IN 1101 ENGINEERING MATHEMATICS I

Module I

Co-ordinate geometry of two dimensions: Standard equations of parabola, Ellipse and hyperbola, their parametric representations, equations of tangents and normals to these curves, simple properties of these curves, asymptotes of a hyperbola, rectangular hyperbola.

Module II

Co-ordinate geometry of three dimensions: Direction cosiness, planes and straight lines, shortest distance between two skew lines, sphere, cone, right circular cylinder.

Module III

Continuity and differentiability of functions of one variable:

Roll's theorem Mean value theorem, Cauchy's theorem, L' Hospitals rule for the evaluation of limits of indeterminate forms. Theory of algebraic equations: relations between roots and coefficients of an equation, transformations of equations, Descarte's rule of signs.

Module IV

Functions of two or more variables: Partial differentiation, Euler's theorem for homogeneous function, differentials and their applications, applications in errors and approximations, Jacobians. Maximum minima of functions of two variables (Proof of result not required).

Module V

Definite integrals: Applications of definite integrals in the evaluation of areas, area of surface of revolution, volumes, moment of inertia, length of are, position of center of mass.

Multiple integrals: Evaluation of double and triple integrals, volumes and surface areas of solids using multiple integrals.

References:

1. B.S. Grewal – Higher Engineering Mathematics – Khanna Publishers.
2. Erwin Kreyszig – Advanced Engineering Mathematics – Wiley Eastern.
3. S. Balachandra Rao and C.K. Shantha – Differentials Calculus – Wiley Eastern.
4. G.B. Thomas – Calculus and Analytic Geometry – Addison Wesley.
5. S. Narayanan, Manikavachagom Pillai and Dr. G. Ramanaiash – Advanced Mathematics for Engineering.
6. N.P. Bali, Dr. Ashok Saxena, N. Ch. Sriman Narayana Iyengar – A Textbook on Engineering Mathematics.

IN 1102 ENGINEERING PHYSICS

Module I

Interference of light – Analytical treatment of interference – Coherent sources – Derivation of expression for fringe width in double slit experiment – White light fringes – Fringe shift with thin transparent plate – Interference on thin films – colour of thin films – Newton's rings – Air wedge – Planeness of surfaces.

Module II

Diffraction of light – Fresnel and Fraunohoffer diffraction – Zone plates – Plane diffraction grating – Measurement of Wave length – Dispersive power of grating – Resolving power – Raleigh's criterion – Resolving power of telescope and grating.

Module III

Polarization of light – Polarization by reflection – refraction – Brenster's law – Double refraction – Negative and Positive crystals – Nicol prism – Quarter and half wave plates – Production and detection of circularly and elliptically polarized lights – Rotatory polarization – Half shade polarimeter – Applications of polarized light.

Module IV

Nuclear fusion – Energy of fission – Chain reaction – Concept of critical size – Thermal power reactor – Breeder reactor – Atom bomb Fusion – Thermonuclear reaction – Fusion bomb – Particle accelerators – Cyclotron – Betatron.

Module V

Wave particle duality – The postulates of quantum mechanics – De Broghlie's concept of matter waves – properties of matter waves – Denisson & Germer's experiment – G.P. Thomsons experiment – Uncertainty principle – Crystal structure – Spare Lattice – Unit cell – Crystal systems – Cubic – Body centered and fare centered cubes – Lattice Planes. Miller indices – sparing between lattice planes. Miller indices – sparing between lattice planes – Powder method for crystal study – production of x-rays. Continuum and characteristics X-ray – Bragg's law.

References

1. J.B. Rajam – Modern Physics
2. Irving Kaplan – Atomic and Nuclear Physics
3. Sathyaprakash – Optics and Atomic Physics
4. C. Kittel – Solid State Physics
5. R.P. Feynmenn – Lectures on Physics.

IN 1103 ENGINEERING CHEMISTRY

Module I

Atomic orbitals – Radial probability distribution function of Hydrogen atom – Quantum numbers, aufban principle for many electron atoms – LCACO method for diatomic like N2, CO etc. – Basic ideas – Hybridisation and molecular shape. Conjugated systems.

Module II

Electrochemistry – Galvanic cells – EMF measurement, classification of electrodes – Nernst" equation – Electrode potential cell reaction relation between cell potential and thermodynamic quantities, Ni Cd cell, Hydrogen – Oxygen fuel cell, electron chemical corrosion.

Module III

Corrosion – Theories of corrosion – Factors influencing corrosion – Corrosion Control – Cathode protection – Protective coatings – Metallic coatings – Hot dipping – electroplating, metal spraying, cladding, Non-metallic coatings – properties and functions of ingredients used in paints, varnishes, Enamels and Lacquers – special paints.

Module IV

Organic chemistry – Nucleophilic aliphatic substitution – Elimination reactions of alkyl halides, nuclephiles – leaving groups: SN2 reaction mechanism, kinetics and stereochemistry, reactivity and steric hindrance, SN, reactions, Mechanism and Kinetics, concept of aromaticity. Hackel's (4n + 2) rule.

Module V

Fuels – classification – Calorific value determination of solids, liquids and Gaseous fuels – solid fuels, wood, peut, lignite, coal and coke proximate analysis of coal – liquid fuels – petroleum and its refining – fractions and their uses – cracking and reforming – petrol knock and octane number – Diesel knock and octane number – Synthetic petrol – Gaseous fuels – Natural cases – Acetylene Combustion calculation – Lubrication – Classification and properties of lubricants – Production of lubricating oils – Synthetic lubricants.

References

1. Castallan – Physical chemistry – Addison Wesley.
2. Galsitone and Leivis – Elementary Physical Chemistry.
3. A. Cotton and G. Wilkinson – Advanced inorganic chemistry.
4. G.S. Munku – Theoretical principles of inorganic chemistry.
5. Hendrickson, Cram and Hammond – Organic Chemistry – McGraw Hill.
6. Morrison and Boyd – Organic chemistry – Prentice Hall India.
7. J.C. Kuriakose and Rajaram – Chemistry in Engineering & Technology, Vol.II
8. P.C. Jain and Monika – Engineering Chemistry
9. L. Munree – Chemsistry of Engineering Materials.

IN 1104 BASIC ELECTRONICS

Module I

Semiconductors : energy distribution of electrons in a metal – fermi dirac function – density of states-electron emission from a metal carrier concentration in an intrinsic semiconductor – fermi level in semiconductor having impurities – junction diode: open circuited junction, band structure of open circuit p-n junction, biased P-N junction, V-I characteristic. The diode as a circuit elements the load line concept, large signal diode models. Small signal diode models. Junction diode switching times, Tunnel diodes, Zoner diodes. Hotodiodes, schottky barrier diodes.

Module II

Bipolar junction transistors: The junction transistor: Physical behaviour of a bipolar transistor, current components. The Ebers Moll representation of the BJT, The Common base Configuration, Common emitter configuration, cut off and seturation modes. DC models, BJT as an amplifier, BJT small signal models, The BJT as a diode, The emitter coupled pair, BJT ratings.

Module III

Two port networks – transistor hybrid model – conversion formulas – transistor amplifier analysis using h parameters – emitter follower – comparison of configurations – Millers theorem and its dual – cascading – simplified CE, CC configurations – CE amplifier with emitter resistance – high input resistance transistor circuits.

Module IV

Transistor Biasing: Operating point – fixed biasself bias – bias stabilization – bias compensation – thermal runaway – thermal stability.

Module V

Field effect transistors: The junction field effect transistor, pinch-off voltage, JFET Volt-ampere characteristics, FET small signal model, MOSFET, Depletion MOSFET, MOSFET gate protection, CMOS. Low frequency common source and common drain amplifiers. Biasing the FET, FET as a voltage variable register (VVR), The common-source amplifier at high frequencies, The common drain amplifier at high frequencies.

References:

1. Jacob Millman and Arvin Grabel – Microelectronics – McGraw Hill.
2. Jacob Millman and Christos C. Halkias – Integrated Electronics – Tata McGraw Hill.

IN 1105 ELECTRICAL ENGINEERING I

Module I

Electrostatics : Electric charge, Coulomb's law of electrostatics, Electric field, Electric potential, capacitor and capacitance.

Electromagnetism: Magnetic field, Boit-Savart's law, Magnetic field of an infinite linear conductor, field strength due to circular loop, field strength inside a solenoid, force on current carrying conductor in a magnetic field, hysteresis.

Magnetic Circuits: Magnetomotive force, magnetic field strength, reluctance, laws of magnetic circuits, ampere turns of magnetic circuit.

Module II

Electromagnetic induction: Relation between magnetism and electricity, Faradys laws of electromagnetic induction, direction and induced emf, manginutde of induced emf in a coil, dynamically induced emf, statically induced emf, growth of current in inductive circuits, decay of current in inductive circuits. Energy stored in magnetic circuits. Fundamentals of A.C. gneration of alternating current and Voltage, emf equation, phase and phase difference, rms value, average value from factor, peak factor, vector diagram A C through capacitor only.

Module III

A C series circuit: current through resistance and inductance – power factor – active and reactive component of current – Q factor of coil – ac through resistance and capacitance – dielectric loss and power factor – resonance in R L C circuit.

A C parallel circuit: solving parallel circuit – vector method – admittance method – series parallel circuit – resonance in parallel circuits Q factor of a parallel circuit.

Module IV

Mesh and node analysis: Kirchoff's laws, source transformation – Mesh and nodes analysis – network equation for RLC network. Network theorems: Superposition theorem – reciprocity theorem – Thevenin's theorem – Norton's theorem – maximum power transfer theorems – substitution theorem.

Module V

Three phase system: generation of three phase voltage – star connection and delta connection – star/delta and delta/star conversion – power in 3 phase system – measurement of 3 phase power in balanced and unbalanced system.

Symmetrical components: Positive sequence components, negative sequence components and sera sequence components.

References

1. V.N. Mittle – Basic Electrical Engineering – Tata McGraw-Hill.
2. B.L. Thevaja-A textbook of Electrical Technology, Vol.I
3. D. Roy Choudhury – Networks and systems – New age International Publishers.

IN 1106 TECHNICAL COMMUNICATION

This is a practice oriented, need based, and functional – co mmunicative course. It is intended to develop the student's skill of communication in listening, speaking, reading and writing. The student is advised to cultivate the habit of reading newspapers, magazines and books in a free, extensive manner to consolidate the skill already achieved. A more inter-active process of teaching/learning is called for in order to achieve
effective communication.
Questions at the class tests and semester end examination will be largely problem solving and application oriented in nature.

Module I

Communicative Grammar: Time, tense and aspect; Verbs of state and event; Use of preposition; Expressing emotions and attitudes: Hope, anticipation of pleasure, disappointment, approval, disapproval, surprise.

The sounds of English: (it is not a course in phonetics. Technical terms will not be used except when absolutely necessary.)
Length of vowels-long and short vowels
/ | /, / 3 : /, /a :/, / : /, /U : / | / / 2 /, /,/ Λ /, / O /, / U / - Consonants : / f, v, o, o, s, z, 3/ -
Stress pattern -
Intonation: failing and rising.

Oral Communication: starting and ending a conversation; telling and asking people to do things; expressing opinions and ideas, decisions and intentions, offers and invitations, feelings, right and wrong, numbers and money.
Purpose and audience; dealing with customers and clients; face-to-face discussions; interviews; group discussions; meetings and attending meetings; checking understanding; raising questions; giving and receiving feedback; using body language; leading and directing discussions; concluding discussions; using graphics in oral presentations

Reading Comprehension and reference skills: skimming and scanning; factual and inferential comprehension; prediction; guessing meaning of words from context; word reference; comprehending graphics in technical writing.
Reading strategies; reading speed; reading between the lines for hidden meaning; interpreting graphics; using a dictionary; using an index; using a contents list to find information; choosing the right reference source.

Module II

Written Communication: note making and note taking; summarizing; notes and memos; developing notes into text; organization of ideas: cohesion and coherence; Preparing notes – writing business letters and E-mail messages. Organizing a meeting, preparing an agenda, chairing a meeting, drafting motions and resolutions, writing minutes.
Paragraph writing: Paragraph writing – Topic sentence, cohesion and coherence- sentence liners (so, but, however etc), ordering information in space and time; short essays: description and argument; comparison and contrast; illustration; using graphics in writing: tables and charts; diagrams and flow-charts; maps, plans and graphs. Preparation of a business report-writing a business proposal - format, length, structure.

Spelling rules and tips; writing a rough draft; editing and proof reading; writing the final draft; styling text; filling in complex forms; standard letters; Writing a curriculum vitae (both chronological & functional) along with an application for a job; Public relation – Concept and relevance – PR in a business organization-handing the media; writing a report; writing leaflets and brochures; writing references; essay writing: expository writing; description of processes and products; classification; the instructional process;
arguments and presentation of arguments; narrating events chronologically.

References :

1.John Seely, Oxford Guide to Writing and Speaking, Oxford University Press.
2.C. Muralikrishna and Sunita Mishra, Communication Skills for Engineers, 2nd Edition, Pearson, 2011.
3.Meenakshi Raman and Sangeetha Sharma, Technical Communication: Principles and Practice, Oxford University Press, 2004.
4.Krishna Mohan and Meenakshi Raman, Effective English Communication,Tata Mc-GraHill,2000.
5.William Sanborn Pfeiffer, T.V.S. Padmaja, Technical Communication – A Practical Approach, Pearson, 2007.
6.R.C. Bhatia, Business Communication, 2nd Edition, Ane Books Pvt. Ltd., 2008.
7.Krishna Mohan and Meera Banerji, Developing Communication Skills, Mac Millan India Ltd, 2000.

IN 1107 Practicals

Module I

Introduction to Engineering Graphics: Drawing Instruments and their use, familiarization with current Indian Standard Code of Practice for general engineering drawing.
Scales-Plane scale, vernier scale, diagonal scale, Conic sections – Construction of ellipse, parabola, hyperbola, Involute – drawing tangents and normals to these curves.

Module II

Orthographic projection: Planes of projection, principles of first angle and third angle projections, projection of points in different quadrants.

Projection of straight lines parallel to one plane and inclined to the other plane – straight lines inclined to both the planes – True length and inclination of lines with reference planes – traces of lines

Projection of plane laminae of geometrical shapes in oblique postions.

Module III

Projection of solids, simple solids in simple position – Development of surfaces and solids – Development of furstrum of cone, cylinder and prism. Isometric projection of prisms, pyramids and spheres.

Module IV

Introduction to machine drawing: BIS conventions – screw threads – nuts and bolts, Rivetted joints.

Module V

Bearings – simple, bush and thrust bearings. Shaft couplings – muff, flanged and flexible couplings.

References:

1. N.D. Bhatt – Engineering Drawing – Charaotar Publishing House.
2. P.I. Varghese and K.C. John – Engineering Graphics – Jovast Publishers
3. N.D. Bhat and v.m. Panchal – Machine Drawing Charotar Publishing House
4. P.I. Varghese and K.C. John – Machine Drawing – VIP Publishers.

2. **Mechanical and Electrical Workshop**

Welding
Bench work and fitting
Carpentry
Simple exercises in lathe, milling machine, shaping machine, grinding and sheet metal works.
Class work familiarization
Staircase wiring
Hospital wiring
Godown wiring
Fluorescent lamp

IN 1201 ENGINEERING MATHEMTICS II

Module I

Matrix Algebra: Rank of a matrix, Normal form, linear systems of algebric equations, consistency, homogeneous system of equations, linear transformation, orthogonal transformation, Eigen values and Eigen vectors. Cayley Hamilton theorem (No proof), Diagonalisation – real symmetric metrix and quadratic forms.

Module II

Vector Calculus: Vector differential calculus: Scholar and vector point functions, gradient, divergence and curl, their physical interpretation.

Vector integral calculus: Line, surface and volume integrals, Gaussls divergence theorem, stockes theorem (No proof for these theorems), Conservative force fields, scalar potential.

Module III

Laplace Transforms: Definitions, transforms of elementary functions, inverse transforms, transforms of derivatives and integrals, differentiation and integration of transforms, convolution theorem (no proof), use of Laplace transforms in the solution if initial value problems, unit step function, impulse function, transforms of step functions, transforms of periodic functions.

Module IV

Convergence and divergence of infinite series: Integral test, comparison test, ratio test, Cauchy's root test, Raabels test, series of positive and negative terms, concept of absolute convergence, alternating series, Leibniz test (No proofs for any of the above test.).

Power series: Convergence of power series, Taylor and Maclaurin series of functions, Leibniz formula for the derivative of the product of two functions (No proof). Use of Leibniz formula for the determination of coefficients of power series.

Module V

Ordinary differential equations: Solution of a first order differential equation, Equation with separable variables, homogeneous differential equation with constant coefficients, method of solution of these equations.

References:

1. B.S. Crewal – Higher Engineering Mathematics
2. Erwin Kreyzig – Advanced Engineering Mathematics
3. S. Narayanan, Manickavachagom Pillai, Dr. G. Ramaniah – Advanced Mathematics for Engineering
4. David Lewis – Matrix Theory – Allied Publishers.
5. R.V. Churchill – Loperational Mathematics – McGraw Hill.
6. Kaplan W – Operational Methods for Linear System – Addison Wiley

IN 1202 ANALOG ELECTRONICS

Module I

Elementary diodes applications: rectifiers, voltage equations, simple zener regulator regulated power supplies – series voltage regulator. Wave shaping circuits: Linear wave shaping, clipping and comparator circuits, clamping and switching circuits.

Module II

Transistor at high frequencies: Hybrid-pi CE transistor model, CE short circuit current gain, single stage CE transistor amplifier response, gain-bandwidth product, emitter follower at high frequencies Multistage amplifiers: Classification distortion in amplifiers, frequency response, bode plots, step response, band pass of cascaded stages, RC coupled amplifier – low frequency response, high frequency response of two cascaded CE stages, multistage CE amplifier cascades at high frequencies.

Module III

Power amplifier classification – Class A, Class B, Class AB and Class C – transformer less class AB, Push-pull power amplifier – complimentary symmetry power amplifier – harmonic distortion in power amplifiers.

Module IV

DC amplifier – direct coupled amplifier – FET DC amplifier – Zener diode biasing for DC amplifier – Cascade amplifier – Darlington emitter follower – boot strapped darlinton circuit. Amplifier noise: Thermal noise – FET noise – interference – shielding and grounding – eliminating interference – capacitive coupling – Magnetic coupling radio frequency coupling.

Module V

Integrated circuits: Fabrication and characteristics – Integrated circuit tenchlogy – Monolithic integrated circuits – Epitaxial growth – Masking and etching – Diffusion of impurities – Transistors for monolithic diodes – Integrated resistors, capacitors and inductors – circuit layout – LSI and MSI – The metal – semiconductor contact.

References

1. Jacob Millman and Christos C. Halkias – integrated Electronics – Tata McGraw Hill
2. Millamn and Taub – Pulse, digital and switching wave forms – Tata McGraw Hill

IN 1203 ELECTRICAL ENGINEERING II

Module I

Transformer: Working principles of ideal transformer – constructional features – emf equation – vector diagram – equivalent circuit – impedance transformation – transformer losses – flux leakage – efficiency – open circuit and short circuit tests – auto transformer – working principle and saving of copper – Basic idea of current transformer and potential transformer.

Module II

DC Machines: Types of D.C. machines, emf generated in the armature, Torque in DC machin method of excitation, mmf and flux density wave forms in D.C. machines, commutation process, compensating windings, managetisation curve. Effect of armature mmf on D.C. machine calculations. Operating characteristics of D.C. generators and motors. DC motor starting, speed control of DC machines – DC machine applications.

Module III

Alternator: rotating field, speed and frequency – effect of distribution of winding – emf equation – losses and efficiency requlation – emf and mmf methods. Synchronous motor – torque equation – starting methods – effect of over/under excitation.

Module IV

Induction motor: Three phase induction motor – constructional features – principle of operation – Vector Diagram and equivalent circuits – performance calculation using circle diagram – starting and speed control of squirrel cage and wound rotor induction motor.
Single phase induction motor: Principle of operation, Stepper motor, Universal motor, Hysteresis motor

Module V

Introduction to generation of electric power: Hydroelectric, Nuclear, Diesel, Gas power stations.
Elements of transmission and distribution of electric power – Practical working voltage – underground systems and overhead systems – Typical power scheme – Different systems of transmission and circuits – Different types of line insulators used.
Switch gear and protection: Requirement of circuit breaker, type of circuit breakers. Basic principle of operation of circuit breaker.

Reference:

1. P.S. Bimbhara – Electrical Machinery – Khanna Publishers
2. S.L. Uppal – Electrical Power – Khanna Publishers.

IN 1204 ENGINEERING MECHANICS

Module I

Statics : Concurrent forces in a plane – principle of statics – composition and resolution of forces – equilibrium of concurrent forces in a plane – Method of projections – equilibrium of three forces in a plane – Method of moments. Parallel forces in a plane – center of parallel forces and center of gravity – centroids of composite plane figures and curves – distributed forces in a plane – Moment of inertia.

Module II

General case of forces in a plane: composition of forces in a plane – equilibrium of forces in a plane – plane trusses – method of joints and method of sections – plane frames – method of members.

Module III

Rectilinear translation: Kinematics of rectilinear motion – differential equation of rectilinear motion – motions of particles acted upon by a constant force – force as a function of time force proportional to displacement – D' Alemberts principles – momentum and impulse – work and energy – ideal systems – conversion of energy – impact – Curvilinear motion – kinematics of curvilinear motion – differential equation – motion of projectile – kinematics of rotation – equation of rigid body rotating about a fixed axis – rotation under the axis of constant moment – compound pendulum – general cases of moments proportional to angle of rotation.

Module IV

Stress and strain – concepts of stress – equation of equilibrium – stresses in axially loaded members – concept of strain – Hooke's law of isotropic materials – elastic constants – thermal strain – elastic strain energy – idealized stress strain diagram – deflection of axially loaded members – transformation of plane stress – principal stresses – Mohr's circle of stress – measurement of surface strains – Rosettes.

Module V

Bending stresses in beams: shear force and bending moment diagrams – basic assumptions in bending – elastic flexure formula – application of flexure formula – torsion of circular members: basic assumptions – torsion formula – angle of twist – deflection of beams: governing differential equation for deflections – solution by direct integration.

Reference:

1. Timsohenkov and Yound – Engineering Mechanics – McGraw Hill Book Co.
2. Egor P. Popov – Introduction to mechanics of solids – Prentice Hall of India Pvt. Ltd.
3. Laughaar and A.P. Boresi – Engineering Mechanics – McGraw Hill Book Co.
4. Irwing Shames – Engineering Mechanics – Prentice Hall of India Pvt. Ltd.

IN 1205 MATERIAL SCIENCES

Module I

Engineering aspects of materials – structure of materials – bonding in solids – Ionic, covalent and metallic bonding – Vander Waal and Hydrogen bonding – Crystal Structure – X-ray diffraction – Bragg's law – Defects and dislocations in solids – diffusion in solids – Fick's law

Module II

Phase diagrams – Phase rule – Single component Systems – Binary phase diagrams – Applications of phase diagrams – Mechanical properties of materials – Elastic behavious – stress and strain – Hooke's law – Viscous and visco elastic deformation – Plastic Deformation – Creep – Fracture – Mechanical testing and materials – Hardness and Fatigue testing.

Module III

Electrical properties of materials – Free electrons in solids – Metallic conductivity – Resistivity – Elements of band theory – semiconductors – intrinsic and extrinsic –p-n junction – Semiconductor materials – superconductivity – Basic ideas – Magnetic properties of materials – Diamagnetism, para-magnetism and ferromagnetism – Langevin theory – Magnetic materials.

Module IV
Dielectrics and ferroelectrics – Polarization types – Classification of dielectrics – Piezoelectricity – Ferroelectricity – Dielectric behaviour – permittivity oxidation and corrosion – Mechanisms of oxidation – Protection against corrosion.

Module V
Ceramics and composites – Classification – Modern ceramic materials – Cements – Glass ceramics – Glass fibre – Carbon fibre – Whiskers – Thermoplastics – Thermoset materials.
Polymers – Polymerization techniques – Natural and synthetic rubbers – Plastics – Composites – FRP and CFRP materials – Enginering applications.

References:

1. V. Raghavan – Materials Science and Engineering – Prentice Hall of India.
2. Choudhury – materials Science and Processes – Indian Book Distributors.
3. A.G. Guy – Essentials of Materials Science – McGraw Hill.
4. Van Vleck – Elements of Materials Science – Addison Wesley

IN 1206 ECOLOGY AND ENVIRONMENTAL SCIENCE

Module I

Natural resources – issues related to the use and over exploitation of forest resources, water resources, mineral resources, food resources and energy resources – role of an individual in conservation of natural resources – equitable use of resources for sustainable life styles.
Concept of an ecosystem – structure and function – energy flow in the ecosystem – ecological succession – food chains, food webs and ecological pyramids – structure and functions of a forest ecosystem and an aquatic ecosystem.
Definition of biodiversity – genetic, species and ecosystem diversity – biogeographical classification of India – Value of biodiversity : consumptive use, productive use, social, ethical, aesthetic and option values. Threats to biodiversity, Conservation of biodiversity.

Module II

Environmental Pollution - Causes, effects and control measures of air pollution, water pollution, soil pollution , noise pollution, marine pollution, thermal pollution and nuclear hazards – Causes, effects and control measures of urban and industrial solid wastes –Role of an individual in prevention of pollution - An overview of the various environmental legislations in India – Issues involved in enforcement of environmental legislation.
Disaster Management: Floods, earth quake, cyclone and landslides. Role of public awareness in disaster management.

The concept of sustainable development – Urban problems related to energy – Water conservation, rain water harvesting, water shed management – Resettlement and rehabilitation of people ; its problems and concerns - Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust – Population growth and problems of population explosion – Environment and human health- Human rights– Value education – Role of Information Technology in environment and human health - Environmental ethics: issues and possible solutions. Environmental ethics : issues and possible solutions.

References

1. Rajagopalan. R, Environmental Studies: From Crisis to Cure, Oxford University Press, 2005
2. Erach Bharucha, Textbook of Environmental Studies and Ethics, Universities Press (India), Hyderabad, 2005.
3. Jayashree A. Parikh, V.M. Balsaraf, P.B. Dwivedi, Environmental Studies, Ane Books Pvt. Ltd., 2010.
4. Anindita Basak, Environmental Studies, Pearson, 2009.
5. Gouri Suresh, Environmental Studies and Ethics, I.K. International Publishing House Pvt. Ltd., New Delhi, 2007.
6. S.P. Misra, Essential Environmental Studies, 3 rdEdition, Ane Books Pvt. Ltd. , 2011.
7. Benny Joseph, Environmental Science & Engineering, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2010.
8. Meenambal T , Uma R M and K Murali, Principles of Environmental Science and Engineering, S. Chand & Company Ltd, 2005

IV 1207 Practicals

1. **Basic Electronics Lab**

Characteristics of diode
Characteristics of Zener diode
Transistor characteristics in CB configuration
Transistor characteristics in CE configuration
Bias and bias stabilization
PET characteristics
Design of PET amplifiers – frequency response

2. **Computer Programming Lab**

Structure of a C program

C fundamentals – character set, identifiers, keywords, data types, operators, expressions, library functions input and output statements. Control statements – conditional expression, loop statements, breaking control statement.

Arrays – actual notation, declaration, initialization, processing with arrays, multidimensional array, character array.

Functions – actual and formal arguments, local and global variables, multifunction program, recursive functions.

Structures – declaration of structures, initializing a structure, functions and structure, arrays within a structure, structure within a structure union.

Pointers – declaration, pointer and functions, pointer and arrays, pointer and strings, pointers and structures, Data files – Opening and closing a data file, creating a data file.
References: 1. Kerningham and Ritche – C Programming.

IN 1301 Engineering Mathematics III

Module I

Fourier series and Fourier integrals: Periodic functions, Euler formula for Fourier co-efficients, functions having arbitrary period even and odd functions, half range expressions, Fourier integral.

Gamma and Beta functions: Error functions, definitions and simple properties.

Module II

Partial differential equations: Solution of non-linear partial differential equations of the form f (p,q) =0, f (x,p,q) = 0, f (y, p,q) = 0, f (z,p,q) = 0, f1 (x,p) = f 2(y,q), Lagranges form Pp+Qq = R.

Applications of partial differential equations: Vibrating String one dimensional wave equation, D' Alemberts solution, solution by the method of separation of variables, one dimensional heat equations solution of the equation by the method of separation of variables, solution of Laplace equations over a rectangular region and circular region by method of separation of variables.

Module III

Probability and statistics: Definition of probability, Random variables and expectation, Addition multiplication theorem and Baye's theorem, binominal distribution, hypergeometric distribution, Mean and variance of probability distribution, Chebyshev's theorem, Poisson Approximation to Binomial distribution.

Probability densities: Continuous random variables, uniform distribution, normal distribution, gamma distribution, log normal and weibull distribution (Derivation of formula for log-normal, weibull, Gamma distributions not required).

Module IV

Sampling distributions: Population and samples, the sampling distribution of the mean (known), the sampling distribution of the variance, point estimation, interval estimation, tests of hypotheses, null hypotheses and significances tests, hypotheses concerning one mean, type I & type II errors, hypotheses concerning two means.

Module V

The estimation of variances – Hypothesis concerning one variance, Hypothesis concerning two variances. Curve fitting – method of least squares, correlation and regression, lines of regression.

Note: Derivations of various sampling distributions and their means, variances etc. are not required. Treatment of topics in Module III, IV, V should be oriented towards problems in real life.

References:

1. B.S. Grewal – Higher Engineering Mathematics
2. S. Narayanan, T.K. Manickavachagom Pillai, Dr. G. Ramanian – Advanced Mathematics for Engineering Students.
3. Millers and Freund's Probability and Statistics for Engineers – Prentice Hall of India.
4. E. Parzen – Modern Probability Theory and its Applications – Wiley Eastern.
5. Erwin Kreyszig – Advanced Engineering Mathematics – Wiley Eastern.

IN 1302 Digital Electronics

Module I

Number systems and codes – Binary, Octal, Hexadecimal number systems and conversions – Addition, subtraction multiplication and division arithmetic in various number systems – Four bit BCD codes, weighted codes, Excess – 3 code, Gray code, Self complementing code Error detecting and correcting codes – Hamming code – Code conversion – Parity checking.

Module II

Logic gates – AND, OR, NOT, XOR, NAND, NOR Logic families – RTL, DTL, TTL, I^2L, CMOS logic, ECL – TTL characteristics – Open collector TTL-Tristate logic TTL subfamilies-Boolean algebra – De Morgan's thorem-Laws of Boolean algebra – Karnaugh mapping – simplification of Boolean expressions.

Module III

Combinational systems – Encoders, Decoders, Comparators, Multiplexers and Demultiplexers – Adders – Half adder, full adder, serial and parallel adder – addition and substraction by 1's and 2's complement methods – BCD adder –Flip-flops-RS, JK, Master-slave, D-type, T-type-Flip-flop timings.

Module IV

Shift registers – Parallel to serial and serial to parallel converters – Counters – Ring, Ripple, Johnson's counters – Mode N counter – Synchronous sequential systems – state minimization – implication chart – fundamental nodes – Races and Hazards - Presettable counters – shift counters – Digital clock

Module V

Semiconductor memories – Memory addressing – ROMs and EPROMs – RAM-s Dynamic RAMs-Memory cells – implementing logic functions using MSI and programmable devices – Designing with multiplexers – Logic functions using MSI decoders – Using XOR and XNOR elements – using programmable devices – PROM-PAL-PLA-Multi-level PLDs –

References:

1. Malvino and Leach – Digital Principles and Applications.
2. Richard Sandige – Modern Digital Design – McGraw Hill.

IN 1303 Linear Integrated Circuits

Module I

Feedback amplifier – Concept of feedback – types of feedback position and negative feedback effect of feedback on amplifier – expression and derivation – voltage current – series – Shunt – Typical circuits – Frequency response, band width and comparison. Oscillators – concept of positive feedback – types of oscillators – Barkhausen criteria – RC phase shift oscillation – Principle – analysis and design Principle of operation of Hartley, Colpitts, crystal oscillator (analysis and design).

Module II

Operational amplifiers – The basic Op Amp – The differential amplifier – Emitter coupled differential amplifier – Transfer characteristics – An IC Op Amp – offset voltages and currents – Temperature drift – Op Amp parameters – Frequency response of Op Amps – Dominant pole, Pole zero and lead compensation – step response.

Module III

Applications of Op Amps – Inverting and non – inverting amplifiers – Differential DC amplifier – Instrumentation amplifier – stable AC coupled amplifier – Analog integration and differentiation – Analog computation – Solution of differential equations – active filters active resonant band pass filters.

Module IV

Nonlinear analog systems – comparators – sample and hold circuits – Precision AC/DC converters – Logarithmic and anti-logarithmic amplifiers – Waveform generators – AMV, MMV and PMV – regenerative comparators – Multipliers and their applications.

Module V

- Monolithic regulators – Switched mode power supplies – Principles and applications – switching regulators. Phase locked loops and applications – Introduction to PLLs – Operating principles and classification – The linear PLL – Building blocks – Linear PLL performance in locked state – order of the LPLL – Parameters of the PLL – Noise – NPLL – parameters of the PLL – Noise – LPLL applications.

References:

1. Miliman and Halkias – Integrated Electronics, McGraw Hill.
2. R.E. Best – Phase locked loops, Theory, design and applications – McGraw Hill.
3. I.R. Sinclair – Electronic Power Supply handbook – RPB publications.

IN 1304 Electrical and Electronic Instruments

Module I

Measurements and measuring systems: SI units – Significance of measurements – method of measurements – type of instruments – classification of instruments – functions of instruments and measurement system. Measurement and error: Accuracy and precision – significant figures – types of errors – statistical analysis – probability of errors – limiting errors.

Module II

Potentiometers – general principles – use of DC potentiometer in the measurement of voltage, current, resistance and power – calibration of ammeter, voltmeter, wattmeter – A.C. potentiometers – use of A.C. potentiometers in magnetic measurements – measurement of low and medium resistance – bridge methods – measurement of high resistance – insulation measurement of inductance and capacitance – bridge methods.

Module III

Magnetic measurements : Classification of magnetic measurements – measurement of flux density and magnetizing force – magnetic potentiometers – determination of B.H. curve – hysterisis loop – testing of bar and ring specimens – parameters – separation and measurement of iron loss – measurement of air gap flux – testing of permanent magnets.

Module IV

Electrical instruments: constructional details – dynamic behavior of D' Arsonval galvanometer – galvanometer sensitivity – PMMC type – MI type – dynamometer type – induction type measurement of current voltage and resistance – multimeters – power and energy measurements – single phase and polyphase meters – instrument transformers.

Module V

Electronic instruments: C.R.O. – Block diagram – CRT circuit – vertical deflection system – delay line – multiple trace – horizontal deflection system – oscilloscope probes and transducers – oscilloscope techniques – storage oscilloscope – sampling oscilloscope.

References:

1. Albert. D. Helfrick and William D. Cooper – Modern electronic instrumentation and measurement techniques – Prentice Hall of India Ltd.
2. A.K. Sawhney – Electrical and electronic measurements and instrumentation – Dhanpat Rai & Sons.

IN 1305 Mechanical Engineering

Module I

Internal Combustion Engine: Classification of IC engines – Engine components – Four stroke engine – two stroke engine – Petrol and diesel engines – Fuel supply and injection system in diesel engines – Carburetion in petrol engines – Ignition system in petrol engine – cooling of IC engines – Lubrication of IC engines – Engine power - Testing of IC engines.

Module II

Steam generators: Properties of steam classification of boilers – Five tube and water tube boiler – Simple vertical boiler – Cochran Boiler – Lanchashire boiler – Locomotive boiler – Babcock and Wilcox boilers – La – Mont boiler.
Boiler mountings and accessories: Boiler mountings: water gauge and water level indicator – pressure gauge – steam stop valve – Feed check valve – Blow down cock – Fusible plug – Spring loaded safety valve – Dead weight safety valve – lever safety valve – High Steam and low water safety valve.
Accessories : Pressure reducing valve – steam traps – steam separator – Economiser – Feed pump injector.

Module III

Steam engine and turbines : Classification of steam engines – Working indicator diagram – Work done. Steam turbines – Classification of steam turbines – Simple impulse turbine – Velocity diagram – Reaction turbine – Compounding of impulse turbines – Advantages of steam turbines over steam engines.

Module IV

Air compressors: Reciprocating air compressors – Mechanical details – shaft work – Multistage air compressors with inter cooling.
Introduction to condensers and cooling towers.

Refrigeration: Types of refrigerators – refrigerating effect and unit of refrigeration – vapour compression refrigerator – vapour absorption refrigerator – refrigerants.

Module V

Mechanical power transmission: Belt drives – slip and velocity ratio – length of belt – ratio of belt tensions – Power transmitted by belt drives – rope drives – chain drives – gear drives.

Primary shaping processes: Moulding and casting – Forging – Rolling – extrusion – wire drawing – coining – blanking – punching.

Metal joining processes: Welding – brazing – soldering.

References:

1. P.L. Balsaney – Thermal Engineering – Khanna Publishers.
2. P. Balachandran and J. Benjamin – A First Course in Mechanical Engineering – Jalagandeesh Publications.
3. S.K. Hajra Choudhury and A.K. Hajra Choudhury – Elements of Workshop Technology – Media Promoters and Publishers Pvt. Ltd.

IN 1306 Practicals

1. Analog Electronics Lab

Half wave and full wave rectifiers – regulation and ripple
Characteristics with and without filter
Design of RC coupled CE transistor amplifiers.
Design of series voltage regulator.
Characteristic of UJT relaxation oscillator.
Class A, Class B Power amplifiers
Design of emitter – frequency response – effect of carrying load resistance on output voltage.
Clipping and clamping circuits.
Different types of power suppliers – Design and performance analysis.
Control of power using SCR, Triac, and power transistor, Operational amplifiers – inverting, noninverting, differential amplifiers, instrumentation amplifiers – CMRR. Summer, differentiator, integrator, logarithmic, antilogarthmic amplifiers.
Function generators using Op amp.
Active filters using op amps.
555 circuits, phase locked loop.

2. Electrical Machines and Measurement Lab

Load Test on D.C. shunt motor
Local test on D.C. Shunt generator
Open circuit and load test on separately excited D.C. generator
Load test on D.C. Series motor
Load test on D.C.C shunt generator
Torque slip characteristic of single phase induction motor
Circuit diagram of three phase induction motor
No lad characteristic of single phase generator
O.C.C. and S.C.C. of three phase synchronous generator
Open circuit and short circuit test on single phase transformer
Calibration of ammeter and colt meter using precision potentiometer
Testing of energy meter
Measurement of 3 power using two-watt meters
Measurement of power factor
Kelvin's double bridge.

IN 1401 Engineering Mathematics IV

Module I

Complex Analysis: Gurves and regions in the complex plane, complex functions, limit, derivate, analytic functions, Cauchy – Riemann equations, elementary complex functions, such as powers, exponential functions, logarithmic, trigonometric and hyperbolic functions. Conformal mapping: Linear fractional transformations, mapping by elementary function like z^2, e^z, sinz cosz, sinhz, coshz, Scharwz – Christoffel transformation.

Module II

Numerical analysis: Errors in numerical computations, sources of errors, significant digits.

Numerical solution of algebraic and transcendental equations: Bisection method, regul fals method, Newton – Raphson method, Method of iteration, Rates of convergence of these methods, Graffe's root squaring method for roots of algebraic equation.

Solution of system of linear algebraic equations: Exact methods, Gauss elimination method, Grout's triangularisation method, Gauss Jacobi and Gauss Seidel iteration method, Relaxation method.

Module III

Polynomial interpolation: Langrange interpolation polynomial, Polynomial divided differences – Newtons divided difference interpolation Polynomial. Finite differences – Operators and O, Newtons forward and backward differences, interpolating polynomials, central differences, sterlings central differences interpolation polynomial.

Numerical differentiation: Formulae for derivatives in the case of equally spaced points. Numerical integration – Trapezoidal and Simposon's rule, compounded rules, Errors of interpolation and integration formulas.

Module IV

Numerical solution of ordinary differential equations: Single step methods, Taylor series method, Euler's method, modified Eulers method, Modified Eurers method, Picards method, Runge-Kutta formula of 2^{nd}, 3^{rd} and 4^{th} order (derivation), multistep method, milnes predictor corrector method, Adam's method.

Module V

Solution of linear difference equations with constant coefficients. Numerical solution of boundary value problems, methods of finite differences, finite difference methods for solving Laplace's equation in a rectangular region, finite difference methods for solving the wave equation and heat equation.

References:

1. S. Narayanan, Manikavachgom Pillai, Dr. G. Ramanaiah – Advanced Mathematics for Engineering – S. Viswanathan Publishers.
2. Erwin Kreyzig – Advanced Engineering Mathematics – Wiley Easters.
3. S.S. Shastry – Introductory Method of Numerical Analysis – Prentice Hall of India.
4. Ralph G. Statonn – Numerical Methods for Science and Engineering.
5. M.K. Jain, S.R.K. Iyengar, R.K. Jain – Numerical Methods for Scientific and Engineering Computation – Wiley Eastern.
6. Gerald – Applied Numerical Analysis – Addison Wesley.
7. P. Kandaswamy, Thilagavathy, Gunavathy – Numerical Methods – S. Chand & Co
8. E.V. Krishnamoorthy and S.K. Sen – Numerical Algorithm – Affiliated East. West.

IN 1402 Principles of Measurement and Instrumentation

Module I

Static and Dynamic characteristics – Review of static characteristics – Loading effect of instrument – Generalized mathematical model of measurement systems – Operational transfer function – zero, first and second order instruments – impulse, step, ramp and frequency response – response to periodic input – dynamic calibration.

Module II

Signals and noise – Deterministic and random signals – periodic and periodic signals – Bandwidth – Signal conditioning and processing – Filtering – Passive and active filters – types of filters – frequency transformation – signal analysis, frequency analysis – Applications.

Module III

Data acquisition systems: Objectives of DAS, elements of analog data acquisition system – elements of digital DAS –Elementary treatment of A/D and D/A conversion – data loggers – elements of microprocessor and PC based DAS.

Module IV

Data presentation elements – Review and choice of data presentation elements – pointer – scale indicators – Analog chart recorders – Alphanumeric displays – printers – magnetic tap recorders. LCD devices – Digital meters – resolution, sensitivity – Digital Voltmeter – Digital Frequency meter.

Module V

Data transmission and telemetry – Characteristics of telemetry system – Modulation – Land-Line telemetry – radio telemetry – Frequency Division – Multiplexing – Time division multiplexing.

1. D.V.S. Murthy – Transducers and Instrumentation – Prentice Hall India.
2. C.S. Rangan, G.R. Sharma and V.S.V. Mani – Instrumentation Devices and Systems – Tata McGraw Hill.
3. Doeblin – Measurement system Application and Design – McGraw Hill
4. Gently – Principles of Measurement system – Longman Scientific & Technical.

IN 1403 Control Engineering I

Module I

Introduction: Basic ideas of control systems and their classification Differential equations of physical systems – Mechanical, electrical thermal and fluid systems – transfer function – Block diagram, signal flow graphs – illustrative examples.

Feedback characteristics of control systems – Feedback and non feedback systems – Reduction of parameter variation by use of feed back – Control over system dynamics by use of feedback – Control of the effects of disturbances signals by use of feed back – regenerative feed back – illustrative examples.

Module II

Time domain analysis : Design specifications and performance indices Types of test inputs – Time response of first and second order systems – steady state error and error constants – Effect of adding zero to a system design. Specification of second order system – design. Consideration for higher order systems.

Concept of stability – conditions for stability – Routh Hurwitz Criterion.

Module III

Frequency domain analysis – Correlation between time and frequency response – Polar Plot – Bode Plot – All phase and minimum phase system – Experimental determination of transfer functions – Log magnitude vs Phase plots – Nichol's chart stability in frequency domain – Nyquist stability criterion – Relative stability – Sensitivity analysis in frequency domain.

Module IV

Root locus technique concept – Basic theory and properties of root loci – Construction of root loci – Stability in terms of root loci – generalized root locus diagram - Root contours – System with transportation lag – Sensitivity of the roots of characteristic equation.

Introduction to design considerations in classical design –

Module V

Introduction to design considerations in classical design – Realization of basic compensations. Cascade compensation in time domain – Cascade compensation in frequency domain – Feedback compensation – Network compensation of AC system.

References:-

1. Nagarath Gopal – Control Systems Engineering – Wiley Eastern
2. Kashusiko Ogata – Modern Control Engineering
3. Nemka,om C Lip – Automatic Control Systems.
4. Dr. Sushil Das Gupta – Control Engineering

IN 1404 Power Electronics

Module I

Thyristor : Terminal characteristics of thyristors. Thyristor ratings – Thyristor protection – Series and parallel operation of Thyristors. Other members of thyristor family: PUT, SUSI, LASCR, diac, triac, ASCR, RCT, GTSO. Firing circuit for thyristors.

Module II

Phase controlled rectifiers: Half wave circuit with RL Load, Half wave circuit with RL load and free wheeling diode, Half wave circuit with RLE load. Full wave controller converters – Single phase full wave converters – Single phase two pulse converters with discontinuous load current – three phase converter system using diodes – Three phase thyristor converter circuits – Effect of source impedance on the performance of converters – Dual converters.

Module III

Choppers: Principle of Chopper operation – Control strategies – types of chopper circuits – step up choppers – steady state time domain. Analysis of type A chopper – Thyristor. Commutation in copper circuits – Multiphase choppers.

Module IV

Inverters : Single phase voltage source inverters – Three phase bridge inverter – Voltage control in single phase inverters – Pulse width modulated inverters – Reduction of harmonics inverter output Voltage – Current source inverters.

Module V

A C voltage controllers: Types of AC voltage controllers – Single phase voltage controllers – Sequence control of A C voltage controllers. Cycloconverters: principle of cycloconverter operation – Three phase half wave cycloconverters – output voltage equation for a cycloconverter –

References:

1. P.S. Bimbhra – Power Electronics – Khanna Publishers
2. M. Ramamoorthy – An Introduction to Thyristors and their applications East West Press.
3. Chute and R.D. Chute – Electronics in Industry – McGraw Hill.

IN 1405 Pneumatic and Hydraulic Systems

Module I

Comparison of pneumatics, fluidics and electronics – pneumatic power supply – compressor schemes of instrument air production – Distribution filters – Regulators

Module II

Steady state flow of ideal gases – weight flow equation – Mach number – Orifice, nozzle and valve flow calculation – discharges coefficient – Capillary flow – visccus flow equations through parallel coefficient – Capillary flow – Visccus flow equations through parallel plates, circular tube – flow of real gas – linearised flow equations.

Module III

Steady state analysis of pneumatic components – Multiple restrictions. Volume calculations sesing chamber – valves – alternators – transients in pneumatic systems – Pneumatic cylinders – speed control spool valves – Directional control valves – popped valves – Slide valves – Solenoid valves – quick exhaust valve – Brief survey of other types of valves and associated components.

Module IV

Pneumatic control circuits and systems – Manual control of Pneumatic cylinders – Use of five and four port valves and their characteristics – Pilot operated circuits – Sequence operation of two cylinders – Three cylinders and more cylinders.

Module V

Elements of hydraulic systems – Advantages and disadvantages – service properties of hydraulic fluids – Qualities of an ideal hydraulic fluid – additives – filters and strainers – Fluid seals – Hydraulic symbols – Hydraulic accumulators – Fluid power pumps – Hydraulic Jack – Hydraulic lift.

References:

1. W.A. Blaine – Analysis and design of pneumatic system – John Wiley and sons.
2. S.C. Rangwala – Fluid Mechanics – Charotan Publishing House.
3. F.K. Kay – Pneumatic Circuit Design – Machinery Publishing Company.
4. Pneumatic Circuits and Low weight Automation – Trade and Technical Press, England.
5. Principles and Theory of Pneumatics – Trade and Technical Press Ltd., England.

IN 1406 PRACTICALS

1. **Digital Electronics Lab**

Binary adder/subtracter
Digital Comparator
Shift Registers
Counters
IC timer
LED and seven segment display
Encoders and decoders
Multiplexers and demultiplexures
Semiconductor RAM
EPROM

3. Material Sciences Lab

XRD analysis
Hall effect measurements
Electrical resistively measurements.
Characterisation of Polymer materials
Galvanic corrosion of metals and thermodynamic parameters
Tension test
Torsion test
Testing of springs
Impact test
Hardness test
Fatigue test
Performance test on four stroke engine
Viscosity determination
Moment of inertia of connecting rods
Determination of the effectiveness of a parallel and counter flow in a heat exchanger
Valve timing of a four stroke engine and port timing of a two stroke engine.

IN 1501 Control Engineering II

Sample data control systems – spectrum analysis of sampling process – signal reconstruction – Difference equation.
Z transform – Z and pulse transfer function – Inverse Z transform and response of linear.
Discrete systems – Z transform analysis of sampled data control systems response between sampling instants – Z and S domain relationships – Stability analysis – compensation techniques by continuous network time domain techniques – Selection of sampling frequency.

Module II

State variable analysis and design – concept of State, State variables and state model – State variable representation of SISO and MIMO systems – phase variable and canonical methods – state transition matrix, solution of State equations. Concept of controllability and observability – Pole placement by state feedback, state variables and linear discrete – Time systems.

Module III

Optimal control systems – Parameter optimization, Servo mechanisms – Optimal control problem – Transfer function approaches and state variable approaches – The State regulator problem – The infinite time regulator problem – The output regulator and tracking problems – Parameter optimization (regulators).

Module IV

Nonlinear systems – Common physical nonlinearities – phase plane method – Basic concepts – Singular points – Stability of non – linear systems – construction of phase trajectories – system analysis by phase plane method – The describing function method – Jump resonance – Liapunov stability criteria – Popov stability criteria.

Module V

Stochastic optimal linear estimation and control – Stochastic process and linear systems, Optimal estimation for linear continuous time and discrete time system. Stochastic optimal linear regulator – Discrete Adaptive Control.

References:

1. Gopal – Digital Control Engineering
2. Nagarath and Gopal – Control System Engineering
3. Gioson – Nonlinear Control

IN 1502 TRANSDUCERS AND INDUSTRIAL INSTRUMENTATION I

Module I

Measurement of temperature – Temperature scale – Primary and Secondary standards for calibration – different types of filled system thermometers – Installation maintenance, source of errors – Bimetallic thermometer – Thermocouples – Basic principles – various types of thermocouples – materials – construction – characteristics and circuits.

Module II

Resistance thermometer – Temperature coefficient of resistance – RTD – Materials, construction and characteristics – measuring circuits – Three wire and four wire methods – Response – Thermisters – Semiconductor and IC sensors.

Module III

Measurement of pressure – Units of pressure – pressure standards – various types of manometers – Elastic type pressure gauges – Material, construction and calibration – Pressure gauges using strain guage, capacitive, inductive and piezoelectric transfucer – Measurement of low pressure – Mclead gauge – Thermal conductivity gauge – Thermocouple gauges – Ionization gauges – Solid state pressure transducers.

Module IV

Level measurement – Float activated devices – displacer devices – torque tube purge systems – diaphragm box type, manometer type – Boiler drum level measurement – differential pressure method – Hydrastep method – Resistance, capacitive, nucleonic and ultrasonic type level gauges – Solid level measurement – Gamma ray absorption method – Weighing method - Capacitive type – diaphragm method – rotating paddle and stack detector.

Module V

Measurement of speed – Mechanical – Electrical – Electronic methods – Stroboscopic method – Measurement of acceleration – various types – Calibration.

References:

1. E.O. Deoblin – Measurement systems Application and Design – McGraw Hill.
2. C.S. Rangan, G.R. Sharma and V.S.V. Mani – Instrumentation Devices and systems – Tata McGraw Hill
3. D.P. Eckman – Industrial Instrumentation – Wiley Eastern.
4. R.K. Jain – Mechanical and Industrial Instruments – Khanna Publishers.
5. D. Patranabis – Principles of Industrial Instrumentation – Tata McGraw Hill.

IN 1503 MICROPROCESSORS AND APPLICATIONS

Module I

General organization of microprocessor based microcomputer system, internal architecture of 8085, instruction set of 8085, Assembly language programming, examples, 8085 CPU control timing, machine cycles, halt, wait states.

Module II

Memory system design, address and data bus structure, decoding of address bus, memory speed requirement, data transfer between the microprocessor and peripherals, memory mapped I/O, I/O mapped I/O, Device select decoding.

Module III

8255 FPI, 8155 counter timer, serial I/O, 8251 USART, 8085 interrupt structure, 8259 programmable interrupt controller, 8257 DMA controller, 8279 Key board and display controller.

Module IV

Interfacing peripherals; key board interface, LED display, CRT (using 8275 CRT Controller) DAC, ADC, Design of a microcomputer.

Module V

General idea about 8086, 8c x 86 6800 family of microprocessors 8051 microcontroller and RISC processors.

References:

1. Ramesh S Goankar – Microprocessor Architecture, programming and Applications.
2. S.I. Ahsen – Microprocessor with Applications in Process Control – Tata McGraw Hill.
3. M. Rafiquzzaman – Microprocessor and Microcomputer Based System Design – Universal Book Stall, New Delhi.

IN 1504 Analytical Instruments

Module I

UV-VIS-NIR spectrophotometers – Basic Principles – Laws of photometry – Radiation sources – monochromators – Filter, Prism and Grating types – stray light – Bandwidth and resolution detectors – recording instruments – scanning double beam instruments – PC based spectrophotometer.

Module II

Infrared spectrophotometers - Basic principles – Sources – IR optical systems and components – IR detectors – Data recording and analysis – Practical instrument – Fourier transform technique – FTIR principles and instrumentation – Ranan Spectrometry – Principles and instrumentation.

Module III

Atomic absorption spectrometry – sources, components and instrumentation – Analysis – Plasma and plasma excitation – Thermal analysis – Principles and Instrumentation of DTA, DSC and – Applications.

Module IV

Magnetic resonance techniques – Nuclear magnetic resonance – Principles and components – cw NMR spectrometer – Types of magnetic and probes – Measurement techniques – Data analysis – ESR spectrometer – Principles and Instrumentation.

Module V

Mass spectrometry – Principles – Magnetic deflection mass analyzer – Electrostatic analyzer – Instrumentation and data analysis – chromatography – General principles – Classification – Gas and liquid chromatography – Chromatography – Chromatographic detectors – GLC and HPLC – Principles and Instrumentation.

References:

1. Willard, Merrit, Dean and Settle – Instrumental Methods of Analysis – CBS.
2. A Skoog and M. West – Principles of Instrumental Analysis – Hall – Saunders International;
3. G.W. Ewing – Instrumental Methods of Chemical Analysis – McGraw Hill.
4. G.W. Ewing – Instrumental Methods of Chemical Analysis – McGraw Hill.

IN 1505 DIGITAL INSTRUMENTS

Module I

D/A and A/D converters – D/A converters – Binary weighted and R-2R ladder type – D/A accuracy and resolution – A/D converters counter ramp, successive approximation, Simultaneous, dual – slope A/D converters – A/D accuracy and resolution – sample and hold circuit.

Module II

Frequency and time measurement – Frequency counter – Decimal counting and display – multiplexing displays – Time base circuitry – counting input events – Frequency ratio measurement – Period measurement – Time interval and pulse width measurement – Phase measurement – Scaling – Accuracy – Errors – Counting errors.

Module III

Digital voltmeters and multimeters – Staircase – ramp and dual slope DVM – Successive approximation. DVM – sources of error – quantizing error – Automation in Voltmeters – Automatic polarity indication, ranging and zeroing – Fully automatic instrument – Digital multimeters – Current to voltage and resistance to voltage conversion – AC and RMS measurements – Q – measurement.

Module IV

Other digital instruments – Digital storage oscilloscope – Principles and instrumentation – Spectrum analyzer – Digital recorders and plotters.

Module V

Microcomputer based instruments – microcomputer compatible D/A and A/D converters – Handshake input and output – Interfacing keyboard and display – common bus and data communication standards – Parallel bus standard, the HPIB OR IEEE 488 – Serial bus standard – RS 232C and Modems – Interfacing CRT display – CRT character generator – CRT controllers.

References:

1. A.J. Bouwens – Digital Instrumentation – McGraw Hill.
2. A.D. Helfrick and W.D. Cooper – Modern electronic instrumentation and measurement techniques – Prentice Hall India.
3. D.V. Hall – Microprocessors and Digital Systems – McGraw Hill.

IN 1506 Practicals

1. Control Systems Lab

Determination of T.F. of an armature controlled DC motor
Synchors characteristics and use as error detector
Servo amplifier characteristics
Transient response of second order system.
Frequency response of second order system.
Frequency response of lag, lead and lag-lead network.
Design of DC speed control system.
Study of pneumatic and hydraulic servo system.
Study of process trainer
Characteristic of flapper value.
Simultation of position control system on analog computer.

2. Transducers Lab

Local cell characteristics
Strain guage characteristics
RTD and thermister characteristics
Thermocouple calibration
Hall effect senor.
Tachometer
Capacitive sensor characteristics
Inductive sensor characteristics – LVDT
Flapper – Nozzle characteristics
LDR and optocoupler characteristics
Synchro characteristics
Vibration sensor
Elastic transducers – characteristics.

IN 1601 TRANSDUCERS AND INDUSTRIAL INSTRUMENTATION II

Module I

Flow measurement – Bernaullis theorem – Flow of incompressible fluids – compressible fluids – orifice, Nozzle, venture, Piton tubes – installation and maintenance – square root extractor – Rotameter – Installation and maintenance.

Module II

Quantity flow meters – Positive displacement – reciprocating pistons – Oscillating pistons – Rotating disc – Helix – Oval gear – Lobed impeller type – Rotating vane – propeller type – Turbine – Combination meter – Shunt meter – Electromagnetic type – Ultrasonic type meters – Mass flow meter – Anemometer.

Module III

Measurement of weight force, Vibration an torque load cell – various types – springs piezoelectric and strain gauge load cells – Torque transducer – various types – cause of vibration – various methods of measurement – vibration shaker – Piezoelectric and variable reluctance type – vibration analysis by holography.

Module IV

Measurement of density, viscosity specific gravity scales used in petroleum industries – different methods of measuring consistency and viscosity – Methods for measuring moisture and humidity – Electrical conductivity – Dielectric constant – Automatic electric psychometer.

Module V

PH and conductivity meters – PH measurement – PH electrode station – various types of electrodes – installation and maintenance of PH meters – conductivity meter – electrical conductivity of solution – cell construction operating principles.

References:

1. E.O. Deobelin – Measurement Systems Application and Design – McGraw Hill.
2. D. Patronabis – Principles of Industrial Instrumentation – Tata McGraw Hill.
3. D.P. Eckman – Industrial Instrumentation – Wiley Eastern.
4. R.K. Jain – Mechanical and Industrial Measurement – Khanna Publishers.

IN 1602 SIGNALS AND SYSTEMS

Module I

Continuous time signals : representation of continuous time signals – Discrete time signals – Standard test signals- General definition of a system – examples of systems – basic system properties.

Module II

Continuous time systems defined by an input/output differential equation – System modeling – Integrator realizations. Discrete time systems defined by an input / output difference equation – Realisation. Convolution representation – Convolution of discrete time signals – Convolution of linear – time invariant continuous time systems – Numerical convolution.

Module III

Laplace transform – Properties of Laplace transform – Transfer function representation – inverse laplace transform – transform of input/output differential equation – Transfer function of block diagrams. Stability of continuous time systems – Response to sinusoidal input – Frequency response function – Two pole system.

Module IV

Z-transform – properties of Z-transform, transfer function representation – inverse Z transform of rational function – transform of input/output difference equation – stability of discrete time systems – frequency response of discrete time systems.

Module V

Fourier series representation of periodic signals – Symmetry and the exponential form of the fourier series – Response to periodic inputs – Fourier transform – Generalized fourier transform. Computation of output response via the fourier transform – Generalized fourier transform. Computation of output response via the fourier transform – analysis of ideal filters – amplitude modulation – pulse amplitude modulation. Discrete time fourier transform – Discrete fourier transform – System analysis via the DTFT and DFT.

References:

1. Edward W Kamen – Introduction to Signals and systems – Macmillan Publishing Company.
2. Alan V Oppenheim and Alan S Willsky – Signals and System – Prentice Hall India.

IN 1603 OPTOELECTRONIC INSTRUMENTATION

Module I

Interferometers – Fabry – Perot and Michelson intereferometers – Interference filters – Interferometric method of measurement of optical components – Optical spectrum analyzer.

Module II

Modulation of light – Birefringence – Optical activity – Electrooptic effect – Kerr modulators – Magneto – optic devices – Acousto optic modulators Display devices – Luminescence – Electroluminescence – Injection Luminescence – Light emitting diode – Plasma displays – Liquid crystal displays.

Module III

Lasers – Principles of operation – Einstein relations – population inversion – optical feedback – Laser modes – Classes of lasers – Solid state, gas and liquid dye lasers – Semiconductor lasers – Q – switching and mode locking – properties of laser light.

Module IV

Applications of lasers – distance measurement – Holography – Principles and applications – Industrial, biomedical and Pollution monitoring applications – Laser speckle and applications – Optical fibers – Light guidance through fibers – Step index and graded index fibers – Multimode and single mode fibers – Fibre fabrication.

Module V

Measurement of fibre characteristics – Attenuation, dispersion and refractive index profile measurement – OYDER – Fibre optic components – couplers, splicers and connectors – Applications of optical fibres – optical fibre communication – fibre optic sensors – measurement of temperature, pressure, displacement, acceleration, strain, fluid level, current and voltage.

References:

1. J. Wilson and J.F.B. Hawkes – Optoelectronics: An Introduction – Prentice Hall of India.
2. K. Thygarajan and A.K. Ghatak – Lasers: Theory and Applications – Plenum Press.
3. O. Svelto – Principles of Lasters – Plenum Press.

IN 1604 PROCESS CONTROL I

Module I

Process Dybnamics – Process variables – Degree of freedom – characterization of physical systems – Dynamics of liquid, gas and thermal process – interacting and noninteracting systems – continuous and batch process – self regulation and servo regulation operation – problems.

Module II

Control actions and controllers – Basic control actions – characteristics of two position, multi position, floating, proportional I, D control modes – Composite control modes – PI, PD, PID control modes pneumatic and electronic controllers to realize various control actions.

Module III

Optimum controller settings: Evaluation criteria, $1/4^{th}$ decay ratio, IAE, ISE, ITAE - determination of optimum settings for mathematically described process using time response and frequency response – Tuning – Process reaction curve method, continuous – cycling method, Damped oscillation method.

Module IV

Final control element. I/P converter – Pneumatic, electric and hydraulic actuators – valve positioner – Control valves – Effective valve characteristics, valve body – globe, butterfly, diaphragm, Ball valves – value sizing, cavitation, flouting.

Module V

Complex control system: Cascade control – Feed forward control, Ratio control – Multivariable control. Piping and instrumentation diagram, case study – Distillation column control – Combustion control and drum level control in steam boiler.

References:

1. Peter Harriot – Process control – Tata McGraw Hill
2. D. Patranable – Principles of Process Control – Tata McGraw Hill.
3. Curties Johnson – Process Control Instrumentation Technology
4. D.P. Eckman – Automatic Process Control – Wiley Eastern
5. Bela G Liptak – Process Control, Instrument Engineers Handbook.
6. Donald R Coughanowr – Process System Analysis and Control – McGraw Hill.

IN 1605 ENGINEERING MANAGEMENT

Module I

Principles of management – Management concepts – scientific management – Modern trends – Management functions
Finance Management: Sources of finance – Elements of Economics – Supply, demand, price, savings, consumption and investments.
Costing: Types – breakeven analysis – profit and loss account and balance sheet – inferences.

Module II

Production and material management: Plant location lay out – work place design – workstudy maintenance and replacement – Policies – Depreciation – Inventory models – single order inventory policy – Quality control – acceptance sampling – Control charts – Reliability – concept of total quality management.

Module III

Quantitative techniques – linear programming – simple assignments – routing – transportation – queuing theory – CPM and PERT – applications to management practice.

Module IV

Personal management: Functions – manpower – planning and inventory – recruitment – training – motivation – leadership – wage and incentive plans – industrial fatigue – accidents – safety – job evaluation – merit rating change – conflict – communication – industrial relations – disputes – trade union.

Module V

Marketing Management: Production design – sales strategies – sales organizations – distribution channels – marketing services – marketing research.

General Management: Management development – organizational development – behavioural science principles.

References:

1. O.P. Khanna – Industrial Engineering and Management – Dhanpat Rai and Sons
2. Paul Samuelson – Economics – McGraw Hill
3. S.G. Huneryager and I.L. Hechman – Human Relations in Management – D.B. Tarapurvala and sons
4. S.Elion – Elements of production planning and control – Macmillian Co.
5. I.M. Pandy – Financial Management – Vikas Publishing & Co.
6. E.S. Baffa – Modern production management – John Wiley and Sons.
7. I.W. Burr – Engineering Statistics and quality control – McGraw Hill.
8. A.J. Duncan – Quality Control and industrial statistics – Richard D. Irwing Inc.

IN 1606 PRACTICALS

At least 15 softward experiments using 8085 kit
At least 5 experiments in 8051 microcontroller kit

Interfacing of ADC.DAC. Stepper motor, switch, LED, LVDT, thermocouple and tachometer to 8085/8051 kit.

IBM PC assembly language programming.

3. Industrial Instrumentation Lab

Orifice meter, Rotameter, Venturi meter
Level measurement using different techniques
Pressure gauge calibration
EM flow meter and ultrasonic flow meter
Measurement of PH and conductivity
Determination of viscosity coefficient
Operation of level control loop
Operation of pressure control loop
Operation of flow control loop
Test on combustion lab. Unit.

IN 1701 BIOMEDICAL INSTRUMENTATION

Module I

Human anatomy and physiology – Bioelectricity – resting membrane potential, action potential, transmission of impulses – electrical activity of hear, brain and muscle – ECG, EEG and EMG wave forms.

Transducers for biological applications, types, properties, characteristics and selection of transducers for biological instrumentation.

Module II

Leads and electrodes - types selection, materials, equivalent circuit of electrodes, methods of application of electrodes and leads – various functional blocks in bio-medical equipment – requirement and selection – power supplies – different types of amplifiers – Oscillators, modulators and demodulators – Safety instrumentation – different writing systems.

Module III

Electrocardiograph – abnormal waveforms – electro encephalograph – evoked response – electromyograph conduction velocity – Phono cardiography – abnormal waveforms, Electro retinography, electro oculography Blood flowmeter – electro magnetic, ultrasonic and NMR.

Module IV

Therapeutic instruments – Cardiac pacemaker, defibrillators, Hemodialysis machine – Surgical diathermy equipment - physiotherapy equipment – short wave , incrowave and ultrasonic disthermy units Bone and muscle stimulators.

Module V

PH of blood – Ph meter – respiration rate – Spirometer – pneumotactograph – Measurement of concentration of Co2 and O2 in exhaust air and blood – Blood gas analyzer, paramagnetic oxygen analyzer – Spectrophotometer – BSR & GSR – Biotelemetry.

References:

1. Leslie Cromwell – Biomedical instrumentation and measurements – Prentice Hall
2. L.A. Geddes and L.E. Baker – Principles of Applied bio-medical instrumentation – John Wiley and Sons.
3. B. Jacobson and J.G. Webster – Medicine and clinical engineering Prentice Hall India.
4. Mackay Stuart R – Biomedical telemetering – John Wiley
5. R.S. Khandpur – Handbook of biomedical
6. M.C. Albert and J.G. Webster – Therapeutic medical devices – Prentice Hall

IN 1702 PROCESS CONTROL II

Module I

An overview: Introduction to computer control system need for computers in a control system, functional block diagrams of computer control system. Data acquisition system, supervisory control and direct digital control.

Module II

State variable representation in discrete system: Continuous – time state variable problem – Solution of the state equation – matrix exponential series approach solution of the discrete state equation – transfer functions from state variable description – Controllability – observability – State variable representation of discrete system and state variable representation of composite control system.

Module III

Discrete control algorithm: Mathematical modeling for process I – order. I – order and I – order with pure delay II order with pure delay, modified Z-transform – pulse transfer function, analysis of discrete data systems, selection of sampling time, stability in Z-domain, Z-transform for system dead time. Dead beat, Dahlin's, Kalman's and PID control algorithm.

Module IV

Digital control system: Distributed control system (DCS) – Significance of DCS, advantages, Configuration and communication facilities for DCS, programmable logic controllers – Configuration, ladder diagram – interlocking systems.

Module V

Introduction to system identification and self tuning controllers (STC) – Use of artificial intelligence (AI). Expert system control.

References:

1. Johnson – Process control instrumentation technology – Prentice Hall Inc.
2. C.L. Smith – Digital computer process control – Indent Educational Publishers.
3. Pradeep B. Despande and Raymond H. Ash – Elements of computer process control with advanced control applications – Instrument Society of America, 1981.
4. C.M. Houpis and G.B. Lamont – Digital control systems – Van Nostrand Reinhold Company.
5. Michael P. Lukas – Distributed Control Systems – Van Nostrand Reinhold Company.

IN 1703 POWER PLANT INSTRUMENTATION

Module I

An overview: Brief survey of methods of power generation – Hydro thermal, nuclear, solar, wind etc. dependence of instrumentation on the method of power generation, power plant general structure, Pulvarizers and burners, fans, dampers and actuators, super heaters, steam traps, economizers, recupurators and regenerators, cooling towers, feed water, generator turbine cooling systems. Importance of instrumentation and control.

Reading and drawing of instrumentation diagrams: Flow sheet symbols – ANSI symbols for lines, valves, heat transfer, dryer, material handling equipment, storage vessels, flow sheet codes and lines. Graphical symbol for pipe fittings, valves and piping, instrumentation symbols, standards specifications – one line diagram for typical measurement an control schemes for flow, temperature. One line diagram of typical pneumatic, hydraulic and electrical instrumentation system.

Module II

Parameters and measurements: Electrical measurements – current, voltage, power, frequency – nonelectrical parameters, flow of feed water, fuel, air and steam with correction factors for temperature – pressure level. Radiation detectors – smoke density measurement.

Module III

Control loops and interlocks: Combustion control – control of pressure, air/fuel ratio, furnace draught and excess air control, drum level (three element) control. Main and reheat steam temperature control. Burner tilting up, by pass damper – Super heater spray and gas recirculation control – BFP recirculation control – hot well and eaerator level control – interlock MFT turbine trip conditions – Pulversizer control.

Module IV

Turbine monitoring and control: Consenser vacuum control – Gland steam exhaust pressure control – speed, vibration, shell temperature monitoring – Lubricating oil temperature control. H2 generator cooling system.

Nuclear reactor control loops – Description – Function – Safety measures in nuclear reactor control.

Module V

Analysers in power plants: Thermal conductive type – paramagnetic type – oxygen analyzer – infrared type and trim analyzer – spectrum analyzer – hydrogen purity meter – Chromatography – pH meter – conductivity cell – Fuel analyzer. Pollution monitoring and control.

Computer in power plant: Load despatching computer, generation station computer, supervisory, DDC, DAS and DCC.

References;

1. Modern power station practice, volume 6, instrumentation, Control and Testing – Pergamon Press, Oxford.
2. E.L. Wakil MM – Power plant technology – McGraw Hill.
3. Richard Dolezal and Ludrik Varcop – Process dynamics (Automatic control of steam generation plant) – Elsevier Publishing company Ltd.
4. Stephan Michoel Elonka and Anthony Lawrance Kohal – Standard Boiler operations Questions and Answers – Tata McGraw Hill.
5. B.G Liptak – Instrumentation in processing industries – Chiltan Book Co.
6. D.M. Considine and S.P. Ross – Handbook of Applied Instrumentation.
7. Grady C. Caracle – Industrial instrumentation servicing handbook – McGraw Hill.
8. CEGB Engineers Modern Power Station Practice, Vol. 6 – Pergamon.

IN 1704 TELEMETRY AND REMOTE CONTROL

Module I

Fundamental concepts: Functional blocks of telemetry and tele control systems – Methods of telemetry – Electrical, pneumatic and optical telemetry, telemetry standards.

Landline telemetry: Electrical Telemetry – Current, Voltage, synchro and position.

Module II

Radio telemetry: Transmission and receiving techniques, RF modulation and demodulation – AM, FM, PM, PCM, FSK, Delta and adaptive modulation, multiplexing and demultiplexing – Digital coding.

Module III

Optical telemetry: Optical fibers for signal transmission – Source for fibre optic transmission – Optical detectors. Trends in fibre optic device development. Examples of optical telemetry system.

Module IV

Analog and digital techniques in telectrol, Remote transmission, signaling, adjustment, guidance and regulation reliability of telectrol installations. Design of telectrol installations.

Module V

Case Study: Telemetry system in process industries. Satellite telemetry and telecontrol system.

References:

1. E.L. Gruenberg – Handbook of telemetry and remot control – McGraw Hill.
2. R.E. Young – Telemetry Engineering – Little Book Ltd., J.K.
3. G. Swoboda – Telecontrol methods and applications of telemetry and remote control – Reinhold publishing company U. K
4. R.K. Rajangam – Industrial telemetry – Lecture Notes, IISc., Bangalore.

IN 1705 ROBOTICS AND EXPERT SYSTEMS

Module I

Basic concepts, power sources and sensors – Definition and origin of robotics, Different types of robots, degree of freedom Asimov's laws of robotics, different types of robots, dynamic stabilization of robots, Determination of HP of motor and gearing ratio, variable speed arrangement, had acid and nickel cadmium batteries, path determination, vision, ranging, laser, acoustics and tactile sensors.

Module II

Manipulators, actuators and grippers, construction of manipulators, Manipulator dynamics and force control, Electronics and pneumatic manipulator, control circuits, pneumatic hydraulic and electric actuators and effectors, various types of grippers, design considerations.

Module III

Kinematics – Homogeneous Co-ordinates, solution of inverse. Kinematic problem, multiple salutations Jacobians, Work envelope.

Module – IV

AI and Expert system – Introduction, components of export system- construction, methodology and tools for building – Expert system, characteristics of E.S. Hill climbing techniques, knowledge representation, Predicate calculus, Resolution, Robot programming languages.

Module V

Robots for production and component handling spare parts policy payback analysis, Multiple robots and machine interference, future trends in robotics.

References:

1. Mikell P. Groover, Mitchell weiss, Roger N. Nagel and Bnicholas G. Odery- industrial robotics Technology programming and Applications – McGraw Hill.
2. E.L. Safford – Complete Handbook of Robotics – Tab Books,
3. K. Shimon – Handbook of Industrial Robotos – John Wiley.
4. John J. Grey – Introduction to Robotics, Mechanics and Control – Addison Wesley.

IN 1706 : PRACTICALS

Process Control Lab

Response of controllers
Integral and derivative controlled process
On-off controlled process
Proportional control process
Calibration of Control valves
Closed loop air temperature control
Cascade control

IN 707: MINI PROJECT

IN 708: SEMINAR

IN 1801 VACUUM AND CRYOGENIC INSTRUMENTATION

Module I

Vacuum – Basic ideas – Vapours and saturated vapour pressure – gas mixtures – partial pressures – Mean free path – Volume flow rate – Vacuum pumps – Diffusion pumps – accessories – Turbomolecular pumps – Cryopumps

Module II

Vacuum measurement – vacuum scale – Mechanical phenomena gauges - Transport phenomena gauges – Ionization phenomena gauges – Mounting gauge heads – Calibration – Accuracy.

Module III

Design considerations – conductance – Gas flow regions – Gas and vapour load – Ultra high vacuum systems – UHV measurement – vacuum leak detection – Identification of gases present.

Module IV

Low temperature – Basic ideas – Production of low temperature – Liquid nitrogen and liquid helium plants – Measurement of low temperatures – Storage and transfer of liquefied gases – Cooling with Helium – The dilution refrigerator – Adiabatic demagnetization

Module V

Design of cryostats – General considerations – Cryostats for specific heat, thermal conductivity and electrical resistivity measurements – Cryostats for optical and X-ray studies, magnetic susceptibility measurements – Closed cycle nitrogen and helium refrigerators.

References:

1. N. Harris – Modern vacuum practice – McGraw Hill.
2. G.K. White – Experimental techniques in low temperature Physics – Clarendon Press
3. A. Roth – Vacuum techniques – North Holland.

IN 1802 MICROCONTROLLER AND MICROCOMPUTER BASED INSTRUMENTATION

Module I

8051 architecture: 8051 microcontroller hardware – Input/output pins, ports and circuits – External memory – Counter and timers – Serial data Input/Output – Interrupts.

Module II

8051 Programming: 8051 instruction syntax – moving data – Logical operations – Arithmetic operations – Branching Instructions.

Module III

8051 based system design: Microcontroller based system design – testing the design – timing routines – Look up table for the 8051 – Serial data transmission.

Module IV

PC Hardware: Computer components, PC expansion architecture – Design consideration of PC expansion cards. Interfacing standards for PC – General-purpose Instrumentation bus (GPIB) – IEEE-488 protocol – IEEE-488-2 standard – GPIB hardware – Basic concepts of programming the IEEE 488 GPIB.

Module V

PC assembly language and programming: The general software environment for the PC – operating system – Boot processing – system program loader – program addressing. The DEBUG program – entering and executing program. Steps in assembling, linking and executing assembly language program. Writing COM programs – Screen and key board processing in assembly language. Printing reading and writing files in assembly language.

References:

1. Kenneth J. Ayala – The 8051 Microcontroller architecture, programming and applications – Penram International Publishing
2. Peter Norton – Inside the PC – Prentice Hall India
3. Anthony J. Caristi – IEEE 488 General purpose Instrumentation bus Manual – Academic Press.
4. Peter Abel – IBM PC assembly language and programming – Prentice Hall India.

IN 1803: ELECTIVE – II
(From list of electives)
IN 1804: COMPREHENSIVE VIVA VOCE
IN 1805 : PROJECT
Project Work
Viva – Voce

LIST OF ELECTIVES (IN 803)
Digital Signal Processing

Module I

The system function and the frequency response of LTI systems – Computation of frequency response function – Linear time – invariant systems as frequency selective filters – Design of digital filters by placement of poles and zeros in the Z-plane – inverse systems Deconvolution and system identification.

Module II

Time domain sampling of continuous-time signals-Analog to digital conversion-Digital to analog conversion – frequency domain sampling of discrete – time signals – Discrete Fourier transform.

Module III

Implementation of discrete time systems: Structure for FIR systems: Structure for FIR Systems – Structures for IIR systems – state space system analysis and structures – representation of numbers – quantization of filter coefficients – Round off effect in digital filters.

Module IV

Design of digital filters: Design of FIR filters – Design of IIR filters from analog filters – Frequency transformation – Design of digital filters based on least – square method.

Module V

The DFT and its properties – Linear filtering methods based on the DFT – FFT algorithms – Linear filtering approach to computation of DFT – Quantisation effect in the computation of the DFT.

References:

1. John G. Proakis and Dimitris G. Manolakis – Digital signal processing principles, algorithms and applications – Prentice Hall India.
2. Alan V. Openheim and Ronald W. Schafer – Discrete time signal processing.

ENVIRONMENTAL MONITORING INSTRUMENTS

Module I

Pollutants produced by human and industrial activities – Need for monitoring – Classification – Ambient environmental monitoring Source monitoring – Inplan environmental monitoring – Personal monitoring.

Module II

Air Pollution – Different air pollutant – Effects – Monitoring and abatement conductivity – Coulometry – Electrochemical cell – Priezoelectric – Optical methods – instruments and case study.

Module III

Water pollution – Water pollutants – Health hazards. Detection techniques – Emission spectroscopy – Atomic absorption spectroscopy – Polarography – Chromatography – Computer methods – Waste Water treatment.

Module IV

Soil pollution – Industrial solid pollutant – pesticides – their effect on agriculture products – salinity nutrients – residuals – monitoring – control.

Module V

Noise pollution and measurement – The effect of noise on human beings and environment – sources of noise – Method to measure and reduce the noise.

References:

1. S.P. Mahajan – Pollution Control in Process Industries – Tata McGraw Hill.
2. J.F. Andrew, P. Briggs and S.H. Jankrins – Instrumentation for control and automation for water – waste water treatment system – Pergamon Press
3. C.S. Arthur – Air pollution – Academic Press

NONLINEAR CONTROL SYSTEMS

Module I

Concept of control system design: Basic concept of control system design, optimum design problem, problem formulation and performance indices and state variable representation of system.

Module II

Describing function and phase plane method: Definition and derivation of describing functions of nonlinear control systems, phase plane methods of constructing trajectories, phase plane analysis of linear and non-linear control systems.

Module III

Observer: Linear observer design I & II order problems.
Stability: Second method of Liapunov's stability for linear and nonlinear systems.

Module IV

Maximum principle: Statement of maximum principle theory and application to minimum time, energy and control effort problem and terminal control problem.

Module V

Calculus of variations: Basic minimization problem, Meyar and Bolzu problem, Euler – Lagrange equations, transversality conditions, Lagrange multiplier, I order problems as examples.

References:

1. J.C. Hsu and A.U. Meyer – Modern Control Principles and Applications – McGraw Hill.
2. J.E. Gibson – Nonlinear Control Theory – Kogakusha Co. Ltd.,
3. A.P. Sage and C.C. White – Optimum system control – Prentice Hall of India.
4. Katsuhiko Ogata – Modern Control Engineering – Prentice Hall of India.
5. M. Gopal – Modern Control System Theory – Wiley Eastern.

ADAPTIVE CONTROL AND LEARNING SYSTEMS

Module I

Mathematical Model – Mathematical model for processes of I order, II order – I order with pure delay – Higher order systems. Discretisation techniques and computer solution of differential

equations – Simulation of process dynamics – introduction to adaptive control, MRAC and self tuning control.

Module II

Identification of continuous data, systems – Conventional methods techniques, identification of system with dead time – smith controller, Pade approximation – Multilog methods.

Module III

Identification of discrete time systems – ARMA process least squares techniques – recursive least squares – Generalized recursive least squares algorithms – Fixed memory algorithm.

Module IV

State estimation and observers – Parameter estimation and state estimation techniques – Adaptive observers – Extended Recursive least squares FM and Kalman filter.

Module V

Adaptive control of deterministic and stochastic systems – Minimum prediction – error adaptive controls – Direct approach and indirect approach – Adaptive algorithm for pole placement – Adaptive control of time varying systems – Optimal controllers.

References:

1. G.C. Goodwin and K.S. Sin – Adaptive filtering, prediction and control – Prentice Hall.
2. P. Eykhoff – system identification – John Wiley and Sons.
3. J.M. Mandel – Discrete Technique of Parameter Estimation – Marcel Dekker.
4. C.J. Harris and S. Abillings – Self Tuning and adaptive Control – Peter Peregrinus Ltd.
5. TCH Hise – System Identification – Lexington Books.

PROCESS DYNAMICS

Module I

Introduction: Process defined, chemical production processes, Unit process and unit operation, conservation of mass, energy and momentum, batch and continuous processes, static and dynamic characteristics, degrees of freedom and their importance in process control, equipment design and its constraint on automation, integral approach, formulation of mathematical model for simple processes.

Module II

Mass Transfer Dynamics: Mass transfer process, rate equation, driving force, fugacity and concentration, Fick's law of diffusion in gas phase, equimolar counter diffusion, diffusion through stationery gas, Maxwell's law, diffusion in liquids, mass transfer in a turbulent fluid, mass transfer across phase boundary transfer units.

Module III

Thermal Process Dynamics: Basic thermal process, Physical concept, manipulation of thermal process, forced and natural convection, convection heaters, heat exchanges – Two convection, convection heaters, heat exchangers – Two convectors as heaters in series, derivation of general equation for convection heat transfer, equation for liquid vapour heat exchanger, dynamic response of heat exchangers, thermal circuits.

Module IV

Simultaneous Heat and Mass Transfer: Cddy transfer, quantitative relationship between heat, mass and momentum transfer, Reynold's analogy between heat transfer and mass transfer, interaction of air and water adiabatic humidifier, cooling towers, drying mechanism, dryers distillation, general principles, distillation columns, column dynamics.

Module V

Chemical process Dynamics: Chemical Processes, reaction kinetics modeling of chemical reaction systems, elements of reactor dynamics composition regulation, recycle process.

References:

1. Champbell P. Donald – Process dynamics – John Wiley and Sons.
2. Sherwood Thomas K and Red Charier E – Applied Mathematics in Chemical Engineering – McGraw Hill.
3. F.G. Shinskey – Process Control System – McGraw Hill.

ADVANCED ANALYTICAL TECHNIQUES

Module I

X-ray methods of analysis – Basic principles – sources – Detectors X-ray absorption methods – X-ray fluorescence technique – X-ray diffraction methods – Electron probe micro analysis.

Module II

Electron and ion spectroscopy – X-ray and UV photoelectron spectroscopy – ESCA – Electron impact spectroscopy – Auger electron spectroscopy – Ion scattering –Spectroscopy Rutherford back scattering Principles – Instrumentation and analysis.

Module III

Advanced topics in magnetic resonance spectrometry – Fourier transform techniques – Nuclear quadruple resonance spectroscopy – C13 NMR – 2-d NMR – Advanced topics in mass spectrometry – Quadruple mass analyzer.

Module IV

Electron microscopy – TEM – SEM – Principles, instrumentation and analysis, Scanning tunneling microscopy, Atomic force microscopy – Principles, instrumentation and analysis – Applications

Module V

Photo acoustic and photo thermal spectrometers – Principles and instrumentation – spectroflourimeters and phosphorimeters – Electrochemical instruments – Conductivity meters – Coulometers – Amperometers – Radiochemical instruments.

References

1. Willard, Merrit, Dean and Settle – Instrumental Methods of Analysis – CBS
2. G.W. Ewing – Instrumental methods of chemical analysis – McGraw Hill
3. A. Skoog and M. West – Principles of instrumental analysis – Hall Sanders International
4. R.S. Khandpur – Handbook of Analytical instruments – Tata McGraw Hill.

ADVANCED BIOMEDICAL INSTRUMENTATION

Module I

Heart-lung machine – Artificial heart valves – Pacemakers and Defibrillators – Anesthesia machine – Blood cell counter – digital thermometer – Audiometer – Electron Microscope – up based ventilator bio-materials.

Module II

X-ray machine – Radiography and fluoroscopy – Image intensifiers – conventional X-ray imaging – Angiography – Computed tomography – Linear tomography – tomography scanner – applications. Magnetic resonance imaging systems- Basic NMR Components

Module III

Ultrasonic imaging systems – physics of ultrasonic waves, medical ultrasound, construction of an ultrasonic transducer, different modes of operations of ultrasound – A scan, B scan – Echocardiograph (M mode), Real time ultrasonic imaging system, computer controlled ultrasonic imaging – Applications.

Module IV

Laser application in machine – Laser – Pulsed Ruby Laser, Nd – YAG laser, Argon Laser, CO2 laser, Helium –neon laser – applications – Advantages of laser surgery – Laser based Doppler blood flow meter – Endoscope – Cardio scope – Laparoscope – Endoscope laser coagulator cryogenic surgery.

Module V

Medical thermography – Physics of thermography – Thermographic equipment – Quantitative medical thermography – Infrared, Liquid crystal and microwave thermography – Medical applications of thermography.

Computer applications in medicine – Computer aided ECG analysis – computerized catheterization laboratory – Computerized patient monitoring system.

References:

1. Leslie Cromwell – Biomedical instrumentation and measurements – Prentice Hall.
2. L.A. Geddes and L.E. Baker – Principles of Applied biomedical instrumentation – John Wiley and sons
3. B. Jacobson and J.G. Webster – Medicine and Clinical Engineering – Prentice Hall of India.
4. Mackay Sturat R – Biomedical telemetering – John Wiley.
5. R.S. Khandpur – Handbook of Bio-medical Engineering – Tata McGraw Hill
6. M.C. Albert and J.G. Webster – Therapeutic medical devices – Prentice Hall.

IN 705 (Elective)
ROBOTICS AND EXPET SYSTEMS

Module I

Basic concepts, power sources and sensors – Definition and origin of robotics, Different types of robots, degree of freedom Asimov's laws of robotics, different types of robots, dynamic stabilization of robots, Determination of HP of motor and gearing ratio, variable speed arrangement, had acid and nickel cadmium batteries, path determination, vision, ranging, laser, acoustics and tactile sensors.

Module II

Manipulators, actuators and grippers, construction of manipulators, Manipulator dynamics and force control, Electronics and pneumatic manipulator, control circuits, pneumatic hydraulic and electric actuators and effectors, various types of grippers, design considerations.

Module III

Kinematics – Homogeneous Co-ordinates, solution of inverse. Kinematic problem, multiple salutations Jacobians, Work envelope.

Module – IV

AI and Expert system – Introduction, components of export system- construction, methodology and tools for building – Expert system, characteristics of E.S. Hill climbing techniques, knowledge representation, Predicate calculus, Resolution, Robot programming languages.

Module V

Robots for production and component handling spare parts policy payback analysis, Multiple robots and machine interference, future trends in robotics.

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5. Mikell P. Groover, Mitchell weiss, Roger N. Nagel and Bnicholas G. Odery- industrial robotics Technology programming and Applications – McGraw Hill.
6. E.L. Safford – Complete Handbook of Robotics – Tab Books,
7. K. Shimon – Handbook of Industrial Robotos – John Wiley.
8. John J. Grey – Introduction to Robotics, Mechanics and Control – Addison Wesley.