# B.Sc. (H) INSTRUMENTATION

## THREE-YEAR FULL-TIME PROGRAMME
## (Six-Semester Course)

## COURSE CONTENTS

## (Effective from the Academic Year 2011-2012)

**UNIVERSITY OF DELHI**
**DELHI – 110 007**

**Syllabus Structure for Semester I-VI {B.Sc (H) Instrumentation} Semester Mode**

| Paper No. | Semester-I | L-I | Paper No. | Semester-II | L-I |
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| INHT 101 | Network Analysis | 4-1 | INHT 201 | C and Data Structures | 4-1 |
| INHT 102 | Applied Physics | 4-1 | INHT 202 | Introduction to Instrumentation | 4-1 |
| INHT 103 | Mathematics I | 4-1 | INHT 203 | Mathematics II | 4-1 |
| INHT 104 | Chemistry | 4-1 | INHT 204 | Biology | 4-1 |
| ***INHP 105*** | ***Instrumentation Practical - I(INHT 101)*** | ***8 periods per week*** | ***INHP 205*** | ***Instrumentation Practical – III (INHT 202)*** | ***8 periods per week*** |
| ***INHP 106*** | ***Instrumentation Practical - II (INHT 102 and 104)*** | ***8 periods per week*** | ***INHP 206*** | ***Instrumentation Practical – IV (INHT 201and 204)*** | ***8 periods per week*** |
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| Paper No. | Semester-III | L-I | Paper No. | Semester-IV | L-I |
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| INHT 301 | Digital Electronics | 4-1 | INHT 401 | Industrial Instrumentation | 4-1 |
| INHT 302 | Analog Electronics-I | 4-1 | INHT 402 | Analog Electronics II | 4-1 |
| INHT 303 | Biochemistry | 4-1 | INHT 403 | Statistical methods and Reliability | 4-1 |
| INHT 304 | Signal & Systems or Microbiology & Genetics | | INHT404 | Electronics Instrumentation | 4-1 |
| ***INHP 305*** | ***Instrumentation Practical – V (INHT 301 and 303)*** | ***8 periods per week*** | ***INHP 405*** | ***Instrumentation Practical – VII ( INHT 401 and 404)*** | ***8 periods per week*** |
| ***INHP 306*** | ***Instrumentation Practical -V I (INHT302 and 304)or Microbiology & Genetics Practical*** | ***8 periods per week*** | ***INHP 406*** | ***Instrumentation Practical – VIII ( INHT 402)*** | ***8 periods per week*** |
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| Paper No. | Semester-V | L-I | Paper No. | Semester-VI | L-I |
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| INHT 501 | Microprocessor | 4-1 | INHT 601 | Analytical Instrumentation-II | 4-1 |
| INHT 502 | Analytical Instrumentation-I | 4-1 | INHT 602 | Biomedical Instrumentation-II | 4-1 |
| INHT 503 | Electrical Machines & Control Systems | 4-1 | INHT 603 | Statistical Quality Control | 4-1 |
| INHT 504 | Biomedical Instrumentation-I | 4-1 | INHT 604 | Microcontrollers and its applications | 4-1 |
| ***INHP 505*** | ***Instrumentation Practical – IX (INHT502 and504)*** | ***8 periods per week*** | ***INHP 605*** | ***Instrumentation Practical - XI(INHT601 and 603)*** | ***8 periods per week*** |
| ***INHP 506*** | ***Instrumentation Practical – X(INHT 501 and503)*** | ***8 periods per week*** | ***INHP 606*** | ***Instrumentation Practical - XII(INHT 604)*** | ***8 periods per week*** |
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**L-Lecture** **I-Interactive** **P-Practical**

**Courses with 4L and 1I : 4 Credits**
**Courses with Periods Practicals : 4 Credits (2Periods lab equivalent to 1 Credit)**

**SEMESTER I**
**INHT-101: Network Analysis**

**THEORY** **Marks: 100**

**40 Lectures**

**Unit 1**

**Basic Circuit Concepts:** Voltage and current sources, Resistance, Capacitance, Inductance, Mutual Inductance, Series and Parallel elements, Duality, voltage division and current division.
**Circuit Analysis:** Kirchhoff's Current Law (KCL), Kirchhoff's Voltage Law (KVL), Node analysis, Mesh analysis, Star-Delta conversion.
**Network Theorems:** Superposition theorem, Thevenin's theorem, Norton's theorem, Reciprocity theorem, Millman's theorem, Maximum power transfer theorem.

**14 Lectures**

**Unit 2**

**DC Transient Analysis :** Initially charged RC circuit, RL circuit with initial current, time constant, RL and RC circuits with sources, DC response of series RLC circuits (using differential equations).

**6 Lectures**

**Unit 3**

**AC circuit analysis:** Sinusoidal voltage and current, Definition of instantaneous, peak, peak to peak, root mean square and average values. Voltage-current relationship in resistor, inductor and capacitor. Phasor, complex impedance, power in AC circuits: instantaneous power, average power, reactive power, power factor. Sinusoidal circuit analysis for RL, RC and RLC circuits. Mesh analysis, node analysis and network theorems for AC circuits. Resonance in series and parallel RLC circuits, frequency response of series and parallel RLC circuits, Quality (Q) factor and bandwidth. Passive filters: low pass, high pass, band pass and band stop.

**14 Lectures**

**Unit 4**

**Two Port Networks:** Impedance (Z) parameters, Admittance (Y) parameters, Transmission (ABCD) parameters, Hybrid (h) parameters.

**6 Lectures**

**Suggested Books:**


1. W. H. Hayt, J. E. Kemmerly, S. M. Durbin, Engineering Circuit Analysis, Tata McGraw Hill (2005)
2. Robert L. Boylestad, Essentials of Circuit Analysis, Pearson Education (2004)
3. M. Nahvi and J. Edminister, Electric circuits, Schaum's outline series, Tata McGraw Hill (2005)
4. S. A. Nasar, Electric Circuits, Schaum's outline series, Tata McGraw Hill (2004)
5. C. Alexander and M. Sadiku, Fundamentals of Electric Circuits , McGraw Hill (2009)
6. John. D. Ryder, Networks, Lines and Fields, Prentice Hall of India (2002)

## INHT-102: Applied Physics

**Theory** **Marks: 100**

**40 Lectures**

### Unit 1

**Thermodynamics:**Heat and Temperature, Zeroth law of thermodynamics: thermal equilibrium, thermometry and temperature scales, First law of thermodynamics, Thermodynamic systems and processes, Internal energy and heat capacity, adiabatic processes. Second law of thermodynamics, Reversible and irreversible processes.

**8 Lectures**

### Unit 2

**Optics:** Interference**:** Interference of light, Bi prism experiment, displacement of fringes, interference in thin films- wedge shaped film, Newton's rings.

Diffraction - Single, Double & N- Slit, Diffraction grating, Grating spectra, Rayleigh's criterion and resolving power of grating.

Polarization- Phenomena of double refraction, Nicol prism, Production and analysis of plane, circular and elliptical polarized light, Fresnel's theory of optical activity, Polarimeters.

Laser applications-Spontaneous and stimulated emission of radiation, Einstein's Coefficients, construction and working of Ruby, He-Ne lasers and laser applications. Basic principles, different types of laser

**14 Lectures**

### Unit 3

**Nuclear Physics**

Nucleus, constituent of nucleus, Properties of Nucleus size, mass, density, energy, charge, binding energy, nuclear angular momentum, Nuclear force, Radiation. detector- types of detectors, gas filled detectors, Ionization Chamber, Proportional Counter, GM Counter, Scintillation Detector and Semiconductor Detectors.

**8 Lectures**

### Unit 4

**Fluid Mechanics**

Fluid properties; Surface Tension, Viscosity, equation, Bernoullis equation; Navier-Stokes Equations; Differential form of Energy equation. Reynold number, Incompressible and compressible Flow, Laminar and turbulent flows, Flow through pipes **10 Lectures**

**Text books**

Ajoy Ghatak -Optics - (TMH)
M.W. Zemansky and R.H. Dittman- Heat and Thermodynamics (Mc-Graw Hill)
Nuclear physics by Cohen
Fox and Mc Donald- Introduction to Fluid Mechanics
Ghatak and Thayagrajan-Optoelectronics

**Suggested Books:**

Aurthur Beiser -Concepts of Modern Physics - (Mc-Graw Hill)
Anuradha De. -Optical Fibre & Laser ( New Age )
Resnick, Halliday & Walker -Fundamental of Physics - (Wiely )
R.A. Serway & J.W. Jewett -Principles of Physics
H.Callen-Thermodynamics and an Introduction to Thermo statistics (Wiley, New York).

**INHT-103: Mathematics-I**

**THEORY** **Marks: 100**

**40 Lectures**

**Unit 1**

**Sequences and series:** Sequences, Limit of a sequence, Convergence, Divergence and Oscillation of a sequence, Infinite series, Necessary condition for Convergence, Standard Infinite Series: Geometric Series and Harmonic series, Tests for Convergence and Divergence, Comparison Test: Only for Series with Positive Terms, Cauchy's Integral Test, D'Alembert's Ratio Test, Cauchy's nth Root Test, Raabe's Test ( Higher Ratio Test ), Logarithmic Test, De Morgan's and Bertrand's Test, Alternating Series Leibnitz's Theorem, Absolute Convergence and Conditional Convergence, Power Series .

**Mean Value Theorems:** Rolle's Theorem, Lagrange's Mean Value Theorem, Cauchy's Mean Value Theorem, Generalized Mean Value Theorem.

**10 Lectures**

**Unit 2**

**Partial Differentiation:** Functions of Several Variables: Limit and continuity, Partial Differentiation, Variable Treated as Constant, Total Derivative, Partial Differentiation of Composite Functions: Change of Variables, Differentiation of an Implicit Function, Euler's Theorem, Jacobian, Functional Dependence.

**Maxima and Minima:** Taylor's Theorem for Functions of Two Variables, Maxima and Minima of Functions of Two Variables: with and without Constraints, Lagrange's Method of Undetermined Multipliers.

**Curve Tracing:** Curves in Cartesian Form, Polar Curves, Parametric Curves.

**10 Lectures**

**Unit 3**

**Application of Integration:** Length of Plane Curve: Rectification, Volume of solids of Revolution, Area of the Surface of a Solid of Revolution.

**Multiple Integrals:** Introduction, Double Integral, Evaluation of a double Integral, Application of double Integral, Change of Order of Integration: Double Integral, General Change of Variable in double Integral, Change Of Variable: Cartesian to Polar Coordinates, Triple Integrals, General Change of Variable in Triple Integral.

**10 Lectures**

**Unit 4**

**Vector Differential Calculus:** Scalar and Vector, Vector Differentiation, Directional Derivative, Gradient of a Scalar Function and Conservative Field, Divergence, Curl, Related Properties of Gradient, Divergence and Curl of Sums, Second-Order Differential Operator, Curvilinear Coordinates: Cylindrical and Spherical Coordinates.

**Vector Integral Calculus:** Vector Integration: Integration of a Vector Function of a Scalar argument, Line Integrals: Work Done, Potential, Conservative field and Area, Surface Integrals: Surface area and Flux, Volume integrals, Green's Theorem in a Plane: Transformation between Line integral and Double integral Area in Cartesian and Polar Coordinates, Stokes's Theorem, Gauss Divergence Theorem.

**10Lectures**

**Suggested Books:**


1. E. Kreyszig, Advanced Engineering Mathematics, Wiley India (2008)
2. B. V. Ramana, Higher Engineering Mathematics, Tata McGraw Hill Publishing Company Limited (2007)
3. R. K. Jain, and S.R.K. Iyengar, Advanced Engineering Mathematics, Narosa Publishing House (2007)
4. C .R. Wylie and L. C. Barrett, Advanced Engineering Mathematics, Tata McGraw-Hill (2004)

## INHT 104: Chemistry

**Theory** **Marks: 100**

**40 Lectures**

### Unit 1

Chemical bonds and molecules: Recapitulation of general characteristics of ionic & covalent bonds and shapes of molecules.,van der Waal forces of attraction (ion-dipole, dipole-dipole, dipole-induced dipole, and dispersion forces), polar covalent bond, hydrogen bond, effects of hydrogen bonding on physical properties, structure of water. metallic bond, lattice energy, Born Haber cycle, Fajan's rule, bond length, bond angle.

**Periodic Table;**Atomic, ionic and covalent radii, ionization energy, electro negativity and its scales, electron affinity, Lanthanide contraction, Inert pair effect, Slater rules.

**10 Lectures**

### Unit 2

**Acid and Bases:**Bronsted-Lowry theory, concept of leveling and differentiating solvents.

**Organic reactions and their mechanisms, Types of reactions** -,Mechanism of $S_N1$ and $S_N2$ reactions (stereochemistry, nature of substrate, nucleophile and leaving group).Keto-enol tautomerism and its distinction from resonance. Structure and stability of reactive carbon species - carbonium ion, carbanion, free radical, carbenes. Electronic effects in molecules (inductive, hyperconjugation and resonance effects); cleavage of covalent bonds – homolysis and heterolysis. Electrophilic disubstitution in benzene. Reaction mechanisms of Aldol condensation, Hoffman bromamide rearrangement, Cannizzaro reaction, Friedel Craft reaction, Pinacol-pinacolone rearrangement, Beckmann rearrangement.

**10 Lectures**

### Unit 3

**Stereochemistry:** Optical activity and optical isomerism, specific molar rotation, asymmetric carbon atom, chirality, enantiomerism, relative configuration ( R/S nomenclature of chiral centres, sequence rules), absolute configuration (D/L designation in carbohydrates), geometrical isomerism (cis/trans and E/Z nomenclature in olefins) isomers of lactic acid and tartaric acid

Aromaticity**:**Concept of aromaticity, Huckle's rule as applied to benzene, naphthalene, anthracene, phenenthrene, thiophene, furan, pyrrole, pyridine, quinolene and cyclic cations & anions.

**8Lectures**

### Unit 4

Pharmaceuticals:Synthesis of aspirin, paracetamol, sulphanilamide, their uses and drug action. Reagents for organic synthesisActive methylene compounds - preparation, properties and synthetic applications of ethylacetoacetate and diethylmalonate. Grignard reagents – preparation and reactions.

Chemical equilibrium**:**Reversible reactions, law of mass action, equilibrium constant, ionic equilibrium, theory of indicators, factors influencing equilibrium states, relation between Kp & Kc, buffer solution, hydrolysis of salt, pH, Ksp, common ion effect and its applications in mixture analysis**.**

ElectroChemistry; Standardc electrode potential, electrochemical series, Nernst equation, Indicator andreference electrodes, phand its measurementsby glass electrode. Potentiometric determination of pH

**12 Lectures**

**Text Books**


J. D. Lee, *Concise Inorganic Chemistry*, ELBS.
I.L. Finar, Volume I, II, *Organic Chemistry*, ELBS.
M. Barrow, *Physical Chemistry*, Tata McGraw-Hill.


**Suggested Books:**


R.T. Morrison and R.N. Boyd, *Organic Chemistry*, Prentice Hall.
T.W.G. Solomon, *Organic Chemistry*, John Wiley and Sons.
E.L. Eliel, *Stereochemistry of Carbon Compounds*, Tata McGraw-Hill.
G.W. Castellan, *Physical Chemistry*, Narosa Publishing House.
Biochemistry by Lehninger
J.E. Huheey, *Inorganic Chemistry – Principles of Structure and Reactivity*, Pearson Publication.

**INHP 105: Instrumentation Practical – I** **Marks:100**

**8 classes/week**

1. Introduction to Basic Electronic Components (resistor, capacitor, inductor, diode and transistors).
2. Introduction to Test and Measurement Instruments (power supply, signal generator, multimeter, CRO, DSO)
3. Verify the Thevenin, Norton and Superposition Theorem.
4. Verify the Maximum Power Transfer Theorem.
5. RC Circuits: Time constant, differentiator, integrator.
6. Design a Low Pass RC Filter and study its frequency response.
7. Design a High Pass RC Filter and study its frequency response.
8. To study the generation of Lissajous figures.
9. To Measure the Z-parameters of a two-port network.
10. To study the frequency response of a Series LCR circuit and determine its (a) Resonant Frequency (b) Impedance at Resonance (c) Quality Factor Q (d) Band Width.
11. To study the frequency response of a Parallel LCR circuit and determine its (a) Resonant Frequency (b) Impedance at Resonance (c) Quality Factor Q (d) Band Width.

**SOFTWARE BASED SIMULATIONS**

1. Verify the Thevenin, Norton and Superposition Theorem
2. Verify the Maximum Power Transfer Theorem
3. RC Circuits: Time constant, differentiator, integrator.
4. Design a Low Pass RC Filter and study its frequency response.
5. Design a High Pass RC Filter and study its frequency response.
6. To study the generation of Lissajous figures.
7. To Measure the Z-parameters of a two-port network.
8. To study the frequency response of a Series LCR circuit and determine its (a) Resonant Frequency (b) Impedance at Resonance (c) Quality Factor Q (d) Band Width.
9. To study the frequency response of a Parallel LCR circuit and determine its (a) Resonant Frequency (b) Impedance at Resonance (c) Quality Factor Q (d) Band Width.

**INHP 106: Instrumentation Practical - II** **Marks:100**

**Practical based on paper Applied Physics** **4 classes /week**

1. To determine the thermal conductivity of a good conductor by searl's method.
2. Determination of J, mechanical equivalent of heat by calendar and Barne's method.
3. To determine the temperature coefficient of PRT (Platinum Resistance Thermometer).
4. To determine the dispersive power of prism using spectrometer and mercury source.
5 .To determine the refractive index of a prism using spectrometer
6. To determine the wavelength of sodium light by Newton's Ring.
7. To find the wavelength of He-Ne Laser using transmission diffraction grating.
8. To find the thermal conductivity of poor conductors by Lee Disc Method

9. To determine the coefficient of discharge of an orifice of a given shape.
10. Also to determine the coefficient of velocity and the coefficient of contraction of the orifice mouth piece.

**Practical based on paper Chemistry** **4 classes/ week**

1. To estimate iron (II) ions by titrating with potassium permanganate.
2. To determine melting points and boiling points of organic compounds.
3. To detect extra elements (N, S, Cl, Br, I) in organic compounds (containing not more than one extra element).
4. To analyze the following functional groups in the given organic compound: Carboxylic acids, alcohols, phenols, aldehydes & ketones, carbohydrates (monosaccharide's), amides, nitro compounds and primary amines.
5. To determine surface tension of a liquid using a stalagmometer.
6. To determine viscosity of a liquid using an Ostwald viscometer

SEMESTER II

## INHT 201: C Programming and Data Structures

**THEORY** **MARKS: 100**

**40 Lectures**

### Unit 1

**Introduction**-Algorithm / pseudo code, flowchart, program development steps, structure of C program, identifiers, basic data types and sizes, Constants, variables, Operators, expressions, Input-output statements, if and switch statements, loops- while, do-while and for statements, break, continue, goto and labels**.** Designing structured programs, Functions, basics, parameter passing, storage classes- extern, auto, register, static, scope rules, block structure, user defined functions, standard library functions, recursive functions, header files, C preprocessor, example C programs.

**10 lectures**

### Unit 2

**Arrays-** concepts, declaration, definition, accessing elements, storing elements, arrays and functions, two-dimensional and multi-dimensional arrays, applications of arrays. pointers- concepts, initialization of pointer variables, pointers and function arguments, address arithmetic, Character pointers and functions, pointers to pointers, pointers and multidimensional arrays, dynamic memory managements functions, command line arguments, C program examples.

**10 lectures**

### Unit 3

**Derived types**- structures- declaration, definition and initialization of structures, accessing structures, nested structures, arrays of structures, structures and functions, pointers to structures, self referential structures, unions, typedef, bitfields, C program examples. Input and output - concept of a file, text files and binary files, streams, standard I/o, Formatted I/o, file I/o operations, error handling, C program examples. Searching - Linear and binary search methods, sorting - Bubble sort, selection sort, Insertion sort, Quick sort, merge sort.

**10 lectures**

### Unit 4

**Introduction to data structures**- singly linked lists, doubly linked lists, circular list, representing stacks and queues in C using arrays and linked lists, infix to post fix conversion, postfix expression evaluation. Trees- Binary tress, terminology, representation, traversals, graphs- terminology, representation, graph traversals (dfs & bfs)

**10 lectures**

**Suggested Books:**


1. Computer science - A structured programming approach using C, Behrouz A. Forouzan and Richard F. Gilberg, Third edition, Thomson.
2. A. S. Tanenbaum, Y. Langsam, and M.J. Augenstein, Data Structures Using C, Pearson education.
3. P. Padmanabham, C & Data structures, B.S. Publications.
4. B.W. Kernighan, Dennis M.Ritchie, The C Programming Language, Pearson Education
5. J.A. Jones & K. Harrow, C Programming with problem solving, Dreamtech Press
6. Stephen G. Kochan, Programming in C, III Edition, Pearson Education.
7. R. Kruse, C.L. Tondo, BP Leung, Shashi M, Data Structures and Program Design in C, Second Edition, Pearson Education.

INHT- 202: **Introduction to Instrumentation**

**Theory** **Marks: 100**

**40 Lectures**

**Unit 1**

Basic concepts of instrumentation, generalized instrumentation systems block diagram representation, scope of instrumentation in Industrial organization. **4 Lectures**

**Unit 2**

**Measurement systems**- static (accuracy, sensitivity, linearity, precision, resolution, threshold, range, hysteresis, dead band, backlash, drift) ,impedance matching and loading, dynamic characteristics (types, fidelity, speed of response , dynamic error).

**6 Lectures**

**Unit 3**

**Definition of errors:** systematic errors, instrumental errors, environmental errors, random errors, loading errors, random errors, source of errors in measuring instruments, Uncertainities types, propagation of uncertainties) **4 Lectures**

**Unit 4**

**Transducers** - Classification, Active, Passive, Mechanical, Electrical, their comparison**.** Selection of Transducers**:** Desirable characteristics of transducers .

**Principle and working of following types**:

Displacement transducers - Resistive (Potentiometric, Strain Gauges – Types, Gauge Factor, bridge circuits, Semi-conductor strain gauge) Capacitive (diaphragm), Inductive (LVDT-Principle and characteristics, Hall effect sensors, magneto-strictive transducers), Piezoelectric (Element and their properties, Piezo Electric coefficients. Equivalent circuit and frequency response of P.E. Transducers**)**, light ( photo-conductive, photo emissive, photo voltaic, semiconductor, LDR), Temperature ( electrical and non-electrical). Pressure (force summing devices-load cell)

**26 Lectures**

**Text Books:**

Measurement Systems, 4/e Doeblin McGraw Hill, New York, 1992.

Electrical Measurements & Electronic Measurements by A.K. Sawhney

**Suggested Books:**

Instrumentation- Devices and Systems By Rangan, Sarma, and Mani, Tata-McGrawHill

Electronic Instrumentation by H.S Kalsi, McGrawHill

Instrumentation measurements and analysis by Nakra & Choudhary

Measurement & Instrumentation- DVS Murthy

**INHT-203**: **Mathematics –II**

**THEORY** **Marks: 100**
**40 Lectures**

**UNIT 1**

**vector space and linear transformation:** vector spaces, subspaces, bases and dimensions, linear transformations, linear operator equations.
**matrices:** introduction to matrices, System of Linear Algebraic Equations, Gaussian Elimination Method, Gauss-Seidel Method, LU decomposition, Solution of Linear System of LU decomposition, LU decomposition from Gaussian Elimination, LU decomposition by Gaussian Elimination, Solution to Tridiagonal Systems, Crout Reduction for Tridiagonal Linear Systems.

**10 lectures**

**UNIT 2**

**Eigen Values and Eigen Vectors:** Linear Transformation, Eigen Values and Eigen Vectors, Properties of Eigen Values and Eigen Vectors, Cayley-Hamilton Theorem, Diagonalization. Powers of a Matrix.
**Real and Complex Matrices:** Real Matrices: Symmetric , Skew Symmetric , Orthogonal Quadratic Form, Canonical Form: or sum of the squares form, Transformation ( reduction ) of Quadratic Form to Canonical Form, Complex Matrices: Hermitian, Skew Hermitian, Unitary Matrices, Sylvester's Law of Inertia.

**10 lectures**

**UNIT 3**

**Complex Functions:** Complex Function, Continuity, Differentiability, Analyticity, Cauchy-Riemann (C-R) Equations: In Cartesian Coordinates, Harmonic and Conjugate Harmonic Functions, Cauchy-Riemann Equations.
**Elementary Complex Functions:** Exponential Function, Trigonometric Functions, Hyperbolic Functions.
**Complex Integration:** Line Integral in Complex Plane, Cauchy's Integral Theorem, Cauchy's Integral Formula, Derivative of Analytic Functions.
**Complex Power Series:** Sequences: Series and Power Series, Taylor's Series (Theorem), Laurent Series, Zeroes and Poles.
**Theory of Residues:** Residue, Residue Theorem, Evaluation of Real Integrals.

**10 lectures**

**UNIT 4**

**Ordinary Differential Equations (First Order and First Degree):** Basic Definitions, First Order first Degree Differential Equations, Variables Separable or Separable Equation, Homogeneous Equation- Reduction to Separable Form, Non homogeneous equation: Reducible to Homogeneous Form, Exact Differential Equations, Reduction of Non-exact Differential Equations: using Integration factors, Linear Differential Equation: First Order, Bernoulli Equation, Formation of Differential Equation by Elimination of Arbitrary Constants, Geometrical Applications, Orthogonal Trajectories of Curves.

**10 lectures**

**Suggested Books:**


1. E. Kreyszig, Advanced Engineering Mathematics, Wiley India (2008)
2. B. V. Ramana, Higher Engineering Mathematics, Tata McGraw Hill Publishing Company Limited (2007)
3. R. K. Jain, and S.R.K. Iyengar, Advanced Engineering Mathematics, Narosa Publishing House (2007)
4. C. R. Wylie and L.C. Barrett, Advanced Engineering Mathematics, Tata McGraw Hill (2004)

## INHT-204: Biology

**Theory** **Marks: 100**
**40 Lectures**

### UNIT 1

***Life*:**Definition and characteristics of life, Chemical organisation of cell**:** Molecular basis of life, inorganic and organic constituents, micro and macromolecules in the cell.
**Techniques of Study**Microscopy (Simple, Compound, Electron-TM), Cell fractionation, Tissue Culture methods

**06 lectures**

### UNIT 2

**Cell Structure and Function** General structure of prokaryotic and eukaryotic cell, cell wall, plasma membrane, protoplasm and its colloidal nature. Endoplasmic reticulum, lysosome, Golgi apparatus, centriole, basal granule, cillia, flagellum and microtubules, microfilaments, storage bodies and ribosomes. Elementary concepts of cell permeability and endocytosis, cellular motility, cellular secretion, cellular excitability, cellular aging and cell death.
**Chloroplast:** structure, biogenesis,of chloroplast , function and mechanism of photosynthesis.
**Mitochondria:** Structure, biogenesis, function and mechanism of aerobic and anaerobic respiration, fermentation.
**Nucleus:** Structure, nucleosome organization of chromatin, chromosome structure, specialized chromosomes (polytene, lampbrush), Nuclear Division-cell cycle, mitosis, meiosis, cytokinesis.

**10Lectures**

### UNIT3

**Genetics:**History of Genetics, Mendel's laws of inheritance, Deviations from Mendelian laws, dominance, relationships, lethal genes, epistasis, complementary, supplementary, duplicate and inhibitory genes. **Linkage and crossing over:** Discovery, incomplete linkage, coupling and repulsion hypothesis, crossing over, mechanism of recombination, a three point test cross, gene mapping.
**Inheritance:** Chromosome theory of Inheritance**,** Sex determination – Sex linked inheritance, extra chromosomal Inheritance
**Chemical basis of heredity**: DNA and RNA structure, DNA replication, transcription and translation.

**10Lectures**

### UNIT 4

**Human Physiology** Introduction to functional organization of human body, control of internal environment, Animal tissue
**Body Fluid**: Blood, Blood cell, lymph composition & function, erythropoiesis, blood groups, Rh factor, blood coagulation, blood pressure, regulation of blood pressure
**Cardiovascular physiology**: physiology of cardiac muscles, structure & function of heart, circulation, origin & conduction of cardiac impulses, cardiac cycle & cardiac output
**Nerve Physiology**: Nervous system, structure of nerve cell, origin & conduction of membrane potential, excitation of nerve fiber, basic function of nerve synapses, Saltatory nerve transmission
**Respiration:** mechanism of breathing, transport of gases, regulatory mechanism,$O_2$ dissociation curves , chloride shift, Bohr effect, Haldane effect, artificial respiration
**Excretion:** structure of excretory organs, urine formation, counter current principle, controlling factors, micturition, regulation of body fluids & acid base balance

**14Lectures**

**Text Books:**
Cell Biology by Darnell & Baltimore
Human Physiology by Guyton
**Suggested Books:**
Principles of Cell Biology by Kleinsmith & Kish
Physiology by Ganong
Cell Biology by Power(CB) 3rd edition
Principles of genetics by Gardener
Genetics by Stantsfield
Gentics a molecular approach by T.A.Brown

Recombinant DNA technology by Watson
Human Genetics by Jenkins

**INHP 205: Instrumentation Practical - III**

**Practical based on paper Introduction to Instrumentation** **Marks: 100**
**8 classes/week**

Practical based on different types of transducers (any eight)-

1. Measurement of pressure, strain and torque using strain gauge.
2. Measurement of speed using Electromagnetic transducer.
3. Measurement of speed using photoelectric transducers and compass
4. Measurement of angular displacement using Potentiometer.
5. Experiment of Opto coupler using photoelectric transducers.
6. Measurement of displacement using LVDT.
7. Measurement using load cells.
8. Measurement using capacitive transducer.
9. Measurement using inductive transducer.
10. Measurement of Temperature using Temperature Sensors/RTD
11. Characteristics of Hall effect sensor.
12. Measuring change in resistance using LDR

**INHP 206: Instrumentation Practical – IV** **Marks: 100**

**4 classes/ week**

**C Programming and Data Structures**

Implement programs in C exemplifying:

1. Arithmetic operations
2. If-else construct
3. Switch construct
4. While, do while and for loop
5. Arithmetic operations for n x m matrices
6. Passing by reference and passing by value in functions
7. Inline parameter passing
8. Pointers and pointer arithmetic
9. String operations using pointers and arrays explicitly.
10. Bitwise operations
11. Invoking a few DOS routines such as interrupts using C procedures.
12. Structures

**Practical based on paper Biology** **4classes/week**

**Cell Biology**

1. Study of various plant cell-types
2. To carry out gram staining for identifying bacteria
3. To prepare squash mounts from onion root-tips to study mitosis
4. To demonstrate the activity of enzyme amylase, urease and catalase and to study the effect of temperature and pH.
5. Micro chemical tests for the identification of Protein, Starch, Sugar, Fats
6. To study meiosis through permanent slides.

**Human Physiology**

1. Determination of ABO Blood Group & Rh factor
2. Preparation of blood smear observartion of blood cell
3. RBC count and Haemoglobin estimation
4. Determination of ESR,PCV and DLC
5. To observe permanent slides of heart, Pituitary gland, spinal cord, Cerebellum,
6. lung s & trachea
7. To record systemic Arterial Blood Pressure

**SEMESTER III**

**INHT 301**: **Digital Electronics**

**Theory** **Marks: 100**

**40 Lectures**

**Unit 1**

**Number System and Codes**: Decimal, Binary, Hexadecimal, Octal, BCD, conversion of one code to another, Complements (one's and two's), Signed and Unsigned numbers, Addition and Subtraction, Multiplication Gray and Hamming Codes.

**Logic Gates and Boolean Algebra:** Truth Tables, OR, AND, NOT, XOR, XNOR, Universal (NOR and NAND) Gates, Boolean Theorems, DeMorgan's Theorems, Principle of duality.

**Digital Logic families**: Fan-in, Fan out, Noise Margin, Power Dissipation, Figure of merit, Current and Voltage parameters, RTL, DTL, TTL, ECL, HTL, MOS, CMOS.

**10lectures**

**Unit 2**

**Combinational Logic Analysis and Design**: Standard representation of logic functions (SOP and POS), Karnaugh map minimization, Quine McCluskey minimization. Multiplexers (2:1, 4:1) and Demultiplexers (1:2, 4:1), Implementing logic functions with multiplexer, Adder (half and full) and subtractor, Encoder (8 to 3) and Decoder (3 to 8).

**10lectures**

**Unit 3**

**Sequential logic design**: Latch, Flip flop (FF), S-R FF, J-K FF, T and D type FFs, Clocked FFs, Registers, Counters (ripple, synchronous and asynchronous, ring, modulo-N), State Table, State Diagrams and Sequential Machines.

**10lectures**

**Unit 4**

**A/D and D/A Converters:** Successive Approximation ADC, R/2R Ladder DAC.

**Memories**: General Memory Operation, ROM, RAM (Static and Dynamic), PROM, EPROM, EEPROM, EAPROM.

**10lectures**

**Suggested Books:**


1. R.L. Tokheim, Digital Principles, Schaum's Outline Series, Tata McGraw-Hill (1994)
2. Donald P. Leach, Albert Paul Malvino, Digital Principles and Applications, Tata McGraw Hill (1995)
3. M. Morris Mano, Michael D. Ciletti, Digital Design, Pearson Education Asia, (2007)
4. Thomas L. Floyd , Digital Fundamentals, Pearson Education Asia (1994)
5. S.P. Bali , Solved Problems in Digital Electronics, Sigma Series, Tata McGraw-Hill, (2005)
6. W. H. Gothmann, Digital Electronics: An Introduction To Theory And Practice, Prentice Hall of India (2000)
7. R.P. Jain , Modern Digital Electronics, Tata McGraw-Hill (2003)

**INHT 302 Analog Electronics-I**

**THEORY** **Marks: 100**

**Unit 1**

**Diode Circuits:** Ideal diode, piecewise linear equivalent circuit, dc load line analysis, Quiescent (Q) point. Positive, negative and biased clipper circuits, clamping circuits. Half wave rectifier, center tapped and bridge fullwave rectifiers, calculation of efficiency and ripple factor.

**DC power supply:** Block diagram of a power supply, qualitative description of shunt capacitor filter, Zener diode as voltage regulator, temperature coefficient of Zener diode.

**10lectures**

**Unit 2**

**The BJT:** Transistor current components and amplification. Transistor configurations: Common Base (CB), Common Emitter (CE) and Common Collector (CC) configuration, I-V characteristics and hybrid parameters, regions of operation, dc load line, Q point.

**CE amplifier:** Self bias arrangement of CE, dc and ac load line analysis. Hybrid equivalent of CE, Quantitative study of the frequency response of CE amplifier, effect on gain and bandwidth for cascaded CE amplifier (RC coupled).

**Power Amplifiers:** Heat sink, Classification of power amplifiers: A, B, C and AB, analysis of Class B push pull amplifiers (efficiency, power dissipation).

Single tuned amplifiers.

**10lectures**

**Unit 3**

**Feedback Amplifiers**: Concept of feedback, negative and positive feedback, Negative feedback: advantages and disadvantages of negative feedback, voltage (series and shunt), current (series and shunt) feedback amplifiers, derivation of gain, input and output impedances for feedback amplifiers. Positive feedback: Barkhausen criteria for oscillations, Study of phase shift oscillator and Colpitts oscillator . Colpitts Crystal oscillator.

**10lectures**

**Unit 4**

**The MOSFET:** The three configurations: Common Gate (CG), Common Source (CS) and Common Drain (CD), I-V characteristics, regions of operation, small signal equivalent circuit, dc load line, Q point.

**CS amplifier:** CS amplifier circuit analysis, Qualitative study of frequency response of CS amplifier.

**10lectures**

**Suggested Books:**


1. R. L. Boylestad, L. Nashelsky, K. L. Kishore, Electronic Devices and Circuit Theory, Pearson Education (2006)
2. D. L. Schilling and C. Belove, Electronic Circuits: Discrete and Integrated, Tata McGraw Hill (2002)
3. J. R. C. Jaegar and T. N. Blalock, Microelectronic Circuit Design, Tata McGraw Hill (2010)
4. Donald A. Neamen, Electronic Circuit Analysis and Design, Tata McGraw Hill (2002)
5. J. Millman and C. C. Halkias, Integrated Electronics, Tata McGraw Hill (2001)
6. J. J. Cathey, 2000 Solved Problems in Electronics, Schaum's outline Series, Tata McGraw Hill (1991)

**INHT 303: Biochemistry**

**Theory** **Marks: 100**

**40 Lectures**

**Unit 1**

**Aqueous Solution:** Properties of Water, Acids, Bases and Buffers, Biological Buffer.**Biomolecules:** Amino acids, optical activity, "Nonstandard" peptides, Physiology active peptide. **Techniques of protein purification**: Protein Isolation, Solubility's of proteins IEF, Chromatographic Separations, Electrophoresis-SDS PAGE, Ultra centrifugation.**Covalent Structures of Proteins:** Primary structures determination, Polypeptide Synthesis **Three Dimensional structures of proteins**Secondary structure: Fibrous proteins, Globular proteins, Proteins stability, Quaternary structure, Denaturation of proteins, Hoffmeister series, Bohr's Effect of hemoglobin

**10Lectures**

**Unit 2**

**Sugars and Polysaccharides**Monosaccharides,desaccharide's,Glycoproteins, Mucopolysaccharides, Important chemical reaction of monosaccharides. **Lipids:**Lipid classification, simple lipid, compound lipit, glycolipid, Lipid linked protein & lipoprotein, aminolipids, Phospholipids, Sphingolipid, Steroids, Gangliosides, Cerebrosides, Important test, Derived lipid, Prostaglandin's Properties of lipid aggregates. **Introduction to Enzymes and Enzyme action:**Mechanism of Enzyme action: Introduction to Enzymes, substrates specification, coenzymes, Regulation of Enzymatic activity, enzyme nomenclature. Rates of Enzymatic Reaction: Chemical Kinetics, Enzyme Kinetics, inhibition effects of pH, Derivation of Michael's Menten Equation, allosteric enzymes.

**10Lectures**

**Unit 3**

**Biochemical Communication:** Hormones, Molecular mechanism of signal Transduction. C-AMP, C-AMP as a second messenger for number of regulator molecule, C-GMP also act as secondary messenger, Insulin receptor, $Ca^{2+}$ as second messenger, Ion channels gated by ligand and membrane potential, Steroid and thyroid hormones, Neurotransmission. **Membrane and Membrane Transport:** Biological membrane, Membrane proteins, Passive transport a downhill process, Glucose permease of Erythrocytes, Chloride and Bicarbonate are cotransported across Erythrocyte membrane. Active transport result in solution movement against a concentration gradient, Active transport of $Na^+$, $K^+$ ion gradient provide the energy for secondary active transport ion selective channels act in signal transcution.

**10Lectures**

**Unit 4**

**Metabolism:** Introduction to metabolic compartment of cell, Metabolism Pathways, overview of Intermediary metabolism, Experimental Approaches to the study of metabolism, Thermodynamics of phosphate compound, Oxidation Reduction reaction, Thermodynamics of life **Glycolysis:** Glycolytic pathways, utilization of Glucose, Reaction of Glycolysis, Fermentation: The anaerobic fate of Pyruvate, Control of metabolic flux, Metabolism of Hexoses other than Glucose, Feeder's pathway, Gluconeogenesis.**Glycogen Metabolism:** Glycogen breakdown, Glycogen Synthesis, control of glycogen metabolism, Glycogen storage diseases (Vongerk's syndrome) **Citric Acid Cycle:** Cycle overview, Metabolic sources of Acetyl CoA, enzymes of TCA, Regulation of TCA, Amphibolic nature of TCA. Other pathways of Carbohydrate Metabolism, *Glucogenesis, Glyoxylate Pathway,* Pentose Phosphate Pathway, Regulation of blood glucose concentration, Diabetic mellitus, conversion of carbohydrates into fats.,**Introduction to** Lipid Metabolism, Amino Acid Metabolism,Nucleotide Metabolism

**10Lectures**

**Suggested Books:**

1. Zubey,Biochemistry
2. Stryer ,Biochemistry
3. Lehninger ,Biochemistry

**INHT 304: Signals and Systems**

**THEORY** **Marks: 100**

**Unit 1** **40 Lectures**

**Signals and Systems:** Continuous and discrete time signals, Transformation of the independent variable, Exponential and sinusoidal signals, Unit impulse and unit step functions, Continuous-Time and Discrete-Time Systems, Basic System Properties. **10 Lectures**

**Unit 2**

**Linear Time-Invariant Systems (LTI):** Discrete time LTI systems, the Convolution Sum, Continuous time LTI systems, the Convolution integral. Properties of LTI systems, Commutative, Distributive, Associative, LTI systems with and without memory, Invertibility, Causality, Stability, Unit Step response. Differential and Difference equation formulation, Block diagram representation of first order systems. **10 Lectures**

**Unit 3**

**Fourier Series Representation of Periodic Signals**: Continuous-Time periodic signals, Convergence of the Fourier series, Properties of continuous-Time Fourier series, Discrete-Time periodic signals, Properties of Discrete-Time Fourier series. Frequency-Selective filters, Simple RC highpass and lowpass filters, Discrete-Time filters, Recursive, Non-recursive filter.

**Fourier Transform:** Aperiodic signals, Periodic signals, Properties of Continuous-time Fourier transform, Convolution and Multiplication Properties, Properties of Fourier transform and basic Fourier transform Pairs. **10 Lectures**

**Unit 4**

**Laplace Transform**: Laplace Transform, Inverse Laplace Transform, Properties of the Laplace Transform, Laplace Transform Pairs, Solving Differential Equations with Intial conditions, Laplace Transform Methods in Circuit Analysis, Step response of RL, RC and RLC circuits, Impulse response of series RC, Sinusoidal response of RL circuit. **10 Lectures**

**Suggested Books:**


1. A. V. Oppenheim, A. S. Wilsky and S. H. Nawab, Signals and Systems, Pearson Education (2007)
2. S. Haykin and B. V. Veen, Signal and Systems, John Wiley & Sons (2004)
3. H. P. Hsu, Signals and Systems, Tata McGraw Hill (2007)
4. M. Roberts, Fundamentals of Signals and Systems,Tata McGraw Hill (2007)
5. S. T. Karris, Signal and Systems: with MATLAB Computing and Simulink Modelling, Orchard Publications (2008)
6. W. Y. Young, Signals and Systems with MATLAB, Springer (2009)

## INHT 304: Microbiology & Genetics

**THEORY** **Marks: 100**

**40 Lectures**

### Unit – 1

**Basic Concept of Microbiology –** The discovery of Microbial world, Spontaneous generation versus biogenesis, the germ theory of disease, Fermentation and Immunization.

**Survey of Microorganism** – A brief account of structural organization of the prion, viroid, virus, bacteria, protest and fungi.

**7 Lectures**

### Unit – 2

**Cultivation of Microorganism** – Pure culture concept, types of culture media, Synthetic and complex media, sterilization, aseptic transfer, isolation technique, incubation, Microbial Nutrition, nutritional types of Microorganisms, and enrichment culture techniques.

**Microbial Metabolism** – Chemical principles of metabolism-autotrophic and heterotrophic metabolism. Secondary Metabolism, Transport mechanism. Ecological aspects of microbial metabolism. (Biogeochemical cycles carbon, hydrogen, oxygen, nitrogen & sulphur cycles, heavy metals).

**Microbial Growth** – The growth kinetics, batch and continuous (Turbidostat and Chemostat) culture of Microorganism, Factors influencing microbial growth (O2, water, pH, temperature, pressure, salinity), physical and chemical control of Microorganisms, antibiotic control of disease causing microorganisms.

**15 Lectures**

### Unit – 3

**Applied Microbiology** – Basic concept of fermentation technology, Major Products of Industrial Microbiology: antibiotics, Amino acid, Organic acid, Enzymes. Microbial transformation of steroids. Microbial application in food industry, Pharmacuticals, agriculture and Environment (water quality and Bio-degradation of Waste.)

**10 Lectures**

### Unit – 4

**Mutation** – Numerical and structural changes in chromosomes, Gene mutation – spontaneous and induced mutation, base analogue, alkylating agent, acreding dye, de aminating agent, inhibition of nucleic acid precursors.

**Genetic Code** – Theory of genetic code, Gene function and its regulation – Protein synthesis. Regulation of gene expression, negative (Lac operon) and positive control (Arabinose).

**08 Lectures**

**Suggested Books:**


1. Microbiology by Pelzar
2. Principles of genetics by Gardener
3. Genetics by Stantsfield
4. Genetics a molecular approach by T.A. Brown
5. Cell Biology by Power (CB) 3rd edition
6. Cell Biology by Darnell & Baltimore
7. Principles of Cell Biology by Kleinsmith & Kish
8. Principles of genetics by Gardener
9. Genetics by Stantsfield
10. Genetics a molecular approach by T.A. Brown
11. Recombinant DNA technology by Watson
12. Human Genetics by Jenkins
13. Cell Biology by Karp (Gerald) 2nd edition
14. Cell Biology by Smith
15. Techniques in micro and cell biology by V.K. Sharma

**INHP 305: Instrumentation Practical – V** **Marks: 100**

**Digital Electronics** **4 classes /week**

1. To verify and design AND, OR, NOT and XOR gates using NAND gates.
2. Design a Full adder and a full subtractor circuit.
3. Design a 4x1 Multiplexer/ 3 to 8 decoder circuit using logic gates.
4. Implement a function (4 variable) with logic gates , MUX , Decoder ICs
5. Design a 4 bit parallel adder/subtractor circuit using 4 bit adder circuit IC
6. Design a seven-segment Display driver.
7. Using elementary gates build circuits for RS, Clocked RS, D, and JK Flip-Flop).
8. Design a Modulo N Asynchronous and Synchronous Counter using D/T/ JK Flip-Flop ICs.
9. Design a shift register using D/T/ JK Flip-Flops to study Serial and parallel shifting of data.
10. To design a digital to analog converter of given specifications.

Some of the experiments mentioned above may also be implemented using MULTISIM Software

**Biochemistry Practical** **4 classes /week**

**Solutions:**

(a) Preparation of molar, % solution and buffers
(b) Determination of Pka of acid
(c) Determination of PI for Casein

**Chromatography:**

(a) Separation of amino acids by descending paper chromatography
(b) Separation of leaf pigment and sugar by Thin Layer chromatography.

**Electrophoresis:**

(a) SDS-gel electrophoresis, Determination of Mol wt. Of proteins
(b) Agarose gel electrophoresis for DNA

**Carbohydrates:**

Qualitative test for sugars and preparation of osazone

**Chromatography:**

a) Preparation of gel permeation column
b) Separation of $COCl_2$ (Cobalt Chloride) and Blue dextran using sephantex G-25

**Spectrophotometer**

a) Determination of Beer's Law and $\lambda_{max}$ of Cobalt chloride and Methyl orange.
b) The UV absorption of protein and nucleic acid
c) Estimation of protein by Bradford's method and Lowry's method
d) Estimation of sugars by Anthrone method

**Enzymes:**

Isolation and partial purification of enzyme acid phosphatase from moong dal using ammonium sulphate precipitation and find out the activity of enzymes.

**INHP 306: Instrumentation Practical - VI** **Marks: 100**

**Practical based on Analog Electronics-I** **8 classes/week**

1. To study the Half wave rectifier and study the effect of C filter.
2. To study the Full wave rectifier and study the effect of C filter.
3. To study Fixed Bias, Voltage divide and Collector-to-Base bias Feedback configuration for transistor.
4. To design a Single Stage CE amplifier for a specific gain and bandwidth.
5. To study Class A, B and C Power Amplifier.
6. To study the Colpitt's and Phase Shift Oscillator.
7. To study the frequency response of Common Source/ Common Gate FET amplifier.

**Software Based Simulations (to run concurrently)**

1. To study the Half wave rectifier and study the effect of C filter
2. To study the Full wave rectifier and study the effect of C filter
3. To study Fixed Bias, Voltage divide and Collector-to-Base bias Feedback configuration for transistor
4. To design a Single Stage CE amplifier for a specific gain and bandwidth
5. To study the Class A, B and C Power Amplifier
6. To study the Colpitt's and Phase Shift Oscillator
7. To study the frequency response of Common Source/ Common Gate-FET amplifier

**INHP – 306 Instrumentation Practical - VI**
**Instrumentation Practical – IX (INHT 304)**

**4 classes/week**

**Practical based on Microbiology**

1. Microscopic observation of economically important virus, bacteria (Cocci, bacilli, spirals), yeast (Saccharaomyces cerevisiae), fungi (Rhizopus, Aspergillus, Pencillium, Neurospora, Puccinia, Agaricus), Protists (Chlaymodomonas, Euglena, Amoeba, Entamoeba and Paramecium) with the help of permanent slides and Electron Micrographs to study morphology and structure.
2. Sterilization and isolation techniques (streaking, spread plate and pour plate)
3. Isolation of microbes from soil, air and water.
4. Demonstration of anaerobic respiration using Saccharomyces cerevistae
5. Alcoholic fermentation of carbohydrates by using S. cervisae
6. Effect of temperatue and pH on the growth of a bacterium
7. Isolation of Rhizobium from root nodules
8. Isolation of dermatophytes (fungi soil using baits such as nails, hair etc)
9. Identification of microbial diseases.

**Practicals based on Genetics**

1. Karyotype analysis – Allium cepa
2. Study of different stages of Meiosis – allium cepa/Phloxathyrous flower buds
3. Chiasma frequency – Allium cepa
4. To demonstrate the coiling of the chromosome- Allium cepa
5. Meiotic preparation to show chromosomal Aberrations- Rhoeo
6. Effect of colchicine and the induction of polyploidy
7. Determination of blood group (ABO series) in human beings
8. Identification of the inactive X-chromosome in buccal smear

## SEMESTER IV

**INHT-401: Industrial Instrumentations** **Marks:100**

**40 Lectures**

### Unit 1

**Flow Measurement:** Introduction, definitions and units, classification of flow meters,Mechanical type flowmeters -Theory of fixed restriction variable head type flow meters – orifice plate – venturi tube – flow nozzle – dall tube – installation of head flow meters Quantity meters, area flow meters and mass flow meters-Positive displacement flow meters – constructional details and theory of operation of mutating disc, reciprocation piston, oval gear and helix type flow meters – inferential meter – turbine flow meter – rota meter –thermal mass flow meter – volume flow meter plus density measurement –Electrical type flow meter-Principle and constructional details of electromagnetic flow meter – different types of excitation – schemes used – different types of ultrasonic flow meters – laser doppler anemometer systems – rortex shedding flow meter – target flow meter – solid flow rate measurement – guidelines for selection of flow meter.

**16 Lectures**

### Unit 2

**Measurement of Speed and Acceleration:** Tachometers - Mechanical, Electric, Contact less, Frequency, Ignition, Stroboscopic tachometers. Comparative methods, Elementary accelerometers, Seismic, Practical accelerometers. **Measurement of humidity and moisture** –basic principles, hygrometers, psychrometers , humidity charts –dew point, measurement systems for humidity.- Infrared moisture measuring systems , radio active moisture measuring systems. **10Lectures**

### Unit 3

**Pressure measurement-**Units of pressure – manometers – different types – elastic type pressure gauges – Bourde type bellows – diaphragms –measurement of vacuum – McLeod gauge, Pirani and Ionisation Gauge– thermal conductivity gauges – Ionization gauge cold cathode and hot cathode types – testing and calibration of pressure gauges – dead weight tester. Vacuum pumps- -Rotary and Diffusion **10 Lectures**

### Unit 4

**Recorders**: types, strip chart, circular, X-Y, oscillographic, magnetic tape, printers- dot matrix, ink jet, laser

**04 Lectures**

**Text Books:**

Liptak B. G. - Process Measurement and Analysis, Third Edition, Chilton Book Company, Pennsylvania, 1995.
D.Patranabis, Principles of Industrial Instrumentation Tata McGraw Hill Publishing Co.,NewDelhi,1999

**Suggested Books**:

A.K . Sawhney, - A course in mechanical measurements and instrumentation, Dhanpat Rai & Co.
Andrew W. G. - Applied Instrumentation in Process Industries - A Survey, Vol.1 & Vol.2, Gulf Publishing Company, Houston, 1992.
R.K. Jain - Mechanical and Industrial Measurements, Tenth Edition, Tata McGraw Hill, New Delhi, 1996.
Doeblin E. O - Measurement Systems: Application and Design, Fourth Edition, McGraw Hill, Singapore, 1992.

## INHT-402: Analog Electronics-II

**THEORY** **Marks: 100**

### Unit 1

**Basic Operational Amplifier:** Concept of differential amplifiers, block diagram of an operational amplifier (IC 741)**Op-Amp parameters:** input offset voltage, input offset current, input bias current, differential input resistance, input capacitance, offset voltage adjustment range, input voltage range, common mode rejection ratio, slew rate, supply voltage rejection ratio.

**Op-Amp in open and closed loop configuration**: Frequency response of an op-amp in open loop and closed loop configurations, Inverting, Non-inverting, summing and difference amplifier, Integrator, Differentiator, voltage to current converter, current to voltage converter.

**10 Lectures**

### Unit 2

**Comparators:** Basic comparator, Level detector, Voltage limiters, Regenerative comparator.
**Signal generators:** Phase shift oscillator, Wien bridge oscillator, Schmitt Trigger, Square wave generator, triangle wave generator, sawtooth wave generator, Voltage controlled oscillator (IC 566), Phase locked loops (PLL). **10 Lectures**

### Unit 3

**Multivibrators (IC 555):** Block diagram, Astable and monostable multivibrator circuit, Voltage to frequency (V/F) and frequency and voltage (F/V) converter. **05 Lectures**

### Unit 4

**Signal Conditioning circuits:** Sample and hold systems, Active filters: First order low pass and high pass butterworth filter, Second order filters, Band pass filter, Band reject filter, All pass filter, Logarithmic and exponential amplifiers. **15 Lectures**

**Suggested Books:**


1. R. A. Gayakwad, Op-Amps and Linear IC's, Pearson Education (2003)
2. S. Franco, Design with operational amplifiers and analog integrated circuits, Tata McGraw Hill (2002)
3. R. F. Coughlin and F. F. Driscoll, Operational amplifiers and Linear Integrated circuits, Pearson Education (2001)


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## INHT403: Statistical Methods and Reliability

**THEORY** **Marks: 100**

**Unit 1**

**Descriptive Statistics:**Graphical and Tabular representation of data. Measures of Central Tendency, Measures of Dispersion, Measures of Skewness and Kurtosis. **Correlation and Regression:**Linear Regression and Correlation. Multiple Linear Regression. **10 Lectures**

**Unit 2**

**Probability**

Introduction of probability, Baye's Theorem, Random Variables, Probability Distributions, Mathematical Expectation. **Sampling and Sampling Distributions:** Sampling distributions and Standard errors. One and two sample estimation of means and proportions. One and two sample tests of hypothesis- means, proportions and variances. Chi-square test. **10 Lectures**

**Unit 3**

**Nonparametric Statistics:** Nonparametric tests: Sign test, Signed-Rank test, Rank-Sum test, Kruskal-Wallis test, Runs test. **5 Lectures**

**Unit 4**

**Reliability:**Different types and modes of failure, causes of failure in electronic components, reliability theory, hazard rate, failure density function, availability, maintainability, mean time to failure and repair system structures: series, parallel, K-type, reliability evaluation, optional reliability and redundancy allocation, Fault tree analysis **15 Lectures**

**Suggested Books:**


1. Probability and Statistics for Engineers and Scientists by Walpole, Myers, Myers and Ye, 7th Edition, Pearson Education.
2. Mathematical Statistics by Freund, Prentice Hall, India
3. Introduction to Statistical Quality Control by Montgomerry, John Wiley and Sons.
4. Principles of Biostatistics by M. Pagano and K. Gauvrean: Thompson learning (2nd edition); 2004.
5. Biostatistics: A Foundation for Analysis in the Health Sciences by W. W. Daniel: John Wiley and Sons Inc (7th edition); Indian Reprint 2006.
6. Reliability Engineering by S.Shreenath

**INHT-404: Electronic Instrumentation** **Marks:100**

**Theory** **40 Lectures**

**Unit 1**

**Basic Measurement Instruments:**

DC measurement: dc voltmeter, ohmmeter and ammeter. Digital type voltmeter, ammeter and ohmmeter ,digital multimeter, AC measurement , voltmeter, ammeter .Digital frequency meter: elements of frequency meter, universal counter and its different modes, measurement errors and extending the frequency range. Digital LCR-Q meter, digital wattmeter. **10 Lectures**

**Unit 2**

**Signal Generators:** Types of generators and their operation: Audio oscillator, Function generators, Pulse generators, RF generators, Random noise generators. **Probes and Connectors:** Test leads, shielded cables, connectors, low capacitance probes, high voltage probes, RF demodulator probes, special probes for IC's, current probes. **Electronic Displays**: The Cathode Ray Oscilloscope (CRO): Block diagram of a General Purpose Oscilloscope and its basic operation, electrostatic focusing and deflection, screen for CRT and graticules, CRT connections,CRO probes. Types of CRO's: dual trace ocilloscope, digital storage oscilloscope.

**15 Lectures**

**Unit 3**

**Frequency Spectrum, Distortion and wave measurement:**

Spectrum analyzer, Harmonic distortion analyzer, intermodulation distortion analyzer, wave analyzer and distortion factor meter, Tuned circuit wave meter for frequency measurement, Different type of wave meters and factors affecting their accuracy, Lumped and cavity wavemeters, Q-meter and its applications.

**10 Lectures**

**Unit 4**

**Network Analyzers :**FFT spectrum analyzers, Bank-of –filters, Wave meters, Resolution B.W,**Logic Analyzers:**Logic probes, timing analyzer, glitch detect, state analyzer **5 Lectures**

**Suggested Books:**

Joseph J Carr, Elements of electronic instrumentation and measurement, Pearson Education
Rangan, Sarma and Mani, Instrumentation, devices and systems, Tata Mc-Graw Hill
H. S. Kalsi , Electronic Instrumentation, Tata Mc-Graw Hill.
Modern electronic Instrumentation and measurement techniques, Helfrick Cooper, Pearson Education
R. A. Witte, Electronic test instruments: analog and digital measurements, Tata Mc-Graw Hill
S. Wolf and R.F.M. Smith, Student Reference Manual, Pearson Education.
Electronic Test Instruments by Robert A. Witte, Pearson Education
Electronic Instrumentation and Measurement Techniques By William D. Cooper, Prentice Hall India
Electronic Instrumentation by Kalsi, Tata-McGraw Hill

**I**

**NHP – 405: Instrumentation Practical – VII** **Marks: 100**

**Practical based on Electronic Instrumentation** **4classes/week**

1. Study and operation of Multimeters (Analog and Digital), Function Generator, Regulated Power Supplies
2. Study and Operation of CRO.
3. Two Stage RC Coupled Amplifier
4. Current shunt and Feedback Amplifier
5. Cascade Amplifier
6. Wien Bridge Oscillator using Transistors
7. RC Phase Shift Oscillator using Transistors
8. **Simulation tools:** Design and Simulation in Simulation Laboratory using P spice or MATLAB or Equivalent Simulation Software

**Practical based on Industrial instrumentation** **4classes/week**

1. Discharge coefficient of orifice plate.
2. Calibration of pressure gauge.
3. Calibration of thermocouple
4. Calibration of RTD.
5. Level transmitters.
6 Conductivity meter calibration and measurements of conductivity of test solutions.
7. EM flowmeter and ultrasonic flowmeter.
8. Ratio control in combustion laboratory unit.
9. AC/DC meter calibrator.
10. To study of Circular chart recorder

**INHP 406 Instrumentation Practical – VIII**

**Practical based on Analog Electronics-II** **Marks: 100**

**8 classes/week**

1. To design an amplifier of given gain for an inverting and non-inverting configuration using an op-amp.
2. To design an integrator using op-amp for a given specification and stud its frequency response.
3. To design a differentiator using op-amp for a given specification and stud its frequency response.
4. To design a First Order Low-pass filter using op-amp.
5. To design a First Order High-pass filter using op-amp.
6. To design a Second Order Low-Pass filter using op-amp.
7. To design a Second Order High-Pass filter using op-amp.
8. To design a Band Pass/ Band Reject filter using op-amp.
9. To design a RC Phase Shift Oscillator using op-amp for a given specification

**Software Based Simulations (to run concurrently)**

1. To design an amplifier of given gain for an inverting and non-inverting configuration using an op-amp.
2. To design an integrator using op-amp for a given specification and stud its frequency response.
3. To design a differentiator using op-amp for a given specification and stud its frequency response.
4. To design a First Order Low-pass filter using op-amp.
5. To design a First Order High-pass filter using op-amp.
6. To design a Second Order Low-Pass filter using op-amp.
7. To design a Second Order High-Pass filter using op-amp.
8. To design a Band Pass/ Band Reject filter using op-amp.
9. To design a RC Phase Shift Oscillator using op-amp for a given specification

**SEMESTER V**

**INHT-501: Microprocessor** **Marks: 100**

**40 Lectures**

**Unit 1**

8085 pin diagram and architecture, CISC architecture, system bus architecture, internal registers, fetch-decode-execute cycle, Addressing modes and instruction set

**Unit 2**

Subroutines, stacks and its implementation, delay subroutines, hardware and software interrupts, programming based on above concepts

**Unit 3**

8086 pin diagram and internal architecture, Minimum and maximum operating modes, Functional Units of 8086, Bus Interface Unit and internal registers, Addressing modes of 8086. 8086 instruction set and assembly language programming

**Unit 4**

Strings, procedures & macros: 8086 string instructions, writing and using procedures, writing and using assembler macros, 8086 Assembler Directives, 8086 system connections and timing**:** Read and Write cycles and their timing diagrams, Wait state, Basic Interrupt processing, interrupt flag bits and interrupt instructions

**Suggested Books:**


1. Ramesh Gaonkar, "Microprocessors architecture, programming and Applications", Wiley Eastern Ltd. (2002)
2. K. Udaya Kumar & B.S. Umashankar, "The 8085 Microprocessor: Architechture, Programming and Interfacing", Pearson Education
3. Liu Gibson, "Microprocessor Systems: The 8086/8088 family Architecture, Programming& Design", PHI, 1999.
4. Barry B. Brey and C R Sarma, "The Intel Microprocessors 8086/8088, 80186/80188, 80286, 80386, 80486, Pentium and Pentium Pro-Processor Architecture, Programming and Interfacing", Pearson Education, (2005)
5. Walter Triebel & Avtar A, Singh, "8088 and 8086 Microprocessors: Programming, Interfacing, Software, Hardware and Applications", Pearson Education
6. D. V. Hall, "Microprocessors and Interfacing", Tata Mc Graw Hill (2005)
7. Peter Able, "IBM PC Assembly language programming", PHI, 1994.


**INHT-502: Analytical Instrumentation-I** **Marks: 100**

**40 Lectures**

**Unit 1**

**Introduction. :** Methods of Analysis – Qualitative, quantitative and instrumental methods.
Principal ,types of instrumentation, advantages and disadvantages of instrumental methods. Steps involved in chemical analysis, types of analytical methods, qualitative ndquantitativeanalysis. **Atomic absorption and flame photometry.** Principle, instrumentation, interferenceand applications. **06 Lectures**

**Unit 2**

**Separation techniques:** Basic Chromatographic techniques, Planar (Paper, TLC/HPTLC) Column(gel permeation, ion exchange), Solvent extraction and centrifugation

**10 Lectures**

**Unit 3**

**Column Chromatography**- Theory, Principle, Instrumentation and application of column chromatography (Gas Liquid Chromatography and High Performance Liquid Chromatography)

**10 Lectures**

**Unit 4**

**Spectroscopy-I:** Spectro analytical methods – Energy, properties of electromagnetic radiation (EMR) General features of spectroscopy, interaction of EMR with matter. Spectrometers, molecular energy levels. Types of molecular transitions, applications.

**Ultraviolet-Visible Spectroscopy:** Theory, types of transitions. Instrumentation – Radiation source, monochromators, detectors. Double beam spectrophotometer, derivation of Beer's Law, numerical problems. Deviations from Beer's Law – Chemical, instrumental and real deviations.**Infrared Spectroscopy:** Principles, diatomic molecules as a simple harmonic oscillator, numerical problems. Instrumentation – Components of dispersive IR spectrometer. Source, Optical system, sampling, detectors. Double beam IR spectrometer, FTIR spectrometer. Applications – Limitations, advantages, comparison of dispersive and FTIR instruments.

**Raman Spectroscopy:** Principles, Mechanism of Raman Effect – Quantum theory and classical theory. Techniques and Instrumentation, Applications

**14 Lectures**

**Text Books:**

H.H.Willard, *Instumental Methods of Analysis,* CBS Publishers

**Suggested Books:**

Skoog & Lerry, *Instrumental Methods of Analysis,* Saunders College Publications, New York
R.M.Silverstein, *Spectrometric Identification of Organic Compounds*, John Wiley
D.C. Harris, Quntitave Chemical Analysis, W.H.Freeman
Vogel's Textbook of Qualitative Chemical Analysis, ELBS
W.Kemp, *Organic Spectroscopy*,ELBS
J.A. Dean, *Analytical Chemistry Notebook*, Mc Graw Hill
Jagmohan, *Organic Analytical Chemistry*, Narosa Publishing House
R.A.Day and A.L. Underwood, *Quantitative Analysis*, Prentice Hall of India
John H. Kennedy, *Analytical Chemistry: Principles*, Saunders College Publications**INHT-503:**

**INHT 503: Electrical Machines & Control Systems** **Marks:100**

**40 Lectures**

**Unit 1**

**Basic Power Devices and Circuits**

Brief review of SCR, Diacs and Triacs, their construction. and IV characteristics. Two transistor model of SCR. Resistive and RC triggering circuits. **Applications of SCRs:**Basic series inverter circuit and the improved circuits, Parallel Inverters, Chopper circuit – Basic concept, step up and step down choppers. Jones and Morgan's chopper. **10 Lectures**

**Unit 2**

**Electro-mechanical Machines:** Principle of electromechanical conversion, DC motors, operational comparison between generator and motor action (without constructional comparison). Significance of back EMF, Maximum power, Torque and speed relation, Characteristics of series, shunt and Compound excited, necessity of motor starters, Three point starter, Speed control methods, SCR speed control using chopper and controlled rectifiers circuits. **10 Lectures**

**Unit 3**

**AC Machines:** Types of transformers, Transformer Construction, E.m.f. equation, Transformer Losses, condition for maximum efficiency, all day efficiency, Auto transformers, Induction Motor, constructional features, Rotating magnetic field, generation of rotating magnetic field in single phase motors. **10 Lectures**

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**Unit 4**

Open loop and closed loop control system illustration, block representation, signal terminology, general explanation with illustration of servomechanism, regulation system, Linear and non linear controls, continuous and sampled data controls digital control.

**Mathematical modeling and system representation:**Differential equation of physical systems such as mechanical, electrical electromechanical ,thermal, pneumatic ,liquid level etc .Analogues System , 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 system parameters , system dynamics and effect of disturbances

**10 Lectures**

**Suggested Books:**


1. G. Mc. Pherson, An introduction to Electrical Machines & Transformers, John Wiley & Sons (1990)
2. H. Cotton, Advanced Electrical Technology, CBS Publishers and Distributors, New Delhi (1984)
3. B. L. Thareja and A. K. Thareja, Electrical Technology, S. Chand & Sons., 23rd Edition
4. I. J. Nagrath and D. P. Kothari, Electrical Machines, Tata McGraw Hill (1997)
5. S. Ghose, Electrical Machines, Pearson Education (2005)
6. N. K. De and P. K. De, Electric Drives, Prentice Hall of India (1999)
7.Control systems, Nagrath and Gopal, New Age International
8.Automatic Control Systems, Kuo, Wiley international

**INHT-504: Biomedical Instrumentation-I Marks:100**

**Theory** **40 Lectures**

**Unit 1**

**Introduction** to bioelectric potential, bioamplifier, components of man Instrument system, types of bio-medical systems, design factors and limitations of biomedical instruments, terms and transducers to various physiological events, types of bio-potential electrodes.

**06 Lectures**

**Unit 2**

**Cardiac vascular system** : - origin of ECG, Instruments of ECG, bipolar system lead system I, II, III, Einthovan's triangle, Augmented lead system, uni polar chest lead system, types of display.
Defibrillators – AC, DC, Cardiovertor, Pacemakers- Internal, External. Blood pressure measurements:- direct, indirect.
**Respiratory system**: types of volume, types of measurements, Instrumentation of respiratory system, principle & types of pneumograph, Spirometer, pneumo tachometers, nitrogen wash out technique, apnoea detectors

**15 Lectures**

**Unit 3**

**Nervous system**:- Action potential of brain, brain wave, Instrumentation – Electro encephalography (EEG), analysis. **04 Lectures**

**Unit 4**

**Medical Imaging system**:Thermal imaging system, working, IR detectors, application. Ultra sound, properties, its generation & detection, types of transducers, diagnostic application – A Scan, B Scan, M Scan(echo cardio graph), real time ultrasonic imaging, linear array scanners.Radiography- conventional X ray, properties, generation of X-ray, Fluoroscopy,
X Ray computed tomography (CT Scanner) and computer-aided tomography (CAT)- principle, contrast scale, scanning system, processing unit, viewing, storage.

**15 Lectures**

**Text Books**:
Khandpur R. S. - Handbook of Biomedical Instrumentation, TMH
**Suggested Books:**
Bertil Jacobson & John G. Webster - Medicine and Clinical Engineering, PHI
Prof. S.k.VenkataRam-Bio-Medical Electronics and Instrumentation, Galgotia Publications
John G.Webster- Medical Instrumentation-Application and Design Wiley Student Edition)
L.Cromwell et al- Biomedical Instrumentation and Measurements PHI

**INHP 505: Instrumentation Practical – IX** **Marks: 100**

**Practical based on Analytical Instrumentation-I** **4 classes/week**

1. To determine the concentration of Na &K in the unknown sample using flame photometer
2. To find out the concentration of Potassium ions in the given sample using standard addition method
3. To find the concentration of various dyes in the given unknown solution
4. To select the appropriate filter and find the concentration of unknown solution
5. To carry out the spectrophotometric determination of any solutions
6. To find the moisture content in a given sample using Karl Fisher titrator
7. To determine the contents of unknown solution by using GC.
8. To analyze quantitatively in the given sample using interval standard in GC

**Practical based on paper Biomedical Instrumentation I** **4classes/week**

1 .Characterization of bio potential amplifier for ECG signals.
2. Study on ECG simulator
3. Measurement of heart sound using electronic stethoscope. Study on ECG heart rate monitor /simulator
4 .Study of pulse rate monitor with alarm system
5. Determination pulmonary function using spirometer (using mechanical system).
6. Measurement of respiration rate using thermister /other electrodes.
7. Study of Respiration Rate monitor/ apnea monitor
8. Study on ultrasound transducers based on medical system
9. Study of a Pacemaker.
10. Measurement of pulse rate using photoelectric transducer & pulse counting for known period.

**INHP 506: Instrumentation Practical – X** **Marks: 100**

**Practical based on Paper Microprocessor and Electrical Machines and Control Systems**

**8classes/week**

(To be implemented on both 8085 and 8086 microprocessors)

1. To write an assembly language program to perform basic mathematical operations (addition, subtraction, multiplication, division)
2. To write an assembly language program to generate first N terms of an A.P. / G.P. series
3. To write an assembly language program to generate first N terms of Fibonacci series
4. To write an assembly language program to arrange the given list of number in ascending / descending order
5. To write an assembly language program to calculate N!
6. To write an assembly language program to separate prime numbers in a given list of number
7. To write an assembly language program to convert a number from one number system to another
8. To write an assembly language program to design a clock

9. To write an assembly language program to calculate a mathematical expression (for e.g. $2^N/N!$)
10. To write an assembly language program to calculate value of sin(x)
11. To implement basic 8086 interrupts using assembler
12. Power measurement in single & three phase circuit.
13. Load characterstics of D.C motor
14. Speed control of D.C. motor
15. Brake test of D.C. motor
16. Brake test of induction motor
17. Study of the Stepper motor
18. Study of Servo motor.

## SEMESTER VI

### INHT- 601: Analytical Instrumentation-II Marks: 100

**40 Lectures**

**Unit 1**

**Gas & Air pollution analyzers**: Introduction to types of gas analyzers- flue gas analyzers, paramagnetic oxygen analyzers. Hydrogen gas analyzers-IR gas analyzers, analyzers based on gas density systems based on ionization of gases. Air pollution monitoring, instrument systems for-carbon monoxide-sulpher dioxide-nitrogen oxides-hydro carbons-ozone

**6 Lectures**

**Unit 2**

**Spectroscopy-II:**Nuclear, Magnetic Resonance Spectroscopy: Basic principles of NMR, Chemical shift, spin – spin coupling. Instrumentation – Magnet, sweep generator, RF generator, RF receiver, signal recorder. Applications – Structural diagnosis, quantitative analysis. Atomic Absorption and Flame Photometry- Principle, Instrumentation, Interference and applications ,Mass Spectroscopy -Theory, instrument and application

**1**6 **Lectures**

**Unit 3**

**Potentiometry**

Introduction, reference and indicator electrodes, ion selective electrodes and their applications. Potentiometric titrations. **08 Lectures**

**Unit 4**

**Thermal Instrumentation:** Thermal detectors. TG (thermogravimetry). – DTA(Differential Thermal analysis). – DSC(differential scanning calorimetry) – X-ray spectroscopy. Production of X-rays and X-rays spectra. Monochromators and detector used in that. X-ray diffraction and diffractometer, X-ray fluorescence.

**10 Lectures**

**Text Book**

R.S Khandpur- Analytical Instrumentation
Skoog and West: Analytical Instrumentation

**Suggested Books:**

Williard Meritt & Dean: Instrumental methods of analysis, (Dvan Nostr and Co)
Ewings E.W.: Instrumental methods of chemical analysis
B.E.Noltigk , Jones – Instrument Technology – Volume 2 & 3 (ELBS)
Ewings Analytical instrumentation handbook By Jack Cazes, Galen Wood Ewing

**INHT-602 Biomedical Instrumentation-II** **Marks: 100**

**Theory** **40 Lectures**

**Unit 1**

**Ventilators**: Parameters, system concepts, their classification, valve, humidifiers, nebulizers.**Oximeter-**in vivo, invitro, pulse and ear type. **Blood flow meter**- electromagnetic types. Blood gas analyzers- acid base balance, blood ph, $pCO_2$, $pO_2$ measurement

**10 Lectures**

**Unit 2**

**Biotelemetery**- design, single channel, bio telemetery transmitter and receiver system, based on AM, FM modulation, pulse modulation. **5 Lectures**

**Unit 3**

**Nuclear medicine system**- radioactive emissions, rectilinear scanner, gamma camera, imaging system, ECT (emission coupled tomography),positron emission tomography, safety measures.

**10 Lectures**

**Unit 4**

**Clinical Instruments:** General principle, working and application of Auto analyzers, elisa reader, Thermal Cycler, Blood cell counter, equipments used in surgery, safety.Fibre Optic Endoscopy: Principles and applications, neonatal instrumentation, Incubators, anaesthesia equipment.

**15 Lectures**

**Text Books**

Joseph J. Carr & John. M. Brown - Introduction to Biomedical Equipment technology
R.S. Khandpur - Handbook of Biomedical Instrumentation, McGraw Hill.

**Suggested Books:**

J.G. Webster - Medical instrumentation application and design, Houghton Miffin Co., Boston USA.
Mohan Murali H. - Monograph on Biomedical engineering, O.U. Press 1985.
Geddes L. A. & L. E. Baker - Principles of Applied Biomedical Instrumentation, Wiley, 1989.
Leslie Cromwell, Fred J. Weibell and Erich A. Pfeiffer - Biomedical Instrumentations and Measurements (2e), PHI, 1991.

**INHT-603: Statistical Quality Control** **Marks: 100**

**40 Lectures**

**Unit 1**

**Quality Concepts**: Meaning of Quality, Approaches- Deming's Approach, Juran's Approach, Quality of Product, Quality of Service, Cost of Quality, Value of Quality, Difference between Inspection, Quality Control and Quality Assurance, Evaluation of Quality control, concept change, Quality Improvement Techniques Pareto Diagrams, Cause-Effect Diagrams Quality Circles, Kaizen, six sigma

**10 Lectures**

**Unit 2**

**Control Charts:** Chance and assignable causes, Statistical Basis of the Control Charts (basic principles, choices of control limits, sample size and sampling frequency, rational subgroups, analysis of pattern on control charts, warning limits, ARL, sensitizing rules for control charts ,Control Charts for X-bar& R (statistical basis, development and use, estimating process capability; interpretation, the effect of non normality on the chart, the OC function, average run length and control chart for attribute (p,np,c ) **10 Lectures**

**Unit 3**

**Design of experiment & Acceptance Sampling:** Meaning, objective, and types of research, approaches, two factorial experiments, Taguchi Method. National quality Award and other quality awards, Principle of acceptance sampling. Producer's and consumer's risk. AOQLand LTPD , Sampling plans –single, double O C curve. **10 Lectures**

**Unit 3**

**ISO 9001-2000 &14000Series of Standards-** History and Evolution of ISO 9000 Series, importance and overview of ISO 9000- 1998 Series standards, structure of ISO 9000-2000 Series standards, clauses of ISO 9000 series standards and their interpretation and implementation, quality system documentation and audit. Environmental management concepts, and requirement of ISO 14001, benefits of environmental management Systems

**10 Lectures**

**Text Books:**

D. C. Montgomery -Introduction to Statistical Quality Control, 4th edition 2001,
Wiley publisher.
S.Dalela - ISO 9000 Quality System

**Suggested Books:**

E.L.Grant & R.S. Kearenworth-Statistical Quality Control.
Kaoru Ishikawa-Guide to Quality Control, Asian Productivity Organization, Series
Jerry Banks –"Principles of Quality Control", Wiley publisher.
Juran's Quality Control Handbook.

**INHT-604: Microcontrollers and its applications**

**Theory** **40 Lectures**

**Unit 1**

Introduction to 8051 family microcontrollers. 8051 architechture, Register banks and Special Function Registers. Memory organization. Addressing modes. Instruction set: Data transfer, Arithmetic, Logical, Boolean and Branch instructions. **10 Lectures**

**Unit 2**

Oscillator and Clock Circuit, Input / Output Ports, Timers, Serial Interface, Interrupts, External Interrupts. 8051 Programing **10 Lectures**

**Unit 3**

8051 interfacing with Keyboard, display Units (LED, 7-segment display, LCD), ADC, DAC, Stepper motor. RS232 and RS485 driver interfacing. **10 Lectures**

**Unit 4**

Introduction to RISC microcontrollers. Von-Neumann and Harvard architectures. Advance microcontroller features: Reset (Power ON, Watchdog, Brown-out, External), Power Saving and Sleep Modes, Timer modes (Input capture, output compare, PWM), SPI, USART, $I^2C$ and CAN bus

**10 Lectures**

**Suggested Books:**


1. Muhammad Ali Mazidi, Janice Gillispie Mazidi, The 8051 Microcontroller and Embedded Systems, Pearson education Asia, New Delhi (1999)
2. Daniel W. Lewis, “Fundamentals of Embedded Software – where C and Assembly Meet”, Pearson Education (2002)
3. John B. Peatman, Design with PIC Microcontrollers, Pearson Education (1998)
4. Kenneth J Ayala, The 8051 Microcontroller Architecture, Programming and Applications, Penram Publications.
5. Zdravko Karakehayov, Knud Smed Christensen and Ole Winther, Introduction by: Embedded Systems Design with 8051 Microcontrollers, Marcel Dekker Inc, (1999)
6. Dave Calcutt, Fred Cowan and Hassan Parchizadeh, 8051 Microcontroller :An applications based, Elsevier.
7. Myke Predco, Programming & Customizing the 8051 Microcontroller, Mc Graw Hill, (2000)

**INHP- 606: Instrumentation Practical – XI** **Marks: 100**

**8 classes/week**

**Practical based on paper Statistical Quality Control using latest statistical software package**
**Analytical Instrumentation -II**

1. Analysis of various compounds using atomic absorption system.
   a) Qualitative analysis
   b) Quantitative analysis

**2.** Study of NMR machine (optional)

**3.** Qualitative & quantitative analysis of drugs using mass spectroscopy (optional)

***4.*** Experiment based on ion selective electrodes.

5. T**o** analyze the given sample using external standard method using HPLC
6. To analyze quantitatively in the given sample using interval standard in GC
7. To analyze quantitatively given mixture of compound by comparing their retention time using HPLC

**INHP- 606: Instrumentation Practical - XII** **Marks: 100**

**Practical based on paper Microcontrollers and its applications**

**8 classes/week**

1. Write a program to add N 8 bit unsigned integer numbers.
2. Write a program to multiply two 16 bit unsigned numbers.
3. Write a program to arrange the unsigned integer numbers in ascending/descending order.
4. Interface a display to the micro controller and display number sequentially in a regular interval.
5. Interface switches and LED's. Write program to verify the switch condition and light the LED's accordingly.
6. Generate a PWM waveform whose width can be increased/decreased using switches.
7. Convert the analog voltage to digital using ADC and store the data in memory.
8. Generate the given waveform using DAC.
9. Using display and keys write program to work as a stop clock.
10. Using display and keys write program to work as a counter.
11. Interface a matrix keyboard and display the key pressed.
12. On-OFF temperature controller.
13. RPM meter.
14. Stepper motor control.