

# **Course of Reading for B.E (Instrumentation and Control Engineering)**

TH=Theory (100 marks)

PR=Practical (100 marks)

VS=Valuation of Sessional (100 marks, NO END SEM)

## **Semester 1**

TH1 IC-101 Humanities

TH2 IC-102 Mathematics I

TH3 IC-103 Physics I

TH4 IC-104 Chemistry

TH5 IC-105 Manufacturing Process

PR1 IC-106 Engineering Drawing

PR2 IC-107 Physics I Lab

PR3 IC-108 Chemistry Lab

PR4 IC-109 Workshop I

## **Semester 2**

TH1 IC-111 Principles of Electrical Engineering

TH2 IC-112 Applied Mechanics

TH3 IC-113 Mathematics II

TH4 IC-114 Introduction to Programming

TH5 IC-115 Physics of Materials

PR1 IC-116 Principles of Electrical Engg. Lab

PR2 IC-117 Applied Mechanics Lab

PR3 IC-118 Introduction to Programming Lab

PR4 IC-119 Physics of Materials Lab

## **Semester 3**

TH1 IC-201 Electronics I

TH2 IC-202 Circuit and Systems

TH3 IC-203 Power Apparatus

TH4 IC-204 Electrical Measurements

TH5 IC-205 Mathematics III

PR1 IC-206 Electronics I Lab

PR2 IC-207 Power Apparatus Lab

PR3 IC-208 Electrical Measurement Lab

PR4 IC-209 Machine Drawing

VS1 IC-210 Programming I

## **Semester 4**

TH1 IC 211 Electronics II  
TH2 IC 212 Fluid Mechanics and Thermodynamics  
TH3 IC 213 Electronic Instrumentation and Measurements  
TH4 IC 214 Computer Graphics  
TH5 IC 215 Transducers and components  
PR1 IC 216 Electronics II  
PR2 IC 217 Computer Graphics  
PR3 IC 218 Instrumentation Lab  
PR4 IC 219 Electrical Workshop nad Electrical Drawing Lab  
PR5 IC 220 Practical Training  
VS1 IC 221 Report Writing  
VS2 IC 222 Programming II

### **Semester 5**

TH1 IC 301 Analog and Digital Communication  
TH2 IC 302 Industrial and Analytical Instruments  
TH3 IC 303 Digital Integrated Circuits I  
TH4 IC 304 Linear Integrated Circuits  
TH5 IC 305 Industrial Organisation and Managerial Economics  
PR1 IC 306 Analog and Digital Communication  
PR2 IC 307 Digital Integrated Circuits I  
PR3 IC 308 Linear Integrated Circuits  
PR4 IC 309 Programming III

### **Semester 6**

TH1 IC 311 Microprocessor  
TH2 IC 312 CAD  
TH3 IC 313 Industrial Electronics  
TH4 IC 314 Control Systems I  
TH5 IC 315 Telementary and Data Transmission  
PR1 IC 316 Microprocessor  
PR2 IC 317 CAD Lab  
PR3 IC 318 Control Systems Lab I  
VS1 IC 319 Programming IV  
VS2 IC 320 Based on Practical Training

### **Semester 7**

TH1 IC 401 Control Systems II  
TH2 IC 402 Digital Integrated Circuits II  
TH3 IC 403 Process Control  
TH4 IC 404 Elective I \*  
TH5 IC 405 Elective II \*  
PR1 IC 406 Control Systems II  
PR2 IC 407 Digital Integrated Circuits II  
PR3 IC 408 Instrumentation Lab II

PR4 IC 409 Practical Training  
VS1 IC 410 Programming V

### **Semester 8**

TH1 IC 411 Consumer Electronics  
TH2 IC 412 Elective III \*\*  
TH3 IC 413 Elective IV \*\*  
(PR1 IC 414 Not Applicable)  
PR2 IC 415 PROJECT  
PR3 IC 416 Practical Training  
VS1 IC 417 Seminar and Reports

\* Any two of the following must be selected for ELECTIVE I and II (SEM 7) :

MEDICAL INSTRUMENTATION  
MICROPROCESSOR APPLICATIONS IN INSTRUMENTATION AND CONTROL  
ENVIRONMENTAL INSTRUMENTATION AND SAFETY  
OPTICAL INSTRUMENTATION  
LASER AND FIBRE OPTIC SYSTEM  
COMPUTER CONTROL OF SYSTEMS  
NUCLEAR INSTRUMENTATION  
SAFETY AND RELIABILITY  
NONDESTRUCTIVE TESTING

\*\* Any two of the following must be selected for ELECTIVE III and IV (SEM 8) :

POWER PLANT TRANSMISSION  
COMPUTER CONTROLLED INSTRUMENTATION  
AIRCRAFT INSTRUMENTATION AND CONTROL SYSTEMS  
INERTIAL NAVIGATION AND CONTROL  
ARTIFICIAL INTELLIGENCE  
SELECTED TOPICS IN INSTRUMENTATION  
ROBOTICS  
DIGITAL SIGNAL PROCESSING  
PNEUMATIC AND HYDRAULIC INSTRUMENTATION AND FLUIDICS  
INSTRUMENTATION-METHODS OF ANALYSIS  
FAULT -TOLERANT COMPUTING

# **B.E (Instrumentation and Control Engineering) FIRST YEAR, FIRST SEM. End Sem Examination. (CREDITS=29)**

## **IC 101 : HUMANITIES (TH1)**

### **(A) TEXT.**

**Essay, Short Stories and One Act Plays.**

**Editor : R.R Kaushik & S.C.Bhatia , Published by Oxford University Press.**

The following chapters are prescribed for study.

### **(i) Essays**

- 1) Nehru the Democrat by M.Chalapati Rau
- 2) Bores by E.V. Lucas
- 3) Freedom by G.B. Shah
- 4) What I require from Life by J.B.S. Haldane
- 5) Student Mobs by J.S Pristley

### **(ii) Short Stories**

- 1) The fortune Teller by Karl Capek
- 2) Grief by Anton Chekov
- 3) The Doll's House by Katherine Mansfield

### **(iii) One Act Plays**

- 1) A Marriage Proposal by Anton Chekov
- 2) The Boy Comes Home by A.A.Milne

## **(B) ENGLISH LANGUAGE PRATICE.**

### **Applied Grammar**

Common Errors, Use of words, Synonyms and Antonyms, Formation of Words - Prefixes and Suffixes.

### **Composition**

Comprehension, Dialouge Writing , Conversational and idioms.

### **Spoken English**

Practice in self - Expression talks, Lectures and Speeches.

## **IC 102 : MATHEMATICS - I (TH2)**

### **Algebra**

Partial Fraction, Hyperbolic and inverse hyperbolic functions, De - Movire's Theorem and its applications : Relations between circular and hyperbolic functions. Positive term infinite series and their convergence (Comparison and Ratio tests), Alternating Series.

### **Differential Calculus**

Derivatives of Hyperbolic Functions, successive diffenentiation and Leibnitz's theorem, Taylor's and Maclaurin's Series, Maxima and Minima of functions of one variable, curvature and radius of curvature, points of inflexion.

### **Integral Calculus**

Integration by partial fractions. Integration of forms  $I, I/R$  where  $R = ax^2 + bx + c$ . Properties of definite integrals.

### **Reduction Formulae**

Application of integration to areas, areas, surfaces and volume of solids of revolutions. Trapezoidal and Simpson's rules.

## **IC 103 : PHYSICS - I (TH3)**

### **Relativity**

Absolute and inertial frame of reference, Newtonian and Galilean relativity, Galilean Transformation, Michelson Moreley Experiment and its implications, Einstein's law of addition of velocities. Mass variation with velocity, concept of energy and momentum as four vectors, Einstein's mass energy relation.

### **Inverse square law of Forces**

Fundamental Interactions, Electromagnetic and gravitational interactions. Force and potential control force.

### **Invariance and Symmetry Principles**

Invariance of a physical quantity, laws of conservation of momentum, energy and charge, concept of symmetry and its implications.

### **Wave Oscillations**

Free, damped and forced oscillatory motions, Resonant vibrations and applications, sharpness of resonance, quality factor. Formation of waves in strings, rods and air, acoustic waves, acoustic impedance, transmission through partitions, ultrasonics and applications.

### **Interference of Light**

Wave theory of light, superposition principle, Double slit Experiment, Biprism and Newton's Rings. Theory of interference in thin films, interference filter, Michelson's interferometer.

### **Diffraction of Light**

Fresnel and Fraunhofer class of diffraction, Diffraction at straight edge cornics spiral, Fraunhofer diffraction at a slits, diffraction gratings, Resolving power of optical instruments, telescopes, prism and grating.

### **Polarisation of light**

Elementary aspects of electromagnetic wave theory of light, polarisation, reflection and transmission, Brewster's law, Polarisation due to plates and double refraction, elliptically and circularly polarised light, Nicol prism, quarter and half wave plates.

### **Polarimeters**

Half shade and Bi - quartz.

### **Optical Instruments**

Cardinal points of a co-axial lens system, defects in the images, spherical and chromatic aberration, nodal slide assembly, eye pieces.

## **IC 104 : CHEMISTRY (TH4)**

### **Chemical Kinetics**

Rate Constant, order and molecularity of a reaction, 1st, 2nd, 3rd order reactions, methods of determining order of reactions, effect of catalyst on rate, Activation energy, Industrial applications of catalyst.

### **Electrochemistry**

Transport number Galvanic cells, EMF and its measurements, Nerst Equation of electrode potential, Reference and indicator electrodes at measurements, solar energy.

### **Phase Rule**

Phase Diagrams and phase transformation in Pb-Ag and Cu-Ni systems.

### **Thermal methods of Analysis**

Elementary discussions of thermogravimetric analysis, Differential thermal analysis and differential scanning calorimetry.

### **Metals and Non-Metals**

S and P block elements, bonding in complexes, molecular explanations for magnetic properties and colour, Extraction and technical applications of Titanium, Vanadium, Zirconium, Tungsten and Uranium.

### **Alloys Classifications**

Necessity for making alloys, composition, properties and uses of following alloys  
Brass, Bronze, Gun metal, Duralumin, Effect of alloying elements like C, Ni, Mn, Si, V, Mo, W and Co on the properties of steel.

### **Electronic Effects**

Inductive Effect, Conjugation and resonance and their effect on physical and chemical properties of molecules, carbanion and carbonium ions and free radicals.

### **Organic Polymers**

Polymerisation, Effect of polymer structure on polymer properties, production, properties and technical applications of some important thermoplastics and thermosetting resins, natural rubber and elastomers (SNR, GR-I, GR-P, polyurethane and silicones), molecular weights.

### **Oils, Fats, Waxes, and Detergents**

Production and physico-chemical properties of fatty acids and glycerides, Manufacture of edible fats, soaps, glycerine, waxes, essential oils, perfumes and cosmetics.

## **IC 105 : MANUFACTURING PROCESSES (TH5)**

### **Materials**

Composition, properties and uses of wrought iron, pig iron, cast iron, malleable iron, S.G Iron, Iron, Carbon and alloy steels, lead, brass, bronze, duralumin, bearing metals, high temperature metals, cutting tool materials.

### **Casting Processes**

Principles of metal casting pattern materials, types and allowances, study of moulding, sand moulding tools, moulding materials, classification of moulds, description and operation of Cupola. Special casting processes e.g. die casting, permanent mould casting, centrifugal casting, investment casting.

### **Smithy and Forging**

Basic operations e.g. upsetting, fullering, flattening, drawing, swaging, tools and applications, drop forging, press forging.

### **Metal Joining**

Welding Principles, classification of welding techniques, Oxy-acetylene gas welding, equipment and fields of applications, Arc welding, metal arc, carbon arc, submerged arc and Atomic hydrogen arc welding, Electric resistance (spot welding), seam welding, Butt, Butt seam and percussion welding, Flux, Composition, properties and function electrodes.

### **Types of joints and Edge preparation:**

#### **Sheet Metal Work**

Common processes, tools and equipments, metals used for sheets, standard specifications for sheets.

#### **Bench Work and Fitting**

Fitting , sewing, chipping, thread cutting, tapping, study of hand tools, marking and marking tools.

### **IC 106 : ENGINEERING DRAWING-I (PR1)**

#### **Introduction**

Instruments and their uses, Lettering, Construction and uses of various scales, dimensioning.

#### **Engineering Curves**

Parabola, Hyperbola, ellipse, cycloids, involute, spiral, helix and loci of points of simple moving mechanism.

#### **Projections**

Straight lines, planes and solids, development of surfaces of right and oblique solids, section of solids, interpenetration and intersection of solids, isometric and oblique parallel projection of solids.

### **IC 107 : PHYSICS (PR2)**

Practical work based on TH3 (Physics IC-103).

### **IC 108 : CHEMISTRY (PR3)**

Practical work based on TH4 (Chem. IC-104).

### **IC 109 : WORKSHOP PRACTICE I (PR4)**

Practical work based on TH5 (Manufacturing Processes IC-105).

## **B.E (Instrumentation and Control Engineering) FIRST YEAR, SECOND SEM. End Sem Examination. (CREDITS=28)**

### **IC 111 : PRINCIPLES OF ELECTRICAL ENGINEERING (TH1)**

#### **Properties of Conductors and Insulators**

Factors affecting resistivity of conductors and insulators, resistance temperature co-efficient, insulation resistance, non-linear resistance and resistors, incremental and differential resistance.

#### **Electromagnetism**

The magnetic circuit calculations, magnetic screening, B-H Curves and differential permeability, hysteresis,electromagnets, self and mutual induction, non-linearity of inductance.

#### **D.C.Circuits**

Ohm's Law, Kirchoff's Laws, Network simplification by loop method, node voltage method, star-delta transformations.

### **Alternating Currents**

Introduction to alternating quantities, peak, average and RMS values of sinusoidal and few typical wave forms, crest factor and form factor, Phasor representation in rectangular, polar and exponential forms. Series and parallel circuits containing LCR and concepts of phase, active and reactive power and meaning of power factor.

### **Resonance**

Series and parallel resonance, Q-Factor of a coil, band width, relation between Q, Band Width and resonant frequency, Half power points.

### **Polyphase Circuits**

Analysis of balanced 3 phase circuits, introduction to unbalanced circuits.

### **Measuring Instruments**

Construction of permanent magnet moving coil ammeters and Voltmeters, torque equation, construction of moving iron instruments, attraction and repulsion types, torque equation.

## **IC 112 : APPLIED MECHANICS (TH2)**

### **Basic Laws**

Force, moment of force, couple, equivalent force system, equation of equilibrium, solution of plane trusses using analytical and graphical methods, frictional force, first moment and second moment of area.

### **Simple stresses and strains**

Description of tensile, compressive shear and volumetric stresses and strains, complementary shear stress, lateral strain, and Poisson's ratio.

### **Bending moment and shear force diagrams**

Cantilevers and simply supported beams carrying various types of loads.

### **Theory of Simple Bending**

Determination of bending stresses, deflection of beams.

### **Torsion**

Stresses and strains in pure torsion for solid and hollow circular shafts, power transmitted by shafts.

### **Combine stresses and strains**

Principal stress, strain, combined torsion, bending and direct stresses, equivalent bending and twisted moments.

## **IC 113 : MATHEMATICS II (TH3)**

### **Differential calculus**

Partial and total differentiation, Taylor's series for 2 variables, Maxima and minima of functions of 2 or more variables.

### **Matrices**

Inverse and rank of a matrix, consistency and solution of simultaneous equations, Linear transformations, vector spaces, characteristic equation, eigen values and eigen vectors, Cayley-Hamilton Theorem.

### **Integral Calculus**

Double and triple integrations, change of order of integration, volume of simple solids.



### **Differential Equations**

Leibnitz and Bernaulli forms (1st order 1st degree), Linear diff. equation with constant co-efficients, Operator-D, Complementary function, particular integral, simultaneous linear diff equations, solution in power series, Frobenious method.

### **Laplace Transformations**

Laplace Transformations, inverse Laplace Transformations, convolution theorem, Applications to linear differential equations with constant co-efficients, Unit step function, Impulse function, periodic function.

## **IC 114 : INTRODUCTION TO PROGRAMING (TH4)**

### **Introduction to C**

Introduction to gcc Compiler in LINUX, C Characters set, tokens (identifiers, keywords, constants, operators), Concept of data types, fundamental and derived data types, Operators and precedence, type conversion and type casting, header files, pre-processor (#), role of compiler, linker, standard library.

### **Flow of Control**

Conditional statements : if-else, if, Nested switch, if, break statement, different loops: while, do-while, for, Nested Loops.

### **Array**

Declaration, 1-dim, 2-dim and multidimensional arrays, Accessing and manipulating array elements, sorting. String manipulations (reversal of string and other operations), matrix operations.

### **Functions**

Library functions and user defined functions, function prototype, call by value, call by reference (use of pointers), calling functions with arrays, local and global variables, storage classes, Structure and Union, difference and advantages over one another.

### **Others**

Introduction to stacks and Queues, push and pop operations, Decimal, binary, octal, hexa-decimal number systems and their conversions to other number systems (Number Base Conversion), Computer codes( only ASCII). Preprocessor directives, Escape sequences, different types of errors (run time, compile time etc).

## **IC 115 : PHYSICS OF MATERIALS (TH5)**

### **Fundamental of quantum mechanics crystal structure**

Matter waves and De-Broglie's Hypothesis, Uncertainty principle, wave packets, Schrodinger's wave equation, interpretation of wave function, significance of probability function, simple eigen values, degeneracy.

Bravais lattices, Miller indices, simple crystal structure, kinds of bondings.

### **Metallic Conductors**

Energy distribution of electrons in a metal, fermi-dirac probability function, fermi level, conduction process.

### **Semi Conductors**

Band Theory, P and N type of Semi conductors, holes and electrons, Hall's Effect, effect of temperature on conductivity, life time and recombination, drift and diffusion, p-n junction.

### **Dielectric Materials**

Polarisation and its types, piezo electricity, ferroelectricity, electrets, ceramics.

**Magnetic Materials**

Dia ,para, ferro, Anti ferro, Ferri magnetism, Ferrites.

**IC 116 : PRINCIPLES OF ELECTRICAL ENGINEERING (PR1)**

Practical work based in TH1 ( Principle of Electrical Engg, IC-111)

**IC 117 : APPLIED MECHANICS (PR2)**

Practical work based on TH2 (Applied Mechanics, IC-112)

**IC 118 : INTRODUCTION TO PROGRAMMING (PR3)**

Practical work based on TH4 (Introduction to Programming, IC-114)

**IC 119 : PHYSICS OF MATERIALS (PR4)**

Practical work based on TH5 (Physics of Materials, IC-115)

**B.E (Instrumentation and Control Engineering) SECOND YEAR,  
THIRD SEM. End Sem Examination. (CREDITS=28)****IC 201 : ELECTRONICS I (TH1)****Semiconductor Devices**

PN Junctions characteristics, Zener and avalanche breakdown, diode equation, bipolar transistor, transistor current components, CB,CE and CC configuration, Wbers-Moll model of a transistor, D.C load line and graphical analysis of CE amplifier, transistor as a switch, transistor ratings, hybrid parameters and equivalent circuits, analysis of elementary transistor amplifier, biasing and stablisation.

**Field Effect Devices**

Junction field effect transistor, JFET voltampere characteristics, MOSFET, FET, small signal model and parameters.

**Special Devices**

Unijunction transistor, Zener diode, tunnel and backward diode, varactar diodes, thyristors-SCR firing Optoeletronic devices.

**Cathode Ray Oscilloscope**

Schematic of CRT, electric and magnetic focussing and deflection, block diagram of a CRO, uses of CRO.

**Power Supplies**

Half wave, full wave and bridge rectifiers, smoothing filters, regulated power supply. Clipping clamping, DC restoration, piecewise linear approximation, waveshaping, working of transistor in saturation region.

## **IC 202 : CIRCUIT AND SYSTEMS (TH2)**

Introduction to continuous-time and discrete-time signals and systems. Basic continuous time and discrete time signals, unit step, ramp and impulse, differential and difference equation, formulation for linear time-invariant (LTI) continuous time and discrete-time systems.

Review of Laplace transform (LT) properties and solution of differential equation using T, waveform synthesis and LT of complex wave forms, concept of transform impedance, network functions, two-port parameters, interconnections of 2 port networks, reciprocity, network theorems, block diagram representation of LTI continuous time network and systems, time-domain analysis of LTI network using Laplace transforms, relation between impulse response and system function, convolution integral, concept of poles and zeros, relation between location of poles, time-response and stability.

Fourier transform, basic theorem, application to LTI networks frequency response, fouries series representation of periodic non-sinusoidal signals, application to analysis of LTI networks.

Introduction to graph theory and Z-transforms.

## **IC 203 : POWER APPARATUS (TH3)**

### **Transformers**

Principle, emf equation, no load and load phasor diagrams, equivalent circuit based on magnetic circuit concept, three phase connection of transformers, auto transformers, pulse transformers, instrumentation transformers, audio frequency transformer, audio frequency transformers.

### **Basic Concepts of Rotating Machines**

General working principles and constructional features, types of winding and their mmf patterns, generation of voltage in rotating machines, effect of distribution of winding and generated emf.

### **Polyphase Induction Motors**

General construction features, types of motors, rotating magnetic field, production of torque equation, torque slip characteristics, effect of rotor resistance, brief idea of double cage and deep bar rotor motor, automatic push button and other types of starters, speed control applications.

### **Synchronous Machines**

Brief construction details of three phase synchronous generators, emf equation principle of operation of synchronous motor, power factor corrections.

### **Small Electric motors**

Basic working principle and applications of induction motor, single phase synchronous motors universal motors, permanent magnet D.C motors, AC and DC servometers, stepper motors, selection of motors for different industrial applications.

## **IC 204 : ANALOG ELECTRIC INSTRUMENTS AND MEASUREMENT TECHNIQUES (TH4)**

**Units, Dimensions and Standards**

MKS unit system(only), determination of absolute units of current and resistance, standards of EMF, resistance, capacitance, mutual inductance and their construction, equivalent circuit representations.  
Figures of merit, construction of variable standards and decade boxes.

### **General Theory of Analog Instruments**

Classification, primary and secondary, indicating, recording and integrating types, operating torques, torque/weight ratio, pointers and scales.

### **Analog Measurement Instruments**

Principle of operation, construction, errors, calibration, areas of application of following types of instruments

(a) PMMC (b) Dynamometer (c) Moving Iron (d) Induction (e) Thermal (f) Electrostatic.

Extension of range by shunts, multipliers, instrument transformer, construction, phasor diagram, errors, testing, effects of p.f. burden and frequency, power and energy measurements in polyphase circuits.

### **Potentiometers**

DC potentiometers, standard reference voltage source, principle of operation, construction, calibration of instruments, phantom loading, range extension and applications of DC potentiometers, self balancing potentiometers, AC potentiometers, polar and cartesian co-ordinate types.

### **Bridge-General Principle**

Measurement of R, C, L, M, etc by wheatstone, Kelvin, Maxwell, Ray, Anderson, Owen, Hay, Schering, Wien bridges. Bridge Sensitivity, errors and detectors, shielding and screening, wagner earthing.

### **Magnetic Measurements**

Ballistic Galvanometer, fluxmeters, permeameters, DC and AC testing of magnetic materials, hysteresis loop, separation of losses by wattmeter and bridge methods.

## **IC 205 : MATHEMATICS (TH5)**

### **Vector Analysis**

Triple product, differentiation, The operators grad, div. and curl and their geometrical and physical significance, integration of vectors, workdone in vector fields, Green's stroke's and gauss divergence theorems.

### **Fourier Series**

Fourier Series, euler's formulae, even and odd functions, function having arbitrary periods, half range expansions, harmonic analysis.

### **Special Functions**

Beta and Gamma functions, Bessel function of first kind, recurrence relations, modified bessel function of first function, Ber and Bei functions, Legendre polynomials, Rodrigue's formula, orthogonal expansion of function.

### **Functions of complex Variable**

Analytic function, harmonic conjugate, conformal transformation, cauchy's integral theorem, cauchy's integral formula, Residue theorem, evaluation of real integrals.

## **IC 206 : ELECTRONICS I (PR1)**

Practical work based on TH1, (ELECTRONICS, IC-201)

### **IC 207 : POWER APPARATUS (PR2)**

Practical work based on TH3, (POWER APPARATUS , IC-203)

### **IC 208 : ELECTRICAL ANALOG INSTRUMENTS AND MEASUREMENT TECHNIQUES (PR3)**

Practical work based on TH4, ( ELECTRICAL ANALOG INSTRUMENTS AND MEASUREMENT TECHNIQUES , IC-204)

### **IC 209 : MACHINE DRAWING (PR4)**

#### **Introduction**

Conventional representation of common features and materials, various rolled sections and uses.

#### **Screw Thread**

Projection and forms of screw threads and their conventional representation. Free hand sketching of scale drawings, components like pipe fitting and joints, turn buckling and shaft couplings, bolts, nuts and keys, bush bearing and ball bearings.

### **IC 210 : PROGRAMMING I (VS1)**

#### **Computer languages**

Basic concepts of FORTRAN, arithmetic expressions, simple and output statements, flow charts, loop instructions, transfer of control, field specifications GO-TO, arithmetic IF, logical IF, DO statement, data and type statements logical operations.

Programs on simple problems like evaluation of a function, summation of series, solution of equation by Newton-Raphson's method, calculation of statistical evaluation of integrals, solution of differential equations, operations on matrices.

## **B.E (Instrumentation and Control Engineering) SECOND YEAR, FOURTH SEM. End Sem Examination. (CREDITS=32)**

### **IC 211 : ELECTRONICS II (TH1)**

#### **Amplifier Fundamentals**

Dynamic transfer characteristics, decibel notation, distortion in amplifiers, bipolar transistor, FET and tube amplifier, classification, noise figure.

#### **Small Signal Amplifier**

High frequency effects and hybrid T model frequency parameter of RC coupled amplifier using bipolar transistor, FET and vacuum pentode, gain bandwidth product, multistage amplifiers, emitter follower at low and high frequency, Darlington connection, cathode follower and source follower, cascade amplifier, tuned voltage amplifiers.

### **Power Amplifiers**

Single ended and push pull, class B and class C power amplifiers, conversion efficiency, power considerations and heat sinks.

### **Feedback Amplifiers and Oscillators**

Principle, advantages of negative feedback, effect on impedance, Nyquist criterion for stability, Barkhausen's criterion, phase shift oscillator, Weinbridge oscillator, resonance circuit oscillator, crystal oscillator, frequency stability.

Amplitude modulation and detection  
Analysis and Simple Circuits.

## **IC 212 : FLUID MECHANICS AND THERMODYNAMICS (TH2)**

### **Part A : Fluid Mechanics**

Fluid and flow, properties of fluid, pressure variation in static fluid, stability of submerged bodies.

Description of fluid motion, stream lines, continuity equation, particle acceleration, velocity gradient, rotation and rate of strain.

Euler's equation, Bernoulli's eqn, momentum eqn, energy eqn and their applications.

Newton's viscosity law, laminar and turbulent flow, drag and lift, boundary layer flows, flow through pipes, and plane surfaces.

### **Part B : Thermodynamics**

System, properties and equilibrium, Zeroth law, heat, work, First law, non flow and steady flow energy equations, second law, reversibility, entropy.

Properties of ideal gases, various thermodynamic processes, properties of vapour, steam tables and Mollier diagram, air-water-vapour mixture, psychrometry.

## **IC 213 : ELECTRIC INSTRUMENTS AND MEASUREMENTS (TH3)**

Basics of OP-amp circuits, active filters, waveform generators, regulated power supply, modulation and demodulation, logic circuits, D/A and A/D converters, multiplexing and demultiplexing, data acquisition systems.

Voltmeters and digital voltmeters, automation, A.C and RMS measurements, multimeters and digital multimeters, digital LCR-Q meters, digital wattmeters.

CRO and its applications, special purpose Oscilloscope, storage scopes, multichannel oscilloscope and frequency response display systems, network analyser, spectrum analyser.

Distortion measurement, distortion analyser. Digital phase angle meters, digital counters, pulse timer and counters universal counters.

## **IC 214 : COMPUTER GRAPHICS (TH4)**

### **Introduction to graphics**

Graph plotting, windows and clipping, segmentation, viewports, interactive programming, planning and zooming.

Overview of graphics Hardware, implementation of simple graphics package (SGP). 2D transformations, Matrix representation of 2D and 3D transformations, composition of 3D transformations.

### **Projections**

Parallel and perspective, mathematics of planar geometric projections, image transformations.

Character circles, region filling, polygon clipping, hiding surfaces, representation of 3D shapes, polygon meshes, parametric cubic curves and surfaces, B-spline, bezier curves.

## **IC 215 : TRANSDUCERS AND COMPONENTS (TH5)**

Performance characteristics- accuracy, sensitivity, precision, linearity, resolution, hysteresis and dead zone, I/O impedance, static and dynamic characteristics.

Resistance transducers, resistance potentiometers, strain gauges, thermistors, photo transistors and resistors.

Capacitance transducers

Piezoelectricity, crystals and properties, configurations, sensitivity, uses.

Magnetostrictive Transducers-materials and applications.

Feedback transducers-application of -ve feedback.

Elastic transducers, Hall transducers, AC tachogenerators.

Linear variable differential transformer, microsyn, capacitive pick ups, thermo emf transducers, accelerometers and vibration pick ups, flowmeters, strip chart recorders, Synchros, magnetic amplifiers, rotating amplifiers, thyristorised chopper, power MOSFET devices, stepper motors, P-D, P-I, P-I-D controllers.

Temperature transducers and related aspects.

## **IC 216 : ELECTRONICS II (PR1)**

Practical work based on TH1, (ELECTRONICS II , IC-211)

## **IC 217 : COMPUTER GRAPHICS (PR2)**

Practical work based on TH4, (COMPUTER GRAPHICS , IC-214)

## **IC 218 : INSTRUMENTATION LAB I (PR3)**

Practical work based on TH3 and TH5, (IC-213 and IC-215).

## **IC 219 : ELECTRICAL WORKSHOP AND ELECTRICAL DRAWING (PR4)**

### **Electrical wiring**

Types of electrical wiring, comparative features, materials employed in following domestic wiring-conduit, cleat, casing capping and TRS on batteries, exercises in hospital godown.

**Winding of Electrical machines**

Materials employed for winding of electrical machines, enamelled wires, cotton and silk covered wires, bar conductors, simple lap and wave winding for DC machines, single and double layer AC winding, fault location and DC armature testing of machines.

**Circuit Drawing**

Lay out and circuit diagram for domestic, industrial lighting and power schemes, energy meter connections, circuit diagrams for a.c and d.c starters, layout of distribution substation.

**Electrical Machines**

Sketches of rotating parts of electrical machines (dimensioned) such as armature, commutator, field magnet frame, poles and shoes etc., details of transformers transmission line pole, crossarm and insulators.

**IC 220 : PRACTICAL TRAINING (PR5)**

Training undergone for 20 days in college workshop at the end of III semester.

**IC 221 : REPORT WRITING (VS1)**

Report writing (Sessional)

**IC 222 : PROGRAMMING II (VS2)**

Number and character representation, identifiers, declaration, syntax charts, expressions, assignments, I/O statements, control statements i.e GOTO, while, Report, for, if, case data type, array.

Procedure and function, more data types, files, applications of pascal including development of programmes for scientific engineering problems using the above features.

**B.E (Instrumentation and Control Engineering) THIRD YEAR,  
FIFTH SEM. End Sem Examination. (CREDITS =27)****IC 301 : ANALOG AND DIGITAL COMMUNICATION (TH1)**

Elements of communication system, signal noise, Modulation-Linear, exponential and pulse.  
Digital modulation, demodulation for various modulation systems, SNR for various modulation systems.

Review of digital modulation systems, bandwidth compression, digital multiplexing, modem, overview of transmission media, data transmission, channel capacity, introduction to telephone exchange system, telecommunication traffic, Switching and its types, protocol structure in networks, routing, resource sharing, multiple access techniques, ALOHA technique, terrestrial packet radio system (TPRS), data networking, combining circuits.



## **IC 302 : INDUSTRIAL AND ANALYTICAL INSTRUMENTS (TH2)**

Pressure measurements, manometers, various gauges, measurement of flow, mass flow meters, electrical type turbomagnetic, ultrasonic, flowmeters for solid materials, electrostatic and nucleonic gauges, strain measurements and extensometers.

On-line instrumentation and laboratory techniques (brief review), sampling technique for liquid and gases for analysis purpose, automatic sampling.

Gas chromatograph, thermal conductivity gas analyser, estimation of a specific gas in a complex gas mixture, gas analysis by chemical absorption.

Humidity and moisture measurements, dry and wet bulb psychrometer, moisture measurements, radio isotope techniques.

Chemical composition analysis, measurement of viscosity and consistency, measurement of pH, various methods, measurement of density, spectrochemical analysis, mass spectrometry and emission spectrometry. Statistical treatment of experimental data, application with reference to various analysis techniques.

## **IC 303 : DIGITAL INTEGRATED CIRCUITS I (TH3)**

Introduction to logic families RTL, DTL, TTL, ECL, IIL, types of MOS etc. Introduction to IC fabrication techniques, logic gates, boolean algebra (complete), Binary arithmetic, binary codes. Transistorised bistable, Astable, Monostable, multivibrator, Schmitt trigger, flip-flop, latch, clocked flip-flop, TTL clock generator, monostable and Astable multivibrator. Counters, ripple, synchronous and programmed counters, decoders, multiplexers, PLAS and code convertors.

Sequential circuits- Synchronous and Asynchronous, digital to analog conversion, analog to digital, voltage to frequency, frequency to voltage conversion, design of display systems.

Semiconductor memories.

## **IC 304 : LINEAR INTEGRATED CIRCUITS (TH4)**

Differential amplifier and its designing, monolithic operational amplifiers and characteristics, frequency response, compensation techniques, measurement to op-amp. characteristics. Typing IC-OP-AMPS, off-set control, basic linear circuits using OPAMPS, inverting and non-inverting amplifiers. OP-AMPS applications, frequency selective amplifiers, logarithmic amplifiers, precision rectifier, peak detector, sample and holding circuits, wave generation and shaping with op-amps.

Monolithic RF-IF amplifier, voltage regulators, timers and waveform generation.

Basic principles of phase-locked loops, PLL components and applications of PLL.

Operational amplifier applications as integrator, differentiator and adders, Analog computation, amplitude and time scaling.

## **IC 305 : INDUSTRIAL ORGANISATION AND MANAGERIAL ECONOMICS (TH5)**

### **Principles of management**

General idea, various functions, scope of engineering.

**Organisation structure**

Types, merits and demerits.

**Plant location and layout**

Factors effecting location, types of layout.

**Production planning and control**

Sequence of planning and control of production. Scheduling , routing, despatching.

**Methods Study**

Methods analysis, time study methods of rating.

**General idea of personnel management**

Industrial psychology, job evaluation and monitoring. Business decision making and forward planning. Demand and demand forecasting of production analysis- prices and pricing decision-profit and capital management. Analysis of inter-industry relation, macro-economics and business.

**IC 306 : ANALOG AND DIGITAL COMMUNICATION (PR1)**

Practical work based on TH1, (ANALOG AND DIGITAL COMMUNICATION, IC-301)

**IC 307 : DIGITAL INTEGRATED CIRCUITS I (PR2)**

Practical work based on TH3, (DIGITAL INTEGRATED CIRCUITS I, IC-303)

**IC 308 : LINEAR INTEGRATED CIRCUITS (PR3)**

Practical work based on TH4, (LINEAR INTEGRATED CIRCUITS, IC-304)

**C 309 : PROGRAMMING III (PR4)**

Programming in C language.

**B.E (Instrumentation and Control Engineering) THIRD YEAR,  
SIXTH SEM. End Sem Examination. (CREDITS= 29)****IC 311 : MICROPROCESSORS (TH1)**

Introduction to 8 bit processor, study of architecture, instruction set and its peripheral support chips like DMAC, programmable interrupt controller, USART, 0255, CRT controllers etc.  
Comparison with other 8 bit microprocessor chip.

Introduction to 16 bit microprocessor, study of Motorola 68000 architecture, addressing modes, instructions, instruction set, interfacing techniques, support chip.  
Comparison with other popular 16 bit microprocessor chip.

## **IC 312 : COMPUTER AIDED DESIGNING (TH2)**

### **Introduction to CAD**

Introduction to interactive computing and use of graphics. Requirements of interactive computing, dedicated Vrs time sharing modes, interactive interface, CRT as display device, Graphical quality, capacity speed of modification, ease of programming, line drawing, solid area graphics and 3 dimensional graphics, Graphics packages, use of interactive input tools such as light pen, cursor, geometry of plotting in 2 dimensions, scaling.

### **Computer Aided Circuit Designing**

Topological structures, network analysis, sensitivity models, optimisation methods in circuit design, designing for filters, printed and integrated circuits, computer aided probabilistic network synthesis.

## **IC 313 : INDUSTRIAL ELECTRONICS (TH3)**

Semiconductor switching devices, rectifying circuits, regulated power supplies, optoelectronic devices and their applications, timers, PLC, high frequency heating converter operation, Cycloconvertors and applications to AC motor control, forced commutation circuits, choppers, inverters, AC controllers, uninterruptable power supplies etc.

## **IC 314 : CONTROL SYSTEMS I (TH4)**

### **Control system types**

open loop and closed loop, block representation, signal terminology, explanation with illustrations of servomechanism, regulating system, linear and non-linear controls, continuous and sampled data controls, digital controls.

### **Mathematical modelling and system representation**

Differential equations of physical systems. Analogous systems, transfer function, block diagram representation and reduction technique, signal flow graph construction, terminology, algebra and Mason's gain formula, state equation, effects of feedback on variation of parameters, system dynamics and on effect of disturbances.

### **Control system components**

Potentiometer, synchros, armature and field controlled d.c, servomotor, a.c. servomotor, stepper motor, rotating amplifiers, magnetic amplifiers, tachogenerators.

### **Time Domain Analysis**

Standard test signals, transient response of first and second order systems, transient response specifications, effects of integral and derivative control action on system performance, performance index concept and error performance indexes- ISE, ITSE, IAE, ITAE, root locus technique concept, construction rules and root contours.

### **Frequency Domain Analysis**

frequency response, response plots- polar plot, bode plot, Log magnitude vs phase angle plot, performance specifications, correlation between time and frequency responses.

### **Stability Analysis**

Stability, conditions, Routh-Hurwitz criterion, Nyquist criterion, gain and phase margin. Constant M and N loci, use of Nicols chart for performance evaluation.

### **Compensation Techniques**

Compensation for system performance improvement, design of series compensators- Lag, Lead and Lag Lead using frequency domains technique, concept of feedback compensation.

## **IC 315 : TELEMENTARY AND DATA TRANSMISSION (TH5)**

Introduction to telementary and telecontrol- telementary links- telementary error.  
Classification of signals-their suitability for telementary - Analog and digital telementary.

Landline telementary- mechanical, pneumatic and electrical systems- industrial telementary.

Application of negative feedback for pneumatic and wire telementary systems.

Telementary and carrier communication systems- distinction and design criteria- modulation techniques- AM, Fm and PM suitability for wire and wireless telementary power- line carrier communication.  
Information carrying capacity- bandwidth and noise considerations- merits of each modulation technique.

AM, FM and PM modulators and demodulators- V to f and f to V convertors- phase locked loop and its applications.

Pulse modulation, PAM, PWM and PPM signals- relative merits- sampling theorems, sampling frequency and sampling techniques- reconstruction of data.

Pulse code modulation- binary and many signal coding formatted- digital data transmission.  
Multiplexing techniques- FDM and TDM systems- relative merits- IRIG standards.

Remote control and telecontrol- mechanical and electronic systems- special considerations.  
Typical telementary and telecontrol schemes related to industry and space exploration.

## **IC 316 : MICROPROCESSOR LAB (PR1)**

Practical work based on TH1, (MICROPROCESSOR, IC-311).

## **IC 317 : CAD LAB (PR2)**

Practical work based on TH2, (COMPUTER AIDED DESIGNING, IC-312).

## **IC 318 : CONTROL SYSTEM LAB I (PR3)**

Practical work based on TH4, (CONTROL SYSTEM I, IC-314).

## **IC 319 : PROGRAMMING IV (VS1)**

Programming in COBOL Language.

## **IC 320 : PRACTICAL TRAINING (VS2)**

Based on practical training.

## **B.E (Instrumentation and Control Engineering) FOURTH YEAR, SEVENTH SEM. End Sem Examination. (CREDITS=30)**

### **IC 401: CONTROL SYSTEMS II (TH1)**

#### **State Space representation of continuous and discrete systems**

Solving the time invariant state equation. State transition matrix, Controllability and observability criteria for time-invariant systems, pole placement using state variable feed back, design of state observer.

#### **Introduction to non linear feed back control systems**

Describing function and phase-plane techniques.

#### **Variation Calculus**

Fixed end point problems-Eulers- Lagrange equation, variable end point problem and transversality conditions, isoperimetric problems, limitations of calculus of variation.

#### **Pontryagin's Maximum Principle**

Index of performance and guideline to its choice- lagrange, bolza, mayer problems, Hamiltonian, derivation of canonical equations for optimisation, Hamilton Jacobi equation.

#### **Application of Pontryagin's Maximum Principle**

Linear regulator theory, matrix- Riccati equation, minimum time problems, 2nd and higher order systems, Theory of (n-1) switchings, bang-bang controller, minimum model problems, minimum energy problems.

#### **Bellman's Dynamic Programming**

Principle of optimality and principle of invariant imbedding, applications of dynamic systems- discrete optimal control, development of computational algorithm.

Introduction to identification and adaptive control.

### **IC 402 : DIGITAL INTEGRATED CIRCUITS (TH2)**

Review of Sequential circuits, state tables and state diagrams, state assignment, designing digital systems with state diagrams, designing of digital circuits with help of hardware programming language, variable machine cycle and fixed cycle length machine, design of an 8- bit processor, Introduction to design of a computer.

### **IC 403 : PROCESS CONTROL (TH3)**

#### **Basic Consideration**

Introduction, control loop study-generalization with load changes at arbitrary points in the loop, offset and its analysis.

#### **Controllability and Stability**

Controllability Proportional control factor, Derivation reduction factor, subsidence ratio, process reaction curve, self regulation, general case study,. Stability, different techniques. Application of root contours in process control systems. Bode plot- its application in controllability and stability studies.

GS product, error criteria- Their significance.

Control actions and controllers

On-off , DATA P-reset, rate, programmed controller design parameter adjustment using GS product, PRC and frequency response characteristics, Ziegler Nicols rule, effect of dead time, controllers- pneumatic electrical/ electronic, hydraulic, electro-hydraulic, digital.

Multiloop controls

Ratio, cascade, feedforward, split range, selector, inverse rate, anti reset, generalisation- multivariable control.

Connecting elements in the loop and standard control processes

'R', 'L', 'I' elements in pneumatic, hydraulic and electric systems. Flow, pressure, level and temperature control.

Plants and Processes

Process modelling- Model Theory, parameter estimation and evaluation by testing, limitation of process equation formulation, some typical processes.

Final control Elements

Control valves, Electrical actuators- Servomotors, stepper motors, power cylinders, hydraulic motors, electro-hydraulic systems of actuators.

P-I diagrams

Worksheet and specification preparation, control room and control panel specifications - A model Example.

Introduction to digital computer control of processes.

#### **IC 404 : ELECTIVE I (TH4)**

Will be posted later. (Within 2 days)

#### **IC 405 : ELECTIVE II (TH5)**

Will be posted later. (Within 2 days)

#### **IC 406 : CONTROL SYSTEM LAB II (PR1)**

Practical work based on TH1, (CONTROL SYSTEM II , IC-401).

#### **IC 407 : DIGITAL INTEGRATED CIRCUITS LAB II (PR2)**

Practical work based on TH2, (DIGITAL INTEGRATED CIRCUITS II, IC-402).

#### **IC 408 : INSTRUMENTATION LAB II (PR3)**

Practical work based on TH3, TH4, TH5, ( IC-403, IC-404, IC-405).

**IC 409 : PRACTICAL TRAINING (PR4)**

Based on practical training.

**IC 410 : PROGRAMMING V (VS1)**

System programming languages.

**B.E (Instrumentation and Control Engineering) FOURTH YEAR,  
EIGHTH SEM. End Sem Examination. (CREDITS=27)**

**IC 411 : CONSUMER ELECTRONICS (TH1)**

Hi-fi audio systems, stereophonic sound systems, public address systems, acoustic quadrophonic sound systems, graphic equalizers, electronic tuning, dolby noise reduction, speech synthesisers.

Video systems, BW TV, Colour TV and HDTV systems, video Camera, Video monitoring, electronic cameras. Recording systems- Audio, video recording media and systems, compact disc systems, digital and analog recording, principles of high density recording, VCRs, VCPs, memory diskettes, disks and drums.

Switching systems for telephone exchange PABX, EPBX, modular telephones, telephone message recording concepts, remote controlled systems.

**IC 412 : ELECTIVE III (TH2)**

Will be posted later. (Within 2 days)

**IC 413 : ELECTIVE IV (TH3)**

Will be posted later. (Within 2 days)

**\*\*IC 414 (PR1) is not applicable for IC.**

**IC 415 : PROJECT (PR2)**

Based on project assigned to the student involving investigations, design, development, fabrication etc.

**IC 416 : PRACTICAL TRAINING (PR3)**

Based on practical training

**IC 417 : SEMINAR AND REPORTS (VS1)**

Based on seminar and report work undertaken in VIII semester.

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