of potentiometric Strip- chart recorder , X-Y recorder and dot-matrix recorder; Magnetic recorder and digital tape recording.

Texts/References:

1. Sawhney A.K., "A course in Electrical and Electronic Measurement and Instrumentation", Dhanpat Rai and sons, New Delhi, 2003.
2. D. Helfrick and W. D. Cooper, Modern Electronic Instrumentation and Measuring Techniques. Prentice-Hall of India, 1990
3. Kalsi H.S., "Electronic Instrumentation", Second Edition, Tata Mc Graw Hill Company New Delhi, 2004.
4. B. M. Oliver and J. M. Cage, Electronic Measurements and Instrumentation. McGraw-Hill, 1975
5. Gupta J.B., "A course in Electrical and Electronic Measurement and Instrumentation", 12th Edition, Katson Publishing House, 2003.
6. E.W. Golding & F.C Widdis – Electrical Measurement and Measuring Instruments.

INDUSTRIAL INSTRUMENTATION

L-3 T-1 P-2

Theory : 100
Practical: 25
Sessional : 50

1. MEASUREMENT OF FORCE, TORQUE AND VELOCITY: Electric balance – Different types of load cells – Hydraulic, pneumatic strain gauge-Magneto elastic and Piezo electric load cell – Different methods of torque measurements: strain gauge-Relative angular twist-Speed measurement:-Capacitive tacho- Dragcup type tacho-D.C and A.C tachogenerators – Stroboscope.

2. MEASUREMENT OF ACCELERATION AND VIBRATION : Accelerometers:- LVDT, Piezo-electric, Strain gauge and Variable reluctance type accelerometer – Mechanical type vibration instruments – Seismic instruments as an accelerometer – Vibrometers : Calibration of vibration pickups

3. PRESSURE MEASUREMENT: Units of pressure-Manometers-Different types –Elastic type pressure gauges: Bourdon tube, bellows and diaphragms-Electrical methods: Elastic elements with LVDT and strain gauges –Capacitive type pressure gauge –Piezo-resistive pressure sensor-Resonator pressure sensor-Measurement of vacuum:-McLeod gauge- Pirani gauge -Thermal conductivity gauges- Ionization gauges:– Cold cathode type and hot cathode type-Testing and calibration of pressure gauges-Dead weight tester.

4. TEMPERATURE MEASUREMENT: Definitions and standards & Calibration, Liquid in glass thermometers - Sources of errors and their compensation-Bimetallic thermometers – Electrical methods of temperature measurement-Signal conditioning of industrial RTDs and their characteristics-3 lead and 4 lead RTDs -Thermistors. Thermocouples-Laws of thermocouple –Fabrication of industrial thermocouples –Signal conditioning of thermocouple output- Commercial circuits for cold junction compensation-Response of thermocouple –Special techniques for measuring high temperature using thermocouples – Radiation methods of temperature measurement –- Radiation pyrometers-Optical pyrometers- Fiber optic temperature measurement.

5. FLOW AND LEVEL MEASUREMENT: Differential pressure flow meters: Bernoulli's theorem: pitut tube orifice, vanturi, flow nozzle, Hot wire anemometers, constant pressure drop, variable area-meters (rotameter), turbine meters, Electromagnetic flow meters, Ultrasonic flow meters Flow meters for solid materials; Measurement of level- Float type gauge, purge method, differential pressure method, conductive and capacitive method; electromechanical method, radiation level sensors, level transmitter, ultrasonic level detector.

TEXT BOOKS

1. Doebelin, E.O., "Measurement systems Application and Design", International Student Edition, 5th Edition, McGraw Hill Book Company,2004.
2. Patranabis,D., "Principles of Industrial Instrumentation", 2nd Edition, Tata McGraw Hill Publishing Company Ltd., New Delhi, 1999.
3. K.Krishnaswamy- Industrial Instrumentation (New Age)
4. Eckman D.P – Industrial Instrumentation (WE)
5. Alok Barua- Industrial Instrumentation(JW)

REFERENCE BOOKS:

1. Liptak, B.G., "Instrumentation Engineers Handbook (Measurement)", CRC Press, 2005
2. Nakra, B.C and Chaudry, K.K., "Instrumentation measurement and Analysis", TMH
3. Beckwith & Beck, "Mechanical Measurements", Narosa Publishers