

**SYLLABUS PRESCRIBED FOR FOUR YEAR DEGREE COURSE IN BACHELOR OF  
ENGINEERING ELECTRONICS & TELECOMMUNICATION SEMESTER PATTERN  
(CREDIT GRADE SYSTEM)**

**SEMESTER: THIRD**

**3XT01 / 3XN01 MATHEMATICS-III**

**SECTION-A**

UNIT-I Ordinary differential equations:- Complete solution, Operator D, Rules for finding complementary function, the inverse operator, Rules for finding the particular integral, Method of variations of parameters, Cauchy's and Legendre's linear differential equations. (10 Hrs.)

UNIT-II Laplace transforms: definition, standard forms, properties of Laplace transform, inverse Laplace transform, initial and final value theorem, convolution theorem, Laplace transform of impulse function, Unit step function, Laplace transforms of periodic function, solution of Linear differential equations, Simultaneous differential equation by Laplace transform method. (10 Hrs.)

UNIT-III a) Difference equation:- solution of difference equations of first order, Solution of difference equations of higher order with constant co-efficients, b) Z-transform:- Definition, standard forms, Z-transform of impulse function, Unit step functions, Properties of Z-transforms (linearity, shifting, multiplication by k, change of scale), initial and final values, inverse Z-transforms (by direct division and partial fraction), Solution of difference equation by Z-transforms. (10 Hrs.)

**SECTION-B**

UNIT-IV a) Fourier transforms- Definition, standard forms, inverse Fourier transforms, properties of Fourier transforms, convolution theorem, Fourier sine and Fourier cosine transforms and integrals. b) Partial differential equation of first order of following form-(i)  $f(p,q)=0$ ; (ii)  $f(p,q,z)=0$ ; (iii)  $f(x,p)=g(y,q)$ ; (iv)  $Pp+Qq=R$  (Lagrange's Form); (v)  $Z=px+qy+f(p,q)$  (Clairaut form Statistics: Binomial, Poisson and Normal Distribution. (10 Hrs.)

UNIT-V Complex Analysis :- Functions of complex variables, Analytic function, Cauchy-Reimann conditions, Harmonic function, Harmonic conjugate functions, Milne's method, conformal mappings translation, rotation, magnification, inversion and bilinear transformation), singular points, expansion of function in Taylor's and Laurent's series. Cauchy's integral theorem and formula, Residue theorem. (10 Hrs.)

UNIT -VI Vector calculus:- Scalar and vector point functions, Differentiation of vectors, Curves in space, Gradient of a scalar point function, Directional derivatives, Divergence and curl of a vector point function and their physical meaning, expansion formulae (without proof), line,

surface, volume integrals, irrotational and solenoidal vector fields, Stoke's and Divergence theorem (without proof). (10 Hrs.)

### **Books Recommended:-**

- 1) Elements of Applied Mathematics by P.N.Wartikar and J.N.Wartikar.
- 2) A text book of Differential Calculus by Gorakh Prasad.
- 3) Engg. Mathematics by Chandrika Prasad.
- 4) Advancing Engg. Mathematics by E.K.Kreyzig.
- 5) A text book of Applied Mathematics by P.N.Wartikar and J.N.Wartikar.
- 6) Higher Engg. Mathematics by B.S.Grewal.
- 7) Control System by Gopal and Nagrath.
- 8) Integral Transforms by Goyal & Gupta.

## **3XT02 /3XN02 COMPUTER PROGRAMMING AND APPLICATIONS**

### **SECTION-A**

Unit I : Principles of object oriented Programming: OOP'S paradigm, basic concept of OOP'S Benefits of OOP'S, structure of C++ Programming, Basic data types, user defined data type, derived data type operator and control statement.

Unit II: Functions classes and object in C++: Functions, Function over loading, Friend Functions, types of classes and its use, concept of object and its implementation, constructor and destructors.

Unit III: Operator's overloading: Operator and their definition, overloading unary and binary operator, Rules for overloading operators, overloading binary operators using friends and string manipulation.

### **SECTION-B**

Unit IV: Inheritance and Polymorphism: Defining derived classes, single and multiple Inheritance, multilevel inheritance, member classes pointer to objects, pointer to derived classes, virtual function.

Unit V: Solution of Nonlinear and Polynomial Equations: False position, modified false position, secant, Newton Raphson Method. Solution of Linear Systems of Equations: Gauss elimination method, L.U. factorization method, Gauss seidel iterative method.

Unit VI: Solution of differential equation: Euler's method, Runge Kutta method, Predictor Corrector method. Numerical Integration: Trapezoidal rule, Simpson's 1/3 and 3/8 th rules. Finite differences: Newton forward and backward interpolation formula.

### **Text Books:**

- 1) Object Oriented Programming with C++ -E. Balaguruswamy, Tata -Graw Hill publishing Co.Ltd., New Delhi,1995.
- 2) Introduction to method of Numerical Analysis- S. S. Shastry, Second Edition, PHI Pvt. Ltd., New Delhi.

### **Reference Books:**

- 1) Object Oriented Programming in Turbo C++ Rober Lofore Galgotia Publications Pvt.Ltd., New Delhi,1995.
- 2) The C++ Programming Language (Third Edition) Bjarne Stroustrup Pub.Co.,New York,1995 (AddisonWesley)
- 3) C++ Primer - Lipman Stanley B., (Second Edition) New York, Addison Wesley Pub. Company,1995.
- 4) Computer Oriented Numerical Methods:-V. Rajaraman, Second Edition, Prentice Hall of India Pvt. Ltd., New Delhi.
- 5) Numerical Method for Mathematics Science and Engineering, John H. Mathew, PHI publication.

## **3XT03 /3XN03 ELECTROMAGNETIC FIELDS**

### **SECTION-A**

Unit I: Review of Vector Analysis: Cartesian, cylindrical and spherical co-ordinate systems, vector products, Projection of Vectors, Gradient, Divergence & Curl, Stokes & divergence theorem. (08)

Unit II: Electrostatics: Coulomb's law, Electric field intensity, Evaluation of electric field intensity due to line charge, surface charge & volume charge distribution, Electric flux density, Gauss Law, Electrostatics potential, Potential gradient, Electric dipole & Polarization . (08)

Unit III: Magneto statics: Amper's law of forces, Biot-Savart's law, Ampere's law in integral and differential form., Magnetic field intensity evaluation due to infinite, finite and circular current carrying conductors, Magnetic flux & flux density, Magnetic dipole moment, magnetization. (08)

## SECTION-B

Unit IV: Boundary conditions & Maxwell's equations: Boundary condition of dielectric-dielectric interface, dielectric-conductor interface, boundary conditions for magnetic materials interface, Current continuity equation, Maxwell's equation for steady & time varying fields. (08)

Unit V: Electromagnetic wave propagation: Electromagnetic wave equation for free space, lossy dielectrics, perfect conductors, propagation constant, attenuation constant, phase shift constant, Skin depth, Concept of power flow, Poynting Theorem, Reflection of a plane wave in a normal incidence at dielectric-dielectric interface, dielectric-conductor interface. (10)

Unit V: Radiation: Magnetic scalar and vector potential, retarded potential, Electric & Magnetic fields Power radiated & radiation resistance, due to oscillating dipole, quarter wave monopole & half wave dipole. (08)

### Text Books:

1) Hayt W.H.: "Engineering Electromagnetic" Tata Mc Grawhill 2) Jordan E.C. and Balmain K.C.: "Electromagnetic Waves and Radiating System" Prentice Hall of India Private Limited (Second Edition).

### Reference Books:

- 1) Mathew N.O.Sadiku "Principles of Electromagnetics" (Fourth Edition), Oxford University Press.
- 2) Krauss J.D.: "Electromagnetic" Mc Grawhill Books co. (Third Edition)
- 3) Ramo S. and Whinnery R.: "Fields and Waves in Communication Electronics" John Wiley and sons, New Delhi.

## 3XT04/3XN04 ELECTRIC DRIVES & MEASUREMENTS

### SECTION- 'A'

Unit-I: Measurement of resistance: Kelvin Double Bridge, Loss of charge method and megger. Measurement of Inductance and Capacitance: Maxwell's bridge, Hay's bridge, Anderson's bridge, Schering bridge, De Sauty's Bridge and Carey Foster 5455 bridge. Measurement of Q factor and  $\tan \phi$ .

Unit-II: Measurement of active and reactive power in 3-phase balanced and unbalanced load. Electrodynamic type power factor meter, frequency meter. Watt meter, Digital Energy Meter.

Unit-III: D.C.Motors: Electrical and mechanical characteristics of motor, Speed control methods for constant torque and constant horse power. Application of D.C.motors. Braking-resistance, plugging and regenerative braking.

### **SECTION- 'B'**

Unit-IV: Induction Motors: Characteristics, Speed control methods: Armature voltage, V/f control, rotor control, slip power recovery scheme and applications, plugging, Resistance braking, Regenerative Braking. Eddy current coupling and its application.

Unit-V: Transformers: 3 phase  $\phi$  transformers, rectifier transformers, pulse transformers. Open delta connection, Scott connection, Ferrite core transformer.

Unit-VI: Construction, principle of operation, characteristics and applications of : Tachogenerator, (DC & AC), Stepper motor, A.C.Servo motor 1 Phase  $\phi$  induction motors and Universal motor.

### **Text Books:**

- i) M.V.Deshpande:- Elements of Electrical Machines.
- ii) A.K.Sawhney:- Electrical and Electronic Measurement and Instrumentation.

### **Reference Books:**

- i) E.W.Golding:- Electrical measurement and measuring Instrument, ELBS Pub.
- ii) First Course on Electrical Drives-S.K.Pillai.
- iii) B.L.Theraja VOL II :- Electrical Engineering.

## **3XT05/3XN05 ELECTRONICS DEVICES AND COMPONENTS**

### **SECTION A**

Unit I: Construction, selection and failures of · Resistors: Fixed type, Variable Type , Network and Chip type · Capacitors: fixed and variable Type.

Unit II: Switches & Relays: Types, Construction and Testing. Fuses, Cables and Connectors: Types, Construction, Specification and Application · Introduction to Heat sink, Choke and Transformer.

Unit III: Basics of Electronic Component layout, PCB material, Properties and specifications, basic manufacturing process of PCB , Soldering and De-soldering Techniques.

## SECTION B

Unit IV: P-N Junction diode theory- V-I Characteristics, Temperature dependency, Diode Resistance, Zener diode : characteristics, Avalanche & Zener breakdown, Testing of diode using Ohmmeter and CRO.

Unit V: Theory, Construction, Characteristics and application of Tunnel, Varactor, Shottkey diode Opto-Devices: LED, Photo Diode, LCD.

Unit VI: Theory of PNP and NPN Transistor, Transistor Configurations, Their Characteristics and current Components. Transistor as an amplifier, Testing of Transistor using Ohmmeter and CRO.

### **Text Books:**

1. Maduri Joshi, “ Electronic Component and Material” 3<sup>rd</sup> Edition, Shroff Publication.
2. Millman H Halkies, “ Integrated Electronics” TMH Co. New Delhi.

### **References Books:**

1. Bosshart, “Printed Circuit Board” TMH.
2. David Bell’ “Electronic Devices and Circuits” Oxford University Press, 2010.
3. Boylestad R, “Electronic Devices and Circuits” Prentice Hall of India Pvt. Ltd. New Delhi.

### **3XT06/3XN06 COMPUTER PROGRAMMING AND APPLICATIONS-LAB.**

Minimum Eight experiments based on the 3XT2/3XN2 out of which at least four experiments should be based on the last two Units.

### **3XT07/3XN07 ELECTRIC DRIVES & MEASUREMENTS-LAB.**

Minimum Eight experiments based on 3XT4/3XN4.

### **3XT08/3XN08 ELECTRONICS DEVICES AND COMPONENTS-LAB.**

Minimum eight Practicals Should be conducted based on the 3XT5/3XN5 (at least one on PCB).

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**SEMESTER: FOURTH**

**4XT01/4XN01 COMMUNICATION ENGINEERING-I**

**SECTION-A**

Unit I: Signal and Noise: Signals: Analog & digital, Deterministic & Non-deterministic, periodic & non periodic, Frequency response, bandwidth, bandwidth requirement for different types of signals such as telephone speech, music and video. External and Internal noise, signal to noise ratio, noise figure, noise factor measurement, equivalent noise Temperature, Friiss formula. (6)

Unit II: Signal Analysis: Fourier Series, Exponential Fourier Series, Fourier Transform, Properties of Fourier Transform, Dirac Delta Function, Fourier Transform of Periodic functions, Fundamental of Power Spectral Density & Energy Spectral Density, Correlation: Auto-correlation, Cross-correlation. (9)

Unit III: Probability and Random Signal Theory: Probability, Random variable, PDF Random processes, stationarity, Mean, Correlation and Covariance Functions, Ergodicity, Gaussian Process, White Gaussian Noise. (8)

**SECTION-B**

Unit IV: Wave Propagation: Electromagnetic waves, Ground waves, Sky waves, ground waves, space waves, Ionosphere, critical frequency, maximum usable frequency, virtual height, skip distance, LOS communication, fading, single hop and multi hop propagation, duct propagation. (7)

Unit V: RF Transmission Lines: Parallel and coaxial transmission line, equivalent circuit of transmission line, standing wave, characteristic(shunt) impedance, quarter wave and half wave length transform, Smith chart, Single stub (shunt) matching using smith chart, balun. (8)

Unit VI: Antenna Basics & Types of Antenna: Principle of radiation, antenna power gain, beam width, polarization, bandwidth and radiation resistance, Isotropic radiator, Resonant antenna: Half wave, Folded dipole antenna, Non resonant antenna, antenna arrays, parasitic reflector, parasitic director, design of yagi-uda antenna (up to 5 elements) Long, wire, helical, rhombic, discone, log periodic, loop antenna, low, medium and high frequency antenna. (10)

### **Text books:**

- (1) Kennedy G. "Electronic Communication System" Tata Mc-Graw Hill Co., New Delhi (Third Edition).
- (2) Simon Haykin, "Communication System", John Wiley, Eastern Ltd., New York, (Third Edition), 1994.

### **Reference books:**

- (1) Collins Dennis, Collins John, "Electronic Communications" (PHI)
- (2) B. P. Lathi, "Modern Digital and Analog Communication systems" 3<sup>rd</sup> Edition, Oxford Uni. Press, New Delhi.
- (3) Taub and Schilling D.L., Principles of Communication Systems, Mc-Hill Co, Tokeyo, 1994 (II Ed.)
- (4) Hari Bhat, "Analog communication", 2<sup>nd</sup> Edition Pearson India, 2010.

## **4XT02 / 4XN02 ELECTRONIC DEVICES AND CIRCUITS-I**

### **SECTION-A**

Unit I: Rectifiers: Half wave, full wave and bridge rectifiers and their analysis. Filters: Analysis of capacitor filter, Theory of L, LC & CLC (p) filter, Zener diode as a Voltage regulator.

Unit II: DC load line and operating point (Q point); Methods of biasing & stability factor; ac equivalent circuit and hybrid model analysis of CE configuration.

Unit III: Feedback Amplifier and Oscillator : Classification of amplifier: Voltage current, trans-conductance, Trans-resistance amplifier, feedback concept, effect of negative feedback in amplifier, Methodology of feedback in amplifier and analysis. Oscillators: Barkhausen's criterion for sustained oscillations; study of Harley, Collpit, RC oscillators and crystal oscillator.

### **SECTION-B**

Unit IV: Study of multistage transistor amplifier circuit i) RC coupled amplifier, ii) Transformer coupled amplifier, iii) Direct coupled amplifier, iv) Emitter follower; Darlington emitter follower, Bootstrapping principle, v) Cascade stage.

Unit V: Power Amplifier : Transformer coupled Class A amplifier, Transformer coupled Class B amplifier & transformer coupled Class AB amplifier, capacitor coupled and direct coupled



output stages, modifications to improve power amplifier performance, Class C amplifier and analysis.

Unit VI: JEET : Theory, Construction and Characteristics; parameters ( $m$ ,  $g_m$  &  $r_{ds}$ ); Biasing of JEET amplifiers, MOSFET : Theory, Construction and Characteristics of enhancement & depletion type MOSFET, UJT: Theory, Construction and Characteristics; UJT as relaxation oscillator.

### **Text Books:**

- 1) David Bell, "Electronic Devices and Circuits", Oxford University Press, 2010.
- 2) Milliman H. and Halkies, "Integrated Electronics", Tata McGraw Hill, New Delhi.

### **Reference Books:**

- 1) Mottershead Allen, "Electronics Devices & Circuits", Prentice Hall of India Pvt. Ltd., New Delhi, 1986
- 2) Boylestad R., "Electronics Devices & Circuits", Prentice Hall of India Pvt. Ltd., New Delhi, V Edi. 1993.
- 3) Ramanan K.V., "Functional Electronics", Tata McGraw Hill, New Delhi, 1989.
- 4) Milliman S., Taub H and Halkies., "Electronics Devices and Circuits", McGraw Hill Int. Co., Auckland, 1982.

## **4XT03 / 4XN03 NETWORK ANALYSIS**

### **SECTION-A**

Unit-I: Basic Circuit elements:- Circuit components- assumptions for Circuit analysis, sources of electrical energy-standard input signals- Kirchoff's laws-source transformation- mesh and node analysis-network equation for RLC network-magnetic coupling. (10)

Unit-II: Graph theory and network equation:- Graph of a network-Trees and loops, cut set of a network, Tie-set matrix and loop currents- analysis of network, Network equilibrium equation,duality-network transformation. (10)

Unit-III: Laplace transformation and its applications:- Laplace transfer functions-basic theorems-gate function-Impulse function-Laplace transform of periodic functions. Solution of linear differential equations-Heaviside's partial fraction expansion-Solution of network problems. (10)

## SECTION-B

Unit-IV: Network theorems:- Superposition theorem-Reciprocity theorem, Thevenin's theorem-Norton's theorem-Milliaman's theorem-Max. power transfer theorem-Substitution theorem-Compensation theorem, Tellegen's theorems. (10)

Unit V: Two port network:- Open circuit impedance parameters-short circuit admittance parameters-Transmission parameters-In-verse transmission parameters-Hybrid and inverse hybrid parameters. Interrelationship between the parameters-two port symmetry interconnection of two port networks, input impedance in terms of two-port parameters output impedance-image impedance. (10)

Unit-VI: Network functions:- Ports and terminal pairs-network functions-poles and zeros-necessary conditions for driving point function-necessary conditions for transfer function-Applications of network analysis in driving network functions-positive real functions-driving point and transfer impedance function-LC net work. (10)

### Text Book:

1.Network and systems-D. Roy Choudhary (Wiley Eastern Ltd.1988).

### Reference Book:

1. Circuit Theory- ISKV Iyer (Tata McGraw Hill).
2. Network Analysis, M. E. Van Valkenburg (Prentice Hall India) 3rd Ed.

## 4XT04/4XN04 INDUSTRIAL MANAGEMENT & QUALITY CONTROL

### SECTION-A

UNIT-I: Principles and Techniques of Management : Meaning of and differences among business, management, administration and organisation, Principles of management, functions of management, planning, organisation structure and relationships, direction, co-ordination, control, motivation, delegation and decentralisation, communication, leadership and decision making. (7)

UNIT-II: Market and Materials Management : A) Marketing strategy, market research, consumer behaviour, advertising and sales promotion, channels of distribution, pricing of products. B) Classes of material, scope of material control, scope of purchasing department, purchasing procedures, order procedures, inventory control, introduction to production planning and control. (9)

UNIT-III: Personnel Management : Meaning and functions of personnel management, recruitment, selection, promotion, wages and salary administration, training and development, functions and scope of trade unions in Indian industries. Welfare of labour, Problems of labor turn over & retention. Merit Rating: Job evaluation, different methods of merit ratings, wage incentives, different types of wage incentive schemes. (9)

### **SECTION-B**

UNIT- IV: Project and Financial Management : A) Case studies of project report, preparation of profit and loss statement and balance sheet, ratio analysis. B) Principles of costing , cost sheet preparation, variance analysis, meaning and application of various budgets, types of budgets and their importance. (9)

UNIT- V: Quality Control :Concept of quality and quality control, elements of quality, factors controlling quality of design and conformance, process control, inspection planning and scheduling, 7QC (Seven Quality Control) techniques, vendor inspection, sampling inspection, sampling plans, Quality audit system. (8)

UNIT- VI: Quality Management :Concepts and applications of Kaizen, quality circle, ISO 9000 series, just-in-time, quality planning and total quality management, elements of TQM, Quality Circles. (8)

### **Text Book:**

1. INDUSTRIAL ENGINEERING AND MANAGEMENT, O P Khanna ,2011 ,JAIN BOOK DEPOT, Post Box No. 51, New Delhi – 110001 (INDIA), 81-899-2835-3.
2. INDUSTRIAL & BUSINESS MANAGEMENT, Telsang Mertand.T, S.Chand & Company Limited, NEW DELHI, 81-219-2056-6.
3. MANAGEMENT: PRINCIPLES, PROCESSES, AND PRACTICES, Anil Bhat, Arya Kumar, 2008, Oxford University Press, NEW DELHI., 978-01-956-9445-1.
4. TOTAL QUALITY ,BHARAT WAKHLU, 2/e, 2007, S. Chand & Company Limited, NEW DELHI, 81-219-2866-4.
5. TOTAL QUALITY CONTROL, 4TH ED, Armand V. Feigenbaum, 2005, Tata McGraw-Hill Education, New Delhi, 978-00-702-2003-4.

### **Reference Book:**

1. PRINCIPLES OF BUSINESS MANAGEMENT, Dr. Virendra Sharad Sherlekar, Prof. S. A. Sherlekar, 3/e, 2009, Himalaya Publishing House Pvt. Ltd, MUMBAI, 978-81-8488-082-3.

2. FUNDAMENTALS OF FINANCIAL MANAGEMENT, BOSE, D. CHANDRA ,2/e, PHI Learning Private Limited, NEW DELHI, 978-81-203-4074-9.
3. PRINCIPLES OF MANAGEMENT AND ADMINISTRATION, Chandra Bose, PHI, Learning Private Limited, NEW DELHI, 978-81-203-1929-5.
4. PROJECT MANAGEMENT, Prof. Abdul Matheen, 2/e, 2009, LAXMI PUBLICATIONS(P) LTD, NEW DELHI, 978-81-318-0694-4.
5. TOTAL QUALITY MANAGEMENT, Suganthi & Samuel, PHI. Learning Private Limited, NEW DELHI, 978-81-203-2655-2.
6. TOTAL QUALITY MANAGEMENT, Dr. S. Kumar, 1/e, 2006, LAXMI PUBLICATIONS (P) LTD, NEW DELHI, 978-81-318-0568-8.
7. QUALITY MANAGEMENT, Kaniska Bedi, 2006, Oxford University Press, NEW DELHI, 978-01-956-7795-9.
8. TQM : PLANNING, DESIGN & IMPLEMENTATION, Khanna, V.K., 1/e, 2009, New Age International (P) Ltd., Publishers, NEW DELHI, 978-81-224-2233-7.
9. Fundamentals of Quality Control and Improvement, Mitra Amitava, 2/e, 2009 ,PHI Learning Private Limited, NEW DELHI, 978-81-203-2377-3.

## **4XT05 / 4XN05 INSTRUMENTATION**

### **SECTION-A**

Unit I: Transducer & Instrumentation systems:- (1)Transducer classification: Active / Passive. Primary/Secondary. Analog / Digital and transduction Principles. Basic Signal conditioning Circuits. Resistive/Capacitive/Inductive reactance bridge. Current/Voltage Sensitive Wheatstons bridges & Generalized instrumentation system with particular examples. (9 Lectures)

Unit II: Static characteristics, errors & statistical parameters: (1) Static characteristics: Accuracy, Precision, Sensitivity, Threshold, Resolution, Repeatability and Hysteresis. Errors: Gross error, Systematic error, Random error, Limiting error. Statistical Parameters: Arithmetic mean Average deviation Standard deviation. Probable error, Histogram, Normal & Gaussian curve of errors. (7 Lectures)

Unit III: Electronics Instrumentation: (1, 2, 3): Analog & Digital data acquisition system, Analog electronic multimeter, Introduction to digital voltmeter & universal counter. Stripchart & X-Y recorders. Optical Encoders. Siesmic mass vibration transducer. (3)Introduction to microphones & loud speaker. (9 Lectures)

## SECTION-B

Unit IV: Measurement of Temperature & Strain (1, 3) Temperature Sensors: LM335, RTD. THERMISTORS, Thermocouples, Thermocouples laws & its compensation methods. Pyrometers: Total/Partial radiation & optical pyrometers. Strain Gauges, Gauge factor. Strain measurement & temperature compensation methods. (8 Lectures)

Unit V: Measurement of Displacement. Pressure & Level. Displacement Measurement: (1) using resistive, capacitive, inductive (LVDT & RVDT) & Eddy current. Pressure Measurement: (1) Elastic, Inductive, Piezoelectric & capacitive transducers, Low pressure measurement using ionization gauge, pirani gauge, thermocouple vacuum gauge. Level Measurement: (1, 3) Using ultrasonic, capacitive, inductive, resistive with float, gamma rays & eddy currents techniques. (8 Lectures)

Unit VI: Measurement of Flow, Humidity, Velocity (1) Flow Measurement: using ultrasonic, electroaquatic & hotwire Anemometer. Humidity Measurement: using resistive, Capacitive & Crystal transducers. Velocity Measurement: Using photo detectors (both linear & angular velocity). Introductory block diagram of smart sensors, Wave analyzer & spectrum analyzers. (8 Lectures)

### Books Recommended:

- 1) Sawhney A.K.: A course in Electrical / Electronic Measurement & Instrumentation, Dhanpat Rai & Sons., Delhi.
- 2) Rangan C.S., Sharma G.R. , & Mani V.S.V.: Instrumentation Devices & System, Tata McGraw Hill.
- 3) R. K. Rajput: Electrical & Electronics Measurement & Instrumentation.

### Reference Books:

- 1) Patranbis D. : 'Sensors & Transducers', A.H.Wheeler & Company, Prayag, India.
- 2) H. S. Kalsi : Electronics Instrumentation, Tata McGraw Hill, 2<sup>nd</sup> Edition.
- 3) U.A. Bakshi & A. V. Bakshi : Electronics Instrumentation, Technical Publication.
- 4) Robert A. Witte: Electronics Test Instrumentation : Analog & Digital Measurement.

### 4 XT06 / 4XN06 ELECTRONIC DEVICES AND CIRCUITS-I-LAB.

Any TEN experiments based on contents of 4 XT02/4XN02 ELECTRONIC DEVICES AND CIRCUITS-I.

**4 XT07 / 4XN07 NETWORK ANALYSIS - LAB.**

Any TEN experiments based on contents of 4XT03 / 4XN03 NETWORK ANALYSIS 4 XT.

**08/4XN 08 INSTRUMENTATION-LAB**

Minimum Eight experiments based on 4XT05 / 4XN05 INSTRUMENTATION.