# *BSc Instrumentation (Honours) Syllabus (CBCS)*

Revision Cycle 2.0, August 2019

*Department of Instrumentation & USIC, Gauhati University*
Web : https://gauhati.ac.in
GUWeb : http://web.gauhati.ac.in/syllabus

BSc Instrumentation (Regular) Syllabus (CBCS)
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May 2019


Legends : L - Lecture P - Practical H - Home Assignments T - Tutorial

# Subject Mapping for BSc in Instrumentation under CBCS 2019

B Sc in Instrumentation (Honours)

| Semester | Type | Core | AECC | SEC | DSE | GE |
|---|---|---|---|---|---|---|
| | **Credit** | **14×6=84** | **2×4=8** | **2×4=8** | **4×6=24** | **4×6=24** |
| I | | INS-HC-1016 | | | | INS-HG-1016 |
| | | INS-HC-1026 | ENG-AE-1014 | | | |
| II | | INS-HC-2016 | | | | INS-HG-2016 |
| | | INS-HC-2026 | ENV-AE-2014 | | | |
| III | | INS-HC-3016 | | INS-SE-3xx4 | | INS-HG-3016 |
| | | INS-HC-3026 | | | | |
| | | INS-HC-3036 | | | | |
| IV | | INS-HC-4016 | | INS-SE-4xx4 | | INS-HG-4xx6 |
| | | INS-HC-4026 | | | | |
| | | INS-HC-4036 | | | | |

B Sc in Instrumentation (Regular)

| Semester | Type | Core | AECC | SEC | DSE |
|---|---|---|---|---|---|
| | **Credit** | **14×6=84** | **2×4=8** | **2×4=8** | **4×6=24** |
| I | | INS-RC-1016 | | | |
| | | xxx-RC-1016 | ENG-AE-1014 | | |
| | | yyy-RC-1016 | | | |
| II | | INS-RC-2016 | | | |
| | | xxx-RC-2016 | ENV-AE-2014 | | |
| | | yyy-RC-2016 | | | |
| III | | INS-RC-3016 | | INS-SE-3xx4 | |
| | | xxx-RC-3016 | | | |
| | | yyy-RC-3016 | | | |
| IV | | INS-RC-4016 | | INS-SE-4xx4 | |
| | | xxx-RC-4016 | | | |
| | | yyy-RC-4016 | | | |

**Course Structure for BSc in Instrumentation (Honours) under CBCS 2019**

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|---|---|---|---|---|---|---|
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| | | INS-HC-2026 | ENV-AE-2014 | | | |
| III | | INS-HC-3016 | | INS-SE-3xx4 | | INS-HG-3016 |
| | | INS-HC-3026 | | | | |
| | | INS-HC-3036 | | | | |
| IV | | INS-HC-4016 | | INS-SE-4xx4 | | INS-HG-4xx6 |
| | | INS-HC-4026 | | | | |
| | | INS-HC-4036 | | | | |
| V | | INS-HC-5016 | | | INS-HE-5xx6 | |
| | | INS-HC-5026 | | | INS-HE-5yy6 | |
| VI | | INS-HC-6016 | | | INS-HE-6xx6 | |
| | | INS-HC-6026 | | | INS-HE-6yy6 | |

## List of Papers

### Core Papers

1. INS-HC-1016: Basic Circuit Theory and Network Analysis
2. INS-HC-1026: Applied Physics
3. INS-HC-2016: Analog Devices and Circuits
4. INS-HC-2026: Transducers and Sensors
5. INS-HC-3016: Biomedical Instrumentation
6. INS-HC-3026: Digital Electronics and VHDL
7. INS-HC-3036: Engineering Mathematics
8. INS-HC-4016: Operational Amplifiers and Applications
9. INS-HC-4026: Analytical Instrumentation
10. INS-HC-4036: Electronic Instrumentation
11. INS-HC-5016: Measurement Technology
12. INS-HC-5026: Microprocessors
13. INS-HC-6016: Power Electronics
14. INS-HC-6026: Control Systems

### Discipline Specific Elective (DSE) Papers

1. INS-HE-5016: Signals and Systems
2. INS-HE-5026: Advanced Analytical Instrumentation
3. INS-HE-5036: Communication systems
4. INS-HE-6016: Advanced Biomedical Instrumentation
5. INS-HE-6026: Embedded System and Robotics
6. INS-HE-6036: Dissertation

### Skill Based (SEC) Papers

1. INS-SE-3014: Testing and Calibration
2. INS-SE-3024: Programming in C
3. INS-SE-3034: Programming using MATLAB
4. INS-SE-4014: PLC and SCADA
5. INS-SE-4024: Virtual Instrumentation
6. INS-SE-4034: VLSI Design and Verification

### Generic Electives (GE) Papers

1. INS-HG-1016: Basic Circuit Theory and Network Analysis
2. INS-HG-2016: Transducers and Sensors
3. INS-HG-3016: Electronic Instrumentation
4. INS-HG-4016: Analytical Instrumentation
5. INS-HG-4026: Nuclear & Biomedical Instrumentation
6. INS-HG-4036: Machine Intelligence

# Contents

# Part I

# Core Papers

# 1

# INS-HC-1016
# Basic Circuit Theory and Network Analysis

**Total Lectures : 60** **Credits : 6 (Theory : 04,Lab : 02)**

## 1.1 Theory (Lectures 60)

### 1.1.1 Unit I : *Basic Circuit Concepts* (Lectures 13)

**Voltage and Current Sources, Resistors:** Fixed and Variable resistors, Construction and Characteristics, Color coding of resistors, resistors in series and parallel.
**Inductors:** Fixed and Variable inductors, Self and mutual inductance, Faraday's law and Lenz's law of electromagnetic induction, Energy stored in an inductor, Inductance in series and parallel, Testing of resistance and inductance using multimeter.
**Capacitors:** Principles of capacitance, Parallel plate capacitor, Permittivity, Definition of Dielectric Constant, Dielectric strength, Energy stored in a capacitor, Air, Paper, Mica, Teflon, Ceramic, Plastic and Electrolytic capacitor, Construction and application, capacitors in series and parallel, factors governing the value of capacitors, testing of capacitors using multimeter.

### 1.1.2 Unit II : *Circuit Analysis* (Lectures 13)

Kirchhoff's Current Law (KCL), Kirchhoff's Voltage Law (KVL), Node Analysis, Mesh Analysis, Star-Delta Conversion.
**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

### 1.1.3 Unit III : *AC Circuit Analysis* (Lectures 18)

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..

### 1.1.4 Unit IV : *Network Theorems* (Lectures 16)

Principal of Duality, Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Reciprocity Theorem, Millman's Theorem, Maximum Power Transfer Theorem.
Two Port Networks: Impedance (Z) Parameters, Admittance (Y) Parameters, Transmission (ABCD) Parameters.

## 1.2 *Suggested books*


1. S. A. Nasar, Electric Circuits, Schaum's outline series, Tata McGraw Hill (2004)
2. Electrical Circuits, M. Nahvi and J. Edminister, Schaum's Outline Series, Tata McGraw-Hill.(2005)
3. Robert L. Boylestad, Essentials of Circuit Analysis, Pearson Education (2004)
4. W. H. Hayt, J. E. Kemmerly, S. M. Durbin, Engineering Circuit Analysis, Tata McGraw Hill(2005)
5. Alexander and M. Sadiku, Fundamentals of Electric Circuits , McGraw Hill (2008)


## 1.3 Basic Circuit Theory and Network Analysis Lab

1. Familiarization with
   (a) Resistance in series, parallel and Series - Parallel, Type, Wattage, Tolerance, and Temperature coefficient.
   (b) Capacitors- Tolerance, Voltage rating, Type of capacitor, Capacitors & Inductors in series & Parallel.
   (c) Multimeter (Analog and Digital) - Checking of components.
   (d) Voltage sources in series, parallel and series - Parallel.
   (e) Voltage and Current dividers.
2. Measurement of Amplitude, Frequency & Phase difference using CRO.
3. Verification of Kirchoff's Law.
4. Verification of Norton's theorem.
5. Verification of Thevenin's Theorem.
6. Verification of Superposition Theorem.
7. Verification of the Maximum Power Transfer Theorem.
8. RC Circuits: Time Constant, Differentiator, Integrator.
9. Designing of a Low Pass RC Filter and study of its Frequency Response.
10. Designing of a High Pass RC Filter and study of its Frequency Response.
11. Study of the Frequency Response of a Series LCR Circuit and determination of its (a) Resonant Frequency (b) Impedance at Resonance (c) Quality Factor Q (d) Band Width.

# 2

# INS-HC-1026
# Applied Physics

**Total Lectures : 60 Credits : 6 (Theory : 04,Lab : 02)**

## 2.1 Theory (Lectures 60)

### 2.1.1 Unit I : *Thermodynamics* (Lectures 13)

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.

### 2.1.2 Unit II : *Optics* (Lectures 022)

**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:** Basic principle, Spontaneous and stimulated emission of radiation, Einstein's Coefficients, Laser applications.
**Fibre Optics:** Principles and applications.

### 2.1.3 Unit III : *Nuclear Physics* (Lectures 12)

Nucleus, constituent of nucleus, Properties of Nucleus size, mass, density, energy, charge, binding energy, nuclear angular momentum, Nuclear force.

### 2.1.4 Unit IV : *Fluid Mechanics* (Lectures 13)

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

## 2.2 *Suggested books*


1. Ajoy Ghatak, Optics, fourth Edition, McGraw-Hill
2. M.W. Zemansky and R.H. Dittman- Heat and Thermodynamics (Mc-Graw Hill)
3. Nuclear physics by Cohen
4. Fox and Mc Donald- Introduction to Fluid Mechanics
5. Aurthur Beiser -Concepts of Modern Physics - (Mc-Graw Hill)
6. Anuradha De. -Optical Fibre & Laser ( New Age )
7. Resnick, Halliday & Walker -Fundamental of Physics - (Wiley )
8. R.A. Serway & J.W. Jewett -Principles of Physics
9. H.Callen-Thermodynamics and an Introduction to Thermo statistics (Wiley, New York).


## 2.3 Applied Physics Lab

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.

# 3

# INS-HC-2016
# Analog Devices and Circuits

**Total Lectures : 60 Credits : 6 (Theory : 04,Lab : 02)**

## 3.1 Theory (Lectures 60)

### 3.1.1 Unit I : *Semiconductor Basics* (Lectures 16)

Introduction to semiconductor materials, intrinsic & extrinsic semiconductors. p-n junction diode: Ideal diode, Formation of depletion layer, space charge at a junction, Diode Circuits: clipper circuits, clamping circuits. Half wave rectifier, Center tapped and bridge full wave rectifiers, calculation of efficiency and ripple factor. DC power supply: Block diagram of a power supply, Zener diode as voltage regulator, temperature coefficient of Zener diode.

### 3.1.2 Unit II : *The BJT* (Lectures 15)

Basic transistor action, 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, frequency response of CE amplifier.

### 3.1.3 Unit III : *Feedback Amplifiers* (Lectures 14)

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, Colpitts oscillator and Crystal oscillator.

### 3.1.4 Unit IV : *Junction Field Effect Transistor (JFET)* (Lectures 15)

Construction of JFET, idea of channel formation, pinch-off and saturation voltage, current-voltage output characteristics. Metal Oxide Field Effect Transistor (MOSFET): The ideal MOS diode, accumulation, depletion and inversion, Basic Construction of MOSFET and working, I-V characteristics, enhancement and depletion modes. Complimentary MOS (CMOS), MOSFET amplifier UJT: construction, working and applications.

## 3.2 *Suggested books*


1. R. L. Boylestad, L. Nashelsky, K. L. Kishore, Electronic Devices and Circuit Theory, Pearson Education (2006).
2. N Bhargava, D C Kulshreshtha and S C Gupta, Basic Electronics and linear circuits, Tata McGraw-Hill (2007)
3. J. Millman and C. Halkias, Integrated Electronics, Tata McGraw Hill (2001).
4. David A. Bell, Electronic Devices & Circuits, Oxford University Press, Fifth edition
5. Mottershed, Electronic Devices, PHI Publication, 1st Edition.
6. D. L. Schilling and C. Belove, Electronic Circuits: Discrete and Integrated, Tata McGraw Hill (2002).
7. J. R. C. Jaegar and T. N. Blalock, Microelectronic Circuit Design, Tata McGraw Hill (2010).
8. Donald A. Neamen, Electronic Circuit Analysis and Design, Tata McGraw Hill (2002).
9. J. Cathey, 2000 Solved Problems in Electronics, Schaum's outline Series, Tata McGraw Hill (1991).


## 3.3 Analog Devices and Circuits Lab

1. To study the Half wave rectifier and Full wave rectifier.
2. To study power supply using C filter and zener diode.
3. To study Fixed Bias and Voltage divide Feedback configuration for transistor.
4. To design a Single Stage CE amplifier.
5. To study Class A, B and C Power Amplifier.
6. To study clipping circuits
7. To study clamping circuits
8. To study the Colpitt's Oscillator.
9. To study the Phase Shift Oscillator.
10. To study the frequency response of Common Source FET amplifier.

# 4

# INS-HC-2026
# Transducers and Sensors

**Total Lectures : 60 Credits : 6 (Theory : 04,Lab : 02)**

## 4.1 Theory (Lectures 60)

### 4.1.1 Unit I : *Instrumentation & Measurement Systems* (Lectures 16)

Generalized instrumentation systems block diagram representation, scope of instrumentation in Industrial organization.
**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).

### 4.1.2 Unit II : *Errors* (Lectures 08)

Systematic errors, instrumental errors, environmental errors, random errors, loading errors, random errors, source of errors in measuring instruments, Uncertainties types, propagation of uncertainties.

### 4.1.3 Unit III : *Transducers* (Lectures 20)

Classification, Active, Passive, Mechanical, Electrical, their comparison. Selection 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).

### 4.1.4 Unit IV : *Sensors* (Lectures 16)

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).

## 4.2 *Suggested books*


1. Doeblin & Manek, Measurement Systems, 4/e, McGraw Hill, New York, 1992,5th edition.
2. Nakra & Choudhary ,Instrumentation Measurements and Analysis , Tata McGraw-Hill, 2nd edition.
3. A.K. Sawhney , Electrical & Electronic Measurements & Instrumentation, 19th revised edition.
4. Rangan, Sarma, and Mani, Instrumentation- Devices and Systems ,Tata-McGraw Hill 2nd edition.
5. H.S Kalsi, Electronic Instrumentation ,McGraw Hill, 4th edition.
6. DVS Murthy, Measurement & Instrumentation, PHI.
7. D. Patranabis, Sensors and Transducers, PHI, 2nd edition.
8. Arun K. Ghosh, Introduction to Measurements and Instrumentation, PHI, 4th edition.


## 4.3 Transducers and Sensors Lab

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

# 5

# INS-HC-3016
# Biomedical Instrumentation

**Total Lectures : 60** **Credits : 6 (Theory : 04,Lab : 02)**

## 5.1 Theory (Lectures 60)

### 5.1.1 Unit I : *Bio-potentials, Bio-amplifiers and Bio-electrodes* (Lectures 16)

Introduction to bio-electric potential, bio-amplifier, components of an Instrument system, types of biomedical systems, design factors and limitations of biomedical instruments, terms and transducers to measure various physiological events, types of bio-potential electrodes (Body surface electrodes, Internal electrodes, Micro electrodes), electrolyte interface, electrode circuit model, impedance and polarization, Properties of electrodes.

### 5.1.2 Unit II : *Cardio Vascular System & Measurements* (Lectures 17)

ECG: Origin, Instrumentation, bipolar system lead system I, II, III, Einthovan's triangle, Augmented lead system, unipolar chest lead system, types of display. Blood pressure measurements: direct, indirect. Defibrillators: AC, DC. Pacemakers- Internal, External. Blood Flow meters: Electromagnetic blood flow meter, ultrasonic blood flow meter. Oximeters: Different types of oximetry systems, pulse oximeter.

### 5.1.3 Unit III : *Respiratory Measurement Systems* (Lectures 15)

Types of volume, types of measurements, Instrumentation of respiratory system, principle & types of pneumograph, Spirometer, pneumotachometers, nitrogen wash out technique. Basic principles of ventilators, different generators, inspiratory phase and expiratory phase, types of ventilators.

### 5.1.4 Unit IV : *Imaging* (Lectures 12)

**Nervous system:** Action potential of brain, brain wave, Instrumentation of Electroencephalography (EEG), electrodes used for recording EEG analysis.
**Medical Imaging system:** Thermal imaging system, working, IR detectors, applications. Radiography-conventional X-ray, properties, generation of X-ray, Fluoroscopy

## 5.2 *Suggested books*


1. Cromwell L., Wiebell F. J., Pfeiffer EA, Biomedical Instrumentation and Measurements, Second edition, Prentice Hall (2010), 2nd edition.
2. Carr J. J, Brown J. M. Introduction to Biomedical Equipment Technology, Fourth edition, Pearson Education Inc (2010), 2nd edition.
3. Khandpur R.S., Handbook of Biomedical Instrumentation, Second edition, Tata McGraw-Hill Publishing (2009), 2nd edition.
4. Joseph D. Bronzino, The Biomedical Engineering Handbook, IEEE Press (2000), 2nd edition, Volume 1.
5. Richard Aston, Principles of Biomedical Instrumentation & Measurement, Merrill Publishing Company, (1990), 1st edition.
6. Mandeep Singh, Introduction to Biomedical Instrumentation, PHI learning private limited (2010), 1st edition.


## 5.3 Biomedical Instrumentation Lab

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.

# 6

# INS-HC-3026
# Digital Electronics and VHDL

**Total Lectures : 60 Credits : 6 (Theory : 04,Lab : 02)**

## 6.1 Theory (Lectures 60)

### 6.1.1 Unit I : *Introduction* (Lectures 11)

**Number System and Codes:** Decimal, Binary, Hexadecimal and Octal number systems, base conversions, Binary, octal and hexadecimal arithmetic (addition, subtraction by complement method, multiplication), representation of signed and unsigned numbers, Binary Coded Decimal code.
**Logic Gates and Boolean algebra:** Truth Tables of OR, AND, NOT, XOR, XNOR, Universal (NOR and NAND) Gates, Basic postulates and fundamental theorems of Boolean algebra.
**Digital Logic families:** Fan-in, Fan out, Noise Margin, Power Dissipation, Figure of merit, Speed power product, comparison of TTL and CMOS families.

### 6.1.2 Unit II : *Combinational Logic Analysis and Design* (Lectures 13)

Standard representation of logic functions (SOP and POS), Karnaugh map minimization, Encoder and Decoder, Multiplexers and Demultiplexers, Implementing logic functions with multiplexer, binary Adder, binary subtractor, parallel adder/subtractor.

### 6.1.3 Unit III : *Sequential logic design* (Lectures 16)

Latches and Flip flops , S-R Flip flop, J-K Flip flop, T and D type Flip flops, Clocked and edge triggered Flip flops, Registers, Counters (synchronous and asynchronous, ring and modulo-N), State Table, State Diagrams, counter design using excitation table and equations.

### 6.1.4 Unit IV : *Programmable Logic Devices* (Lectures 20)

**Programmable Logic Devices:** Basic concepts- ROM, PLA, PAL, CPLD, FPGA.
**Introduction to VHDL:** A Brief History of HDL, Structure of HDL Module, Comparison of VHDL and Verilog, Introduction to Simulation and Synthesis Tools, Test Benches. VHDL Modules, Delays, data flow style, behavioral style, structural style, mixed design style, simulating design.
Introduction to Language Elements, Keywords, Identifiers, White Space Characters, Comments, format, Integers, reals and strings. Logic Values, Data Types-net types, undeclared nets, scalars and vector nets, Register type,

Parameters. Expressions, Operands, Operators, types of Expressions.
**Gate level modeling:** Introduction, built in Primitive Gates, multiple input gates, Tri-state gates, pull gates, MOS switches, bidirectional switches, gate delay, array instances, implicit nets, Illustrative Examples (both combinational and sequential logic circuits).

## 6.2 *Suggested books*


1. M. Morris Mano Digital System Design, Pearson Education Asia,( Fourth Edition )
2. Thomas L. Flyod, Digital Fundamentals, Pearson Education Asia (1994)
3. W. H. Gothmann, Digital Electronics: An Introduction To Theory And Practice, Prentice Hall of India(2000)
4. R. L. Tokheim, Digital Principles, Schaum's Outline Series, Tata McGraw- Hill (1994)
5. A Verilog HDL Primer, J. Bhasker, BSP, 2003 II Edition.
6. Verilog HDL-A guide to digital design and synthesis-Samir Palnitkar, Pearson, 2nd edition.


## 6.3 Digital Electronics and VHDL Lab

1. To verify and design AND, OR, NOT and XOR gates using NAND gates.
2. To convert a Boolean expression into logic gate circuit and assemble it using logic gate IC's.
3. Design a Half and Full Adder.
4. Design a Half and Full Subtractor.
5. Design a seven segment display driver.
6. Design a 4 X 1 Multiplexer using gates.
7. To build a Flip- Flop Circuits using elementary gates. (RS, Clocked RS, D-type).
8. Design a counter using D/T/JK Flip-Flop.
9. Design a shift register and study Serial and parallel shifting of data.

**Experiments in VHDL:**

1. Write code to realize basic and derived logic gates.
2. Half adder, Full Adder using basic and derived gates.
3. Half subtractor and Full Subtractor using basic and derived gates.
4. Clocked D FF, T FF and JK FF (with Reset inputs).
5. Multiplexer (4x1, 8x1) and Demultiplexer using logic gates.
6. Decoder (2x4, 3x8), Encoders and Priority Encoders.
7. Design and simulation of a 4 bit Adder.
8. Code converters (Binary to Gray and vice versa).
9. 2 bit Magnitude comparator.
10. 3 bit Ripple counter.

# 7

# INS-HC-3036
# Engineering Mathematics

**Total Lectures : 60 Credits : 6 (Theory : 04,Lab : 02)**

## 7.1 Theory (Lectures 60)

### 7.1.1 Unit I : *Differential Equations* (Lectures 18)

Ordinary differential Equations, Linear Independence and Dependence, Linear Differential Equations of Second Order with Variable Coefficients, Second Order Differential Equations with Constant Coefficients: Homogeneous, Non-Homogeneous Equations, Differential Equation with Variable Coefficients: Reducible to Equations with Constant Coefficients, Method of Variation of Parameters, Electric Circuits, System of Simultaneous Linear Differential Equations with Constant Coefficients

### 7.1.2 Unit II : *Partial Differential Equations* (Lectures 14)

Formation of Partial Differential Equation, Partial Differential Equation of First Order, Linear Equations of First Order, Non-linear Partial Differential Equations of First Order, Method of Separation of Variables, Classification of Partial Differential Equations of Second Order. Convolution theorem, Impulse Function and Unit Step function, solutions to ordinary differential equations. Initial and Final value theorem.

### 7.1.3 Unit III : *Laplace Transform* (Lectures 12)

Laplace Transform and its properties, Convolution theorem, Impulse Function and Unit Step function, solutions to ordinary differential equations. Initial and Final value theorem, system of differential equations, Laplace transforms. Modeling a Vibrating string and the Wave Equation, Separation of Variables, Inverse Laplace transforms and their properties.

### 7.1.4 Unit IV : *Fourier series and Transforms* (Lectures 16)

Functions of any period, even and odd Functions, half range expansions, Forced Oscillations, Complex Fourier Series Fourier Integral, Fourier Sine and Cosine Transforms. , Fourier Transforms, Discrete and Fast Fourier Transforms. Fourier integrals, Modeling a Vibrating string and the Wave Equation, Separation of Variables and Use of Fourier series.

## 7.2 *Suggested books*


1. E. Kreyszig, Advanced Engineering Mathematics, Wiley India (2008), 8th Edition
2. B. V. Ramana, Higher Engineering Mathematics, Tata McGraw Hill Publishing Company Limited (2007), 6th reprint
3. Michel D Greenberg; Advanced Engineering Mathematics, Pearson International
4. R. K. Jain, and S.R.K. Iyengar, Advanced Engineering Mathematics, Narosa Publishing House (2007), 3rd edition
5. C .R. Wylie and L. C. Barrett, Advanced Engineering Mathematics, Tata McGraw-Hill (2004)
6. A.S.Willsky, Oppenheim, Signals and System, Prentice Hall, 2nd edition
7. B.S. Grewal; Higher Engineering Mathematics, Khanna Publishers.


## 7.3 Engineering Mathematics Lab (using Scilab /MATLAB/ any other Mathematical Simulation software)

1. Solve the linear differential equation of second order with variable coefficients.
2. Solve the linear differential equation of second order with constant coefficients.
3. Plot curves like $sin\ x,\ cos\ x,\ tan\ x,\ log\ x,\ exp(x),\ x^2,\ x^3,\ x + x^2 + exp(x)$.
4. Computing Fourier of a given signal.
5. Laplace Transform of a given signal.

# 8

# INS-HC-4016
# Operational Amplifiers and Applications

**Total Lectures : 60 Credits : 6 (Theory : 04,Lab : 02)**

## 8.1 Theory (Lectures 60)

### 8.1.1 Unit I : *Operational Amplifier* (Lectures 18)

**Basic Operational Amplifier:** Concept of differential amplifiers (Dual input balanced and unbalanced output), constant current bias, current mirror, cascaded differential amplifier stages with concept of level translator, 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.

### 8.1.2 Unit II : *Op-Amp Circuits* (Lectures 18)

Op-Amp Circuits: 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. Comparators: Basic comparator, Level detector, Voltage limiters, Schmitt Trigger. Signal generators: Phase shift oscillator, Wein bridge oscillator, Square wave generator, triangle wave generator, saw tooth wave generator, and Voltage controlled oscillator(IC 566).

### 8.1.3 Unit III : *Opamp Based Devices* (Lectures 12)

Multivibrators (IC 555): Block diagram, Astable and monostable multivibrator circuit, Applications of

Monostable and Astable multivibrators. Phase locked loops (PLL): Block diagram, phase detectors, IC565.

Fixed and variable IC regulators: IC 78xx and IC 79xx -concepts only, IC LM317- output voltage equation.

### 8.1.4 Unit IV : *Signal Conditioning circuits* (Lectures 12)

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, Log and antilog amplifiers.

## 8.2 *Suggested books*


1. R. A. Gayakwad, Op-Amps and Linear IC's, Pearson Education (2003)
2. R. F. Coughlin and F. F. Driscoll, Operational amplifiers and Linear Integrated circuits, Pearson Education (2001)
3. J. Millman and C.C. Halkias, Integrated Electronics, Tata McGraw-Hill,(2001)
4. A.P.Malvino, Electronic Principals,6th Edition , Tata McGraw-Hill,(2003)
5. K.L.Kishore,OP-AMP and Linear Integrated Circuits, Pearson(2011).


## 8.3 Operational Amplifiers and Application Lab

1. Study of op-amp characteristics: CMRR and Slew rate.
2. Designing of an amplifier of given gain for an inverting and non-inverting configuration using an op-amp.
3. Designing of analog adder and subtractor circuit.
4. Designing of an integrator using op-amp for a given specification and study its frequency response.
5. Designing of a differentiator using op-amp for a given specification and study its frequency response.
6. Designing of a First Order Low-pass filter using op-amp.
7. Designing of a First Order High-pass filter using op-amp.
8. Designing of a RC Phase Shift Oscillator using op-amp.
9. Study of IC 555 as an astable multivibrator.
10. Study of IC 555 as monostable multivibrator.
11. Designing of Fixed voltage power supply using IC regulators using 78 series and 79 series.

# 9

# INS-HC-4026
# Analytical Instrumentation

**Total Lectures : 60 Credits : 6 (Theory : 04,Lab : 02)**

## 9.1 Theory (Lectures 60)

### 9.1.1 Unit I : *Molecular and Infrared Spectro-analytical Methods* (Lectures 20)

**Molecular Spectro-analytical Methods of Analysis:** Colorimetry and Spectrophotometry: Introduction, theory: molecular energy levels, types of molecular transitions, Lambert-Beer's Law and limitations, types of sources, monochromators and detectors, Instrumentation of single beam and double beam instrument.
**Infrared Spectroscopy:** Theory, diatomic molecules as a simple harmonic oscillator, instrumentation, sample handling techniques. Fourier Transform Infrared Spectroscopy (FTIR): advantages, instrumentation qualitative and quantitative applications, interpretation of Infrared (IR) spectra.

### 9.1.2 Unit II : *Atomic Spectroscopy*(Lectures 10)

Principle, comparison of atomic and molecular spectroscopy, atomic transitions, atomic absorption, atomisation process, types of flames- fuel/ oxidant combinations, instrumentation of spectrophotometers; Interferences: spectral, chemical and ionization; applications. Atomic emission spectroscopy (AES): Flame photometer and its instrumentation, analysis using standard addition method, applications.

### 9.1.3 Unit III : *Chromatography* (Lectures 14)

***Separation methods:*** Theory of chromatography; instrumentation and applications of Thin layer chromatography (TLC).
***Column chromatography:*** Principle, process of elution through a column, chromatogram, band broadening, capacity factor, selectivity factor , Column efficiency, number of plates, plate height, column resolution.

### 9.1.4 Unit IV : *Gas Chromatography* (Lectures 16)

Carrier gases, different type of injection systems, columns, stationary phases and detectors. Isothermal mode, temperature programming mode, analysis by internal standard method, applications.
**High Performance Liquid Chromatography (HPLC):** mobile phase, isocratic and gradient elution, pumps, injection systems, columns, stationary phases, normal phase and reverse phase chromatography, detectors and their application.

## 9.2 *Suggested books*


1. Skoog & Lerry, Instrumental Methods of Analysis, Saunders College Publications, New York
2. H.H.Willard, Instrumental Methods of Analysis, CBS Publishers.
3. D.C. Harris, Quantitate Chemical Analysis, W.H.Freeman
4. Christian G.D, Analytical Chemistry, John & Sons, Singapore
5. Skoog, West and Holler, Analytical Chemistry, Saunders College Publications, New York
6. Vogel's Textbook of Qualitative Chemical Analysis, ELBS
7. J.A. Dean, Analytical Chemistry Notebook, McGraw Hill
8. John H. Kennedy, Analytical Chemistry: Principles, Saunders College Publication
9. W. Kemp, Organic Spectroscopy, ELBS
10. Hand book of Instrumental Techniques for Analytical Chemistry, Frank Settle, editor, Prentice Hall


## 9.3 Analytical Instrumentation Lab

1. Determination of pKa value for a dye using double beam spectrophotometer.
2. Spectrometric determination of iron in water sample using double beam spectrophotometer.
3. Determination of concentrations of sodium, calcium, lithium and potassium in sample using flame photometer.
4. Determination of concentration of potassium ions in sample by standard addition method using flame photometer
5. Spectrum interpretation using FT-IR.
6. Analysis of various ions using atomic absorption system.
7. Thin layer chromatographic (TLC) separation of samples from different origin (Biological / Pharmaceutical / Food).
8. Qualitative analysis of samples using Gas chromatography
9. Qualitative analysis of samples using High Performance Liquid Chromatography.

# 10

# INS-HC-4036
# Electronic Instrumentation

**Total Lectures : 60 Credits : 6 (Theory : 04,Lab : 02)**

## 10.1 Theory (Lectures 60)

### 10.1.1 Unit I : *DC and AC Measurement* (Lectures 18)

DC and AC indicating Instruments: Accuracy and precision - Types of errors, Basic Measurement Instruments- DC Bridges and applications: Wheatstone, Kelvin, AC Bridges: General form of AC bridge balance, comparison bridges, Maxwell, Hay, Schering, Wien, Wagner ground condition. DC measurement: DC voltmeter, ammeter, ohmmeter, multimeter, AC measurement: voltmeter, ammeter. Digital type voltmeters, digital multimeter, Digital LCR meter. Digital frequency meter: Elements of frequency meter, universal counter and its different modes, measurement errors and extending the frequency range.

### 10.1.2 Unit II : *Signal Generators* (Lectures 14)

Types of generators and their operation: Audio oscillator, Function generators, Pulse generators, RF generators, Random noise generators, Sweep generator. Probes and Connectors: Test leads, shielded cables, connectors, low capacitance probes, high voltage probes, RF demodulator probes, special probes for IC's, current probes.

### 10.1.3 Unit III : *Electronic Displays* (Lectures 16)

Cathode Ray Oscilloscope (CRO) and applications: Block diagram of a General Purpose Oscilloscope and its basic operation, electrostatic focusing and deflection, screens for CRT and graticules, CRT Connections, CRO probes. Types of CRO's: dual trace oscilloscope, digital storage oscilloscope, Sampling oscilloscope. Amplitude, Frequency, Phase measurements, Lissajous Figures.

### 10.1.4 Unit IV : *Spectrum Analyser and Wavemeter* (Lectures 12)

Frequency Spectrum, Distortion and wave measurement - Spectrum analyzer, Harmonic distortion analyzer, Intermodulation distortion analyzer, wave analyzer and distortion factor meter, wave meter, Different type of wave meters: Lumped and cavity wavemeters, Q-meter and its applications.

## 10.2 *Suggested books*


1. H. S. Kalsi, Electronic Instrumentation, Tata McGraw Hill (2006)
2. Joseph J Carr, Elements of electronic instrumentation and measurement, Pearson Education (2005)
3. C. S. Rangan, G. R. Sarma and V. S. Mani, Instrumentation Devices and Systems, Tata McGraw Hill (1998)
4. H. Cooper, Modern electronic instrumentation and measurement techniques, Pearson Education (2005)
5. 5. R. A. Witte, Electronic test instruments: Analog and digital measurements, Tata McGraw Hill (2004)
6. 6. S. Wolf and R. F. M. Smith, Student Reference Manual for Electronic Instrumentation Laboratories, Pearson Education (2004)


## 10.3 Electronic Instrumentation Lab

1. Study and operation of Multimeters (Analog and Digital), Function Generator, Regulated Power Supplies, CRO.
2. Study the generation of Lissajous figures to find unknown frequency and phase shift.
3. Frequency measurement using Wein Bridge.
4. Study of R, L, C and Q meter.
5. Study of DSO-Measurement of response time of relay using DSO.
6. Measurements of L, C, R using bridges.
7. To study bridge based loop tests.
8. Study of Universal Counter

# 11

# INS-HC-5016
# Measurement Technology

**Total Lectures : 60 Credits : 6 (Theory : 04,Lab : 02)**

## 11.1 Theory (Lectures 60)

### 11.1.1 Unit I : *Flow Measurement* (Lectures 22)

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, rotameter, 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.

### 11.1.2 Unit II : *Measurement of Speed and Acceleration* (Lectures 15)

Tachometers, Mechanical, Electric, Contact less, Frequency, Ignition, Stroboscopic tachometers. Accelerometers, Elementary, Seismic and Practical accelerometers. Recorders :Types, strip chart, circular, X,Y, oscillographic, magnetic tape, printers, dot matrix, ink jet, laser

### 11.1.3 Unit III : *Measurement of Humidity and Moisture* (Lectures 8)

Basic principles, hygrometers, psychrometers , humidity charts , dew point, measurement systems for humidity., Infrared moisture measuring systems , radioactive moisture measuring systems.

### 11.1.4 Unit IV : *Spectrum Analyser and Wavemeter* (Lectures 15)

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.

## 11.2 *Suggested books*


1. Process Measurement and Analysis, 4th Edition (1995), Liptak B. G., Chilton Book Company, Pennsylvania.
2. Principles of Industrial Instrumentation, 2nd Edition (1997), D.Patranabis, Tata McGraw Hill Publishing Co., New Delhi.
3. A Course in Electrical and Electronic Measurements and Instrumentation, (2005), A.K. Sawhney, Dhanpat Rai & Co.
4. Mechanical and Industrial Measurements, Tenth Edition (1996), R.K. Jain, Khanna Publishers.
5. Measurement Systems: Application and Design, Fourth Edition (1992), Doeblin E. O, McGraw Hill, Singapore.


## 11.3 Measurement Technology Lab

1. Flow rate measurement using orifice plate flowmeter.
2. Calibration of pressure gauge using dead weight calibrator.
3. Experiment on working of thermocouple.
4. Experiment on control of various functions using RTD.
5. To find out level of water using level transmitters.
6. Measurement of conductivity of test solutions using electrical conductivity meter.
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.

# 12

# INS-HC-5026
# Microprocessors

**Total Lectures : 60 Credits : 6 (Theory : 04,Lab : 02)**

## 12.1 Theory (Lectures 60)

### 12.1.1 Unit I : *8085 Microprocessor* (Lectures 18)

Introduction to 8085 Microprocessor, Pin description of 8085, Architecture, register of 8085, addressing mode. Instruction Type and Instruction Set, Machine Cycle, Instruction Cycle, Timing Diagram.
Memory System, internal and external memory and concept of Virtual Memory. Hardware Interfacing or Types of I/O addressing-Interfacing Memory and Peripheral (I/o Mapped I/O and memory mapped I/O).

### 12.1.2 Unit II : *Programming* (Lectures 10)

Assembly Language Programming Stacks and Subroutine, Interrupts of 8085-Hardware and Software interrupts. Difference between RISC and CISC Processor

### 12.1.3 Unit III : *Peripherals* (Lectures 18)

Interfacing ICs, Programmable Peripheral Interface: Intel 8155, 8253, 8255, programmable Interrupt Controller: Intel 8259

### 12.1.4 Unit IV : *Interfacing* (Lectures 14)

Application of Microprocessor 8085 in Instrumentation: Interfacing of Stepper Motor.
Introduction to 8086 Microprocessor: keyboard Basics of 8086 (16 bit Microprocessor), Architecture of 8086, Concept of parallel processing in 8086

## 12.2 *Suggested books*


1. Ramesh Gaonkar, Microprocessors architecture, programming and Applications, Wiley Eastern Ltd. (2002), 2nd Edition
2. P.K Ghosh & P.R Sridhar, 0000 to 8085 microprocessor, John Wiley & Sons, 2nd Edition

3. Liu Gibson, Microprocessor Systems: The 8086/8088 family Architecture, Programming & Design, PHI, 1999, 2nd Edition
4. R. Thegarajan and S. Dhanpal, Microprocessor and its Application, New Age International Private Ltd, 1st Edition
5. K. Udaya Kumar & B.S. Uma Shankar, The 8085 Microprocessor: Architecture, Programming and Interfacing", Pearson Education
6. Barry B. Brey and C R Sarma, The Intel Microprocessors 8086/8088, 80186/80188, 80286, 80386, 80606,
7. Pentium and Pentium Pro-Processor Architecture, Programming and Interfacing, Pearson Education, (2005)
8. Walter Triebel & Avtar A.Singh, 8088 and 8086 Microprocessors: Programming, Interfacing, Software Hardware and Applications, Pearson Education, 4th edition
9. D. V. Hall, "Microprocessors and Interfacing", Tata McGraw Hill (2005), revised 2nd edition

## 12.3 Microprocessors Lab

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. 1To write an assembly language program to design a clock 36
9. To write an assembly language program to calculate a mathematical expression (for e.g. 2N/N!)
10. To write an assembly language program to calculate value of sin(x)
11. To implement basic 8086 interrupts using assembler

# 13

# INS-HC-6016
# Power Electronics

**Total Lectures : 60 Credits : 6 (Theory : 04,Lab : 02)**

## 13.1 Theory (Lectures 60)

### 13.1.1 Unit I : *Basic Power Devices and Circuits* (Lectures 14)

SCR, Diacs and Triacs, Two transistor model of SCR, Resistive and RC triggering circuits. Applications of SCR: Basic series inverter circuit, Chopper circuit - Basic concept, step up and step down choppers.

### 13.1.2 Unit II : *Types of motors and Motor Drives* (Lectures 18)

Constructional features and characteristics of DC Motors, AC Motors, Induction Motors, Single and three phase Motors, Synchronous Motors, Stepper Motors, and Servo Motors. Motor driving and speed control circuits and their applications, motor starters.

### 13.1.3 Unit III : *Generators and AC machines* (Lectures 18)

AC and DC generators, comparison between generator and motor action (without constructional comparison). AC Machines: Types of transformers, Transformer Construction, E.M.F. equation, Transformer Losses, Condition for maximum efficiency, all day efficiency, Auto transformers.

### 13.1.4 Unit IV : *Power Supplies* (Lectures 10)

Regulated power supply, Uninterrupted power supply (UPS) and Switched mode power supply (SMPS).

## 13.2 *Suggested books*


1. Power Electronics, 2nd Edition (2006), M. D. Singh, K. B.Khanchandani, Tata McGraw Hill.
2. Electrical Technology, 23rd Edition (2005), B. L. Thareja and A. K. Thareja, S. Chand & Sons.
3. Electronic Principles, 7th Edition (2007), A. Malvino, D. J. Bates, Tata McGraw Hill.
4. Power Electronics, 4th Edition (2002),P. S. Bimbhra, Khanna Publishers.

5. Electrical Machines, 2nd Edition (1997), I. J. Nagrath and D. P. Kothari, Tata McGraw Hill (1997).

## 13.3 Power Electronics Lab

1. Study of I-V characteristics of SCR.
2. Study of I-V characteristics of DIAC.
3. Study of I-V characteristics of TRIAC.
4. Load characteristics of D.C. motor.
5. Speed control of D.C. motor.
6. Break test of D.C. motor.
7. Break test of induction motor

# 14

# INS-HC-6026
# Control Systems

**Total Lectures : 60 Credits : 6 (Theory : 04,Lab : 02)**

## 14.1 Theory (Lectures 60)

### 14.1.1 Unit I : *Introduction to Control System* (Lectures 16)

Introduction of open loop and closed loop control systems, mathematical modelling of physical systems (Electrical, Mechanical and Thermal), derivation of transfer function, Armature controlled and field controlled DC servomotors, AC servomotors, block diagram representation & signal flow graph, Reduction Technique, Mason's Gain Formula. Effect of feedback on control systems, Basic Control Actions: Proportional, integral and Derivative controls.

### 14.1.2 Unit II : *Time Domain Analysis* (Lectures 16)

Time - Domain Analysis:-Time domain performance criteria, transient response of first, second & higher order systems, steady state errors and static error constants, performance indices, response with P, PI and PID Controllers. Concept of Stability: Asymptotic stability and conditional stability, Routh - Hurwitz criterion, relative stability analysis, Root Locus plots and their applications.

### 14.1.3 Unit III : *Frequency Domain Analysis* (Lectures 15)

Frequency Domain Analysis: Correlation between time and frequency response, Polar and inverse polar plots, frequency domain specifications, Logarithmic plots (Bode Plots), gain and phase margins, Nyquist stability criterion, relative stability using Nyquist criterion, constant M & N circles.

### 14.1.4 Unit IV : *Compensation Techniques & State Analysis* (Lectures 13)

Compensation Techniques: Concept of compensation, Lag, Lead and Lag-Lead networks State Space Analysis: Definitions of state, state variables, state space, representation of systems, Solution of time invariant, homogeneous state equation, state transition matrix and its properties.

## 14.2 *Suggested books*


1. J. Nagrath & M. Gopal, Control System Engineering, New Age International, 2000, 2nd Edition
2. K. Ogata, Modern Control Engineering, PHI 2002, 4th Edition.
3. B. C. Kuo , "Automatic control system", Prentice Hall of India, 2000, 7th Edition
4. I. J. Nagrath & M. Gopal, Control System Engineering, New Age International, 2000, 2nd Edition
5. N.K Jain, Automatic Control System Engineering, Dhanpat Rai Publication,2005, 2nd Edition
6. B. S. Manke, Linear Control Systems, Khanna Publishers, Delhi, 7th Edition


## 14.3 Control Systems Lab

1. To study characteristics of :
   (a) Synchro transmitter receiver
   (b) Synchro as an error detector
2. To study position control of DC motor
3. To study speed control of DC motor
4. To find characteristics of AC servo motor
5. To study time response of type 0,1 and 2 systems
6. To study frequency response of first and second order systems
7. To study time response characteristics of a second order system.
8. To study effect of damping factor on performance of second order system
9. To study frequency response of Lead and Lag networks.
10. Study of P, PI and PID controller.

# Part II

# Discipline Specific Elective Papers

# 15

# INS-HE-5016
# Signals and Systems

**Total Lectures : 60 Credits : 6 (Theory : 04, Lab : 02)**

## 15.1 Theory (Lectures 60)

### 15.1.1 Unit I : *Signals and Systems* (Lectures 13)

Continuous and discrete time signals, Transformation of the independent variable, Exponential and sinusoidal signals, Impulse and Unit step functions, Continuous-Time and Discrete-Time Systems, Basic System Properties.

### 15.1.2 Unit II : *Linear Time-Invariant Systems (LTI)* (Lectures 15)

Discrete time LTI systems, the Convolution Sum, Continuous time LTI systems, the Convolution integral, Properties of LTI systems, Commutative, Distributive, Associative.

### 15.1.3 Unit III : *Properties of LTI System* (Lectures 15)

LTI systems with and without memory, Invariability, Causality, Stability, Unit Step response, Differential and Difference equation formulation, Block diagram representation of first order systems.

### 15.1.4 Unit IV : *Laplace Transform* (Lectures 12)

Laplace Transform, Inverse Laplace Transform, Properties of the Laplace Transform, Laplace Transform Pairs, Laplace Transform Methods in Circuit Analysis, Impulse and Step response of RL, RC and RLC circuits.

## 15.2 *Suggested books*


1. H. P. Hsu, Signals and Systems, Tata McGraw Hill(2007)
2. S. T. Karris, Signal and Systems: with MATLAB ,Computing and Simulink Modelling, Publications (2008)
3. W. Y. Young, Signals and Systems with MATLAB, Springer (2009)
4. M. Roberts, Fundamentals of Signals and Systems, Tata McGraw Hill (2007)

## 15.3 Signals and Systems Lab

1. Learning Scilab/MATLAB (Experiments based on available system)
2. Explorations of Signals and Systems using Scilab/MATLAB
3. Generation of Signals: continuous time
4. Generation of Signals: discrete time
5. Convolution of Signals
6. Solution of Difference equations.
7. Introduction to SIMULINK and calculation of output of systems represented by block diagrams

# 16

# INS-HE-5026
# Advanced Analytical Instrumentation

**Total Lectures : 60** **Credits : 6 (Theory : 04, Lab : 02)**

## 16.1 Theory (Lectures 60)

### 16.1.1 Unit I : *NMR and Mass Spectroscopy* (Lectures 20)

**Nuclear Magnetic Resonance (NMR) Spectroscopy:** Theory, chemical shift and spin-spin splitting, coupling constant, environmental effects- shielding deshielding effects due to electronegativity on NMR spectra, instrumentation of NMR , FT-NMR and its advantages, applications.
**Mass Spectroscopy:** Theory, fragmentation modes, instrumentation: inlet systems, magnetic and electrostatic analysers, detectors. Isotopic abundances, metastable ions and applications.

### 16.1.2 Unit II : *Electro Analytical Methods of Analysis* (Lectures 15)

Potentiometry: Introduction, reference electrode, indicator electrodes, ion-selective electrodes and their applications, instrumentation, direct potentiometry, potentiometric titrations, applications.

### 16.1.3 Unit III : *Radiochemical methods* (Lectures 14)

X-ray spectroscopy- Principle, absorption, emission and diffraction of X-rays, Bragg's Law, Instrumentation: sources, X -ray tube, crystal monochromators, X-ray detectors (Ionization, proportional and GM counter, camera), applications.

### 16.1.4 Unit IV : *Polarography* (Lectures 11)

**Polarography:** Basic principle, direct current polarography, different kinds of currents, reversible and irreversible waves, pulse and ac polarography, applications.
**Automated Methods of Analysis:** Types of automated systems, Flow Injection Analysis, Microfluidics, Discrete automatic system.

## 16.2 *Suggested books*


1. Skoog & Lerry, Instrumental Methods of Analysis, Saunders College Publications, New York
2. H.H.Willard, Instrumental Methods of Analysis, CBS Publishers.
3. D.C. Harris, Quantitative Chemical Analysis, W.H.Freeman
4. Gary D. Christian, Analytical Chemistry, John & Sons, Singapore
5. Skoog, West and Holler, Analytical Chemistry, Saunders College Publications, New York
6. Vogel's Textbook of Qualitative Chemical Analysis, ELBS
7. J.A. Dean, Analytical Chemistry Notebook, McGraw Hill
8. John H. Kennedy, Analytical Chemistry: Principles, Saunders College Publication
9. W. Kemp, Organic Spectroscopy, ELBS
10. Frank Settle, editor, Hand book of Instrumental Techniques for Analytical Chemistry, Prentice Hall.
11. Galen W. Ewing, Instrumental Methods of Chemical Analysis, McGraw-Hill Book Company


## 16.3 Advanced Analytical Instrumentation Lab

1. Quantitative Analysis of organic compounds using Gas chromatography
2. Quantitative Analysis of organic compounds using HPLC.
3. Study of NMR (Simulation based/Demo).
4. Study of Mass spectrometer (Simulation based/Demo).
5. Study of X ray spectrometer (Simulation based/Demo).
6. Potentiometric titrations: (i) Strong acid with strong base (ii) weak acid with strong base and (iii) dibasic acid with strong base
7. Potentiometric titration of Mohr's salt with potassium dichromate
8. pH metric titrations of (i) strong acid and strong base (ii) weak acid and strong base
9. Group Projects based on analytical techniques.

# 17

# INS-HE-5036
# Communication systems

**Total Lectures : 60 Credits : 6 (Theory : 04, Lab : 02)**

## 17.1 Theory (Lectures 60)

### 17.1.1 Unit I : *Basic communication system* (Lectures 07)

Block diagram, Information source and input transducer, Transmitter medium, Noise, Receiver, Destination, Necessity for modulation, Types of communication systems.

### 17.1.2 Unit II : *Analog Modulation* (Lectures 18)

Definition - AM waveforms - Frequency spectrum and hand width - Modulation index - DSB - SC, SSB, Independent SB, Vestigial SB - Comparison and application of various AM schemes, Definition-Relationship between FM & PM - Frequency deviation - Spectrum and transmission BW of FM, comparison of AM and FM systems.

### 17.1.3 Unit III : *Radio Transmitter and Receiver* (Lectures 16)

AM transmitters-High level and low level transmitters - SSB transmitters - FM transmitters - Block diagram - stereo FM transmitter.
AM receivers -operation - performance parameters - Communication Transceivers - Block diagram - SSB receiver - FM receivers - Block diagram.

### 17.1.4 Unit IV : *Digital Communication* (Lectures 19)

Pulse Analog Modulation: Sampling theorem, Errors in Sampling. Pulse Amplitude Modulation (PAM), Time Division Multiplexing (TDM). Pulse Width Modulation (PWM) and Pulse Position Modulation (PPM). Generation and detection of PAM, PWM, PPM, PCM- Need for digital transmission, Quantizing, Uniform and Non-uniform. Quantization, Quantization Noise, Companding, Coding, Digital Formats. Decoding, Regeneration, Transmission noise and Bit Error Rate.

## 17.2 *Suggested books*


1. G. Kennedy and B. Davis, Electronic Communication Systems, Tata McGraw Hill (1999)
2. R. P. Singh and S. D. Sapre, Communication Systems: Analog and Digital, Tata McGraw Hill (2007)
3. L. E. Frenzel, Communication Electronics: Principles and Applications, Tata McGraw Hill (2002)
4. L. W. Couch II, Digital and Analog Communication Systems, Pearson Education (2005)
5. T. G. Thomas and S. Chandra Sekhar, Communication Theory, Tata McGraw Hill (2006)
6. L. Temes and M. E. Schultz, Schaum's outline of theory and problems of Electronic Communication (1997)
7. H. Taub and D. Schilling, Principles of Communication Systems, Tata McGraw Hill (1999)
8. W. Tomasi, Electronic Communication Systems: Fundamentals through Advanced, Pearson Education (2004)
9. L. E. Frenzel, Communication Electronics, Principles and Applications, Tata McGraw Hill (2002)
10. L. W. Couch II, Digital and Analog Communication Systems, Pearson Education (2005)
11. H. P. Hsu, Analog and Digital Communications, Tata McGraw Hill (2006)
12. S. Haykin, Communication Systems, Wiley India (2006)


## 17.3 Communication systems Lab

1. Study of Amplitude Modulation and Demodulation
2. Study of Frequency Modulation and Demodulation
3. Study of Single Side Band Modulation and Demodulation
4. Study of AM Transmitter and Receiver
5. Study FM Transmitter and Receiver
6. Study of Pulse Amplitude Modulation
7. Study of Pulse Width Modulation
8. Study of Pulse Position Modulation
9. Study of Pulse Code Modulation

# 18

# INS-HE-6016
# Advanced Biomedical Instrumentation

**Total Lectures : 60** **Credits : 6 (Theory : 04, Lab : 02)**

## 18.1 Theory (Lectures 60)

### 18.1.1 Unit I : *Laboratory Instruments* (Lectures 15)

**Anaesthesia Machine:** Need of anesthesia, anesthesia delivery system, breathing circuits.
**Clinical Laboratory Instruments:** General principle and working of Blood Gases Analyzer, Auto-analyzer, Blood Cell Counters, ELISA reader, spectrophotometer, flame photometer.

### 18.1.2 Unit II : *Imaging Techniques* (Lectures 17)

**Medical Imaging System:** Ultrasound, properties, its generation & detection, types of transducers, diagnostic application - A Scan, B Scan, M Scan, real time ultrasonic imaging, linear array scanners, X-ray computed tomography (CT Scanner) and computer-aided tomography (CAT)-principle, contrast scale, scanning system, processing Unit, viewing, storage.
**Magnetic Resonance Imaging:** Basic principle, working and construction.

### 18.1.3 Unit III : *Nuclear Medicine System* (Lectures 15)

Radioactive emissions, rectilinear scanner, gamma camera, imaging system, ECT (emission coupled tomography), positron emission tomography (PET), Single-photon emission computed tomography (SPECT), safety measures.

### 18.1.4 Unit IV : *Surgical Scopy and Diathermy Equipments* (Lectures 13)

**Surgical Scopy and Diathermy Equipments:** Fibre Optics- Endoscopes -light sources, video processors, camera, and fiber optic cable, Principles and applications.
**Diathermy:** Infrared radiation (IR) diathermy, ultraviolet (UV) diathermy, short wave diathermy, microwave diathermy, ultrasonic diathermy, Surgical Diathermy.

## 18.2 *Suggested books*


1. Carr J. J, Brown J. M. Introduction to Biomedical Equipment Technology, Fourth edition, Pearson Education Inc (2010), 2nd edition
2. Khandpur R.S., Handbook of Biomedical Instrumentation, Second edition, Tata McGraw-Hill Publishing (2009), 2nd edition
3. Joseph D. Bronzino, The Biomedical Engineering Handbook, IEEE Press (2000), 2nd edition, Volume 1.
4. Richard Aston, Principles of Biomedical Instrumentation & Measurement, Merrill Publishing Company, (1990), 1st edition
5. Mandeep Singh, Introduction to Biomedical Instrumentation, PHI learning private limited (2010), 1st edition.
6. Cromwell L., Wiebell F. J., Pfeiffer EA, Biomedical Instrumentation and Measurements, Second edition, Prentice Hall (2010), 2nd Edition.


## 18.3 Advanced Biomedical Instrumentation Lab

1. Study of ultrasound transducers based on medical system.
2. Differentiating arteries and veins using ultrasound transducers.
3. Measurement of respiration rate using thermistor /other electrodes.
4. Measurement of pulse rate using photoelectric transducer & pulse counting for known period.
5. Study of X ray/CT machine (through demonstration).
6. Study of nuclear imaging techniques (through demonstration).
7. Study of mammograms and CT scan images.
8. Analysis of blood sample using Auto-analyzer
9. To check blood gases using blood gas analyzer
10. To estimate different parameters of blood using blood cell counter.
11. Estimation of serum total protein using spectrometer.
12. Estimation of sodium and potassium in blood serum or urine sample.

# 19

# INS-HE-6026
# Embedded System and Robotics

**Total Lectures : 60 Credits : 6 (Theory : 04, Lab : 02)**

## 19.1 Theory (Lectures 60)

### 19.1.1 Unit I : *Introduction to RISC microcontrollers* (Lectures 18)

Block diagram, Information source and input transducer, Transmitter medium, Noise, Receiver, Destination, Necessity for modulation, Types of communication systems.

### 19.1.2 Unit II : *Introduction to Embedded Systems* (Lectures 14)

Definition - AM waveforms - Frequency spectrum and hand width - Modulation index - DSB - SC, SSB, Independent SB, Vestigial SB - Comparison and application of various AM schemes, Definition-Relationship between FM & PM - Frequency deviation - Spectrum and transmission BW of FM, comparison of AM and FM systems.

### 19.1.3 Unit III : *8051 Interfacing* (Lectures 16)

8051 interfacing with Keyboard, display Units (LED, 7-segment display, LCD), ADC, DAC, Stepper motor, Introduction to AVR family and its architecture.
Interfacing and Communication Links Serial Interfacing: SPI / Micro wire Bus, I2C Bus, CAN Bus.

### 19.1.4 Unit IV : *Robotics* (Lectures 12)

Overview of Robotics, Pattern recognition and robots, Use of Embedded Systems in Robotics, Robots and Computer Vision.

## 19.2 *Suggested books*


1. Fundamentals of Embedded Software - where C and Assembly Meet by Daniel W. Lewis (Pearson Education).
2. Design with PIC Microcontrollers by John B. Peatman (Pearson Education).

3. Embedded C Programming and the Microchip PIC by Richard Barnett, Larry O'Cull and Sarah Cox (Thomson Learning).
4. Microprocessors: From Assembly Language to C using PIC18Fxx2 by Robert B. Reese (Shroff Publishers and Distributors Pvt Ltd)
5. Robotic Engineering - An Integrated Approach by Richard D Klafter, Thomas A. Chmielewski and Michael Negin (PHI).
6. Muhammad Ali Mazidi, Janice Gillispie Mazidi, The 8051 Microcontroller and Embedded Systems, Pearson education Asia, New Delhi (1999), 2nd Edition.

## 19.3 Embedded System and Robotics Lab

1. Write a program to multiply two 16 bit unsigned numbers.
2. Write a program to add N 8 bit unsigned integer 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. Write a program for LED blinking in a predetermined fashion using 8051 * and PIC microcontrollers.
6. Write a Program to OUT an 8 - bit value on a 8051 and PIC microcontrollers.
7. Write a program for a simple counter, where the count has to be displayed on a 7 - segment LED display.
8. Write a program for interfacing LCD display using 8051 and PIC microcontrollers.
9. Write a program to convert an analog voltage to digital bits using 8051 and PIC microcontrollers
10. Write a program to convert a digital signal to analog signal using 8051 and PIC microcontrollers
11. Write a program for temperature sensor interfacing through serial port on 8051 and PIC microcontroller kits.
12. Write a program for P W M control of DC motor using 8051 and PIC microcontrollers.
13. Write a program to drive a stepper motor using 8051 and PIC microcontrollers.

20

# INS-HE-6036
# Dissertation

**Total Lectures : N.A.** **Credits : 6**

# Part III

# Skill Enhancement Papers

# 21

# INS-SE-3014
# Testing and Calibration

**Total Lectures : 40 Credits : 4 (Theory : 04)**

## 21.1 Theory (Lectures 40)

### 21.1.1 Unit I : *Calibration and Standardization Practices Units* (Lectures 10)

Fundamental and Derived Units, Standards: Primary, Secondary and Tertiary standards, Standardizations and Technique: Standardizations of Electrical (voltage, current, frequency, RLC and others), Mechanical (mass, displacement, velocity, acceleration, torque, flow, level, temperature, pressure etc.) and other parameters.

### 21.1.2 Unit II : *Measurement and Calibration* (Lectures 10)

Inductive voltage dividers, AC and DC comparators, Programmable synthetic signal sources and power supplies, Quad bridge, Automatic AC bridges, Phase sensitive detectors, Lock-in-amplifiers, Digital phase and frequency measurements.

### 21.1.3 Unit III : *Standardization and calibration modeling* (Lectures 10)

Standardization in Production Plants and manufacturing houses, Reliability studies and inspection, Product Standardization techniques, Calibration: Calibration of measuring Instruments, Theory and Principles (absolute and secondary or comparison method), Setup, Modeling.

### 21.1.4 Unit IV : *Various testing and calibration systems* (Lectures 10)

Sensor calibration and testing, Analytical methods in calibrating.
Automated test and calibration systems: GPIB based systems, machine computation of errors and uncertainties in measurement.

## 21.2 *Suggested books*

1. Patrick O'Connor, Test Engineering: A Concise Guide to Cost-effective Design, Development and Manufacture (Quality and Reliability Engineering Series), Wiley-Blackwell.

2. Keith R. Cheatle, 2006, Fundamentals of Test Measurement Instrumentation, Illustrated Ed., ISA
3. B.G. Liptak 2003, Instrument Engineers Handbook - Process Measurement and Analysis, volume 1, 4th Ed., ISA.
4. Alan S. Morris, 2003, Measurement and Instrumentation Principles, 1st Ed., Butterworth-Heinemann.
5. N. E. Battikha, 2007, The Condensed Handbook of Measurement and Control, 3rd Ed., ISA

# 22

# INS-SE-3024
# Programming in C

**Total Lectures : 40  Credits : 4 (Theory : 04)**

## 22.1 Theory (Lectures 40)

### 22.1.1 Unit I : *Introduction* (Lectures 15)

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.

### 22.1.2 Unit II : *Functions* (Lectures 10)

Parameter passing, storage Lectures- extern, auto, register, static, scope rules, block structure, user defined functions, standard library functions, recursive functions, header files, C preprocessor, example C programs.

### 22.1.3 Unit III : *Arrays and pointers* (Lectures 15)

Arrays concept, declaration, accessing elements, storing elements, arrays and functions, two dimensional and multidimensional 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.

## 22.2 *Suggested books*


1. Behrouz A. Forouzan and Richard F. Gilberg, Computer science - A structured programming approach using C, Third edition, Cengage Learning.
2. Byron S. Gottfried, Programming with C, 2nd Edition, McGraw-Hill Publishing
3. E Balagurusamy, Programming in ANSI C, 4th Edition, Tata McGraw-Hill Publishing
4. P. Padmanabham, C & Data structures, B.S. Publications.
5. B.W. Kernighan, Dennis M.Ritchie, The C Programming Language, Pearson Education

6. J.A. Jones & K. Harrow, C Programming with problem solving, Dreamtech Press
7. Stephen G. Kochan, Programming in C, III Edition, Pearson Education.

# 23

# INS-SE-3034
# Programming using MATLAB

**Total Lectures : 40 Credits : 4 (Theory : 04)**

## 23.1 Theory (Lectures 60)

### 23.1.1 Unit I : *Introduction* (Lectures 15)

Features, MATLAB Windows(Editor, Work Space, Command History, Command Window),Operations with Variables, Naming and Checking Existence, Clearing Operations, Introduction to Arrays, File Types Data and Data Flow in MATLAB: Matrix Operations & Operators, Reshaping Matrices, Importing Exporting of Data, Arrays, Data types, File Input-Output, Communication with External Devices.

### 23.1.2 Unit II : *Editing, Debugging and Programming* (Lectures 15)

**Editing and Debugging M Files:** Writing Script Files, Writing Functions, Error Correction, M-Lint Automatic Code Analyzer, Saving Files.
**Programming:** Flow Control, Conditional Statements, Error Handling, Work with Multidimensional Array, Cell Array & Characters, Developing User Defined Function, Scripts and Other Functions.

### 23.1.3 Unit III : *Graphics* (Lectures 10)

Simple Graphics, Graphic Types, Plotting Functions, Creating Plot & Editing Plot (2DGraphics Handles, GUI (Graphical User Interface).

## 23.2 *Suggested books*


1. Fausett, L. V., Applied Numerical Analysis Using MATLAB, Prentice Hall, Upper Saddle River, New Jersey.
2. Mathews, J.H. and K.D. Fink, Numerical Methods Using MATLAB - Third Edition, Prentice Hall, Upper Saddle River, New Jersey
3. Linfield, G. & Penny, J., Numerical methods using MATLAB, Ellis- Horwood.
4. Van Loan, C.F., Introduction to Scientific Computing - A Matrix-Vector Approach Using MATLAB, Prentice Hall, Upper Saddle River, New Jersey

5. Nakamura, S., Numerical Analysis and Graphic Visualization with MATLAB - Second Edition, Prentice Hall PTR, Upper Saddle River, New Jersey

# 24

# INS-SE-4014
# PLC and SCADA

**Total Lectures : 40 Credits : 4 (Theory : 04)**

## 24.1 Theory (Lectures 60)

### 24.1.1 Unit I : *Programmable Logic Controllers* (Lectures 10)

Programmable Logic Controllers (PLC), input/output systems, CPU, memory Unit, Programmer Units, Peripheral devices, Controller programming tools, Programming of PLCs, PLC Hardware Environment.

### 24.1.2 Unit II : *Programming* (Lectures 10)

Programming of PLC, programming languages, Basics of programming, Ladder programming, ladder programming rules.

### 24.1.3 Unit III : *Control Mechanisms* (Lectures 10)

Single loop control, Centralized control, Distributed control systems, Open systems, SCADA systems, Types of data available, Data communication components and protocols.

### 24.1.4 Unit IV : *SCADA* (Lectures 10)

Supervisory Control and Data acquisition (SCADA) Systems, Types of supervisory systems, Distributed Digital Control Systems (DCS), Direct digital control (DDC), Components of SCADA Systems, field data interface devices, communication network and other details.

## 24.2 *Suggested books*


1. S. Gupta, JP Gupta, "PC interface For Data Acquiring & Process Control", 2nd Ed., Instrument Society of America.
2. John W. Web, Ronald A. Reis, "Programmable Logic Controllers" 5th Edition, PHI
3. Liptak, B. G. (E.d.), "Instrument Engineers Handbook", vol. I to III, Chilton Book Co.

4. Bhatkar, Marshal, "Distributed Computer control & Industrial Automation", Dekker Publication
5. Frank D. Petruzella, "Programmable Logic Controllers", 3rd Edition, McGraw Hill

# 25

# INS-SE-4024
# Virtual Instrumentation

**Total Lectures : 40 Credits : 4 (Theory : 04)**

## 25.1 Theory (Lectures 60)

### 25.1.1 Unit I : *Introduction* (Lectures 15)

The LabVIEW Programming Environment: Controls/ Indicators, Auto indexing, Debugging, Timing issues (counters), Importing pictures, Simple programming structures and Timing Issues, Basic operations, controls and indicators.

### 25.1.2 Unit II : *Programming Techniques* (Lectures 15)

VIS and sub-VIS, Debugging a VI and Sub-VI's, loops & charts, arrays, clusters, graphs, case & sequence structures, formula modes, local and global variable, string & file input, Graphical programming in data flow.

### 25.1.3 Unit III : *Data Acquisition Basics* (Lectures 10)

ADC, DAC, DIO, Counters & timers, PC Hardware structure, timing, interrupts, DMA, Software and Hardware Installation. GPIB/IEEE 608 concepts, and embedded system buses - PCI, EISA, CPCI, and USB & VXI.

## 25.2 *Suggested books*


1. John Essick , Hands on Introduction to LabVIEW for Scientists and Engineers, 1st Edition
2. S. Gupta, J.P. Gupta, PC Interfacing for Data Acquisition and Process Control, ISA, 2nd Edition
3. Gary Johnson, LABVIEW Graphical Programming, McGraw Hill, 2nd Edition.
4. Lisa K. Wells and Jeffrey Travis, LABVIEW for Everyone, PHI.
5. Skolkoff, Basic concepts of LABVIEW 4, PHI.
6. James K, PC interfacing and data acquisition.
7. Technical Manuals for DAS Modules of Advantech and National Instruments. L.T. Amy, Automation System for Control and Data Acquisition, ISA.

# 26

# INS-SE-4034
# VLSI Design and Verification

**Total Lectures : 40 Credits : 4 (Theory : 04)**

## 26.1 Theory (Lectures 60)

### 26.1.1 Unit I : *MOS Technology and Circuits* (Lectures 17)

MOS Technology and VLSI, Process parameters and considerations for BJT, MOS and CMOS, Electrical properties of MOS circuits and Device modeling, MOS Circuit Design Process, MOS Layers, Stick diagram, Layout diagram, Propagation delays, Examples of combinational logic design, Sealing of MOS circuits.

### 26.1.2 Unit II : *Analog VLSI and High speed VLSI* (Lectures 13)

Introduction to Analog VLSI, Realization of Neutral Networks and Switched capacitor filters, Sub-micron technology and GaAs VLSI technology.

### 26.1.3 Unit III : *Hardware Description Languages* (Lectures 10)

VHDL background and basic concepts, structural specifications of hardware design organization and parameterization.

## 26.2 *Suggested books*


1. Douglas A. Pucknell and Kamran Eshraghian, Basic VLSI Design Systems and Circuits, Prentice Hall of India Pvt.Ltd.
2. Wayne Wolf, Modern VLSI Design, 2 Edition, Prentice Hall.
3. Amar Mukherjee, Introduction to NMOS and CMOS VLSI System Design, Prentice Hall.
4. Randall L Geiger and PE Allen, VLSI Design Techniques for Analog and Digital Circuits, McGraw Hill International Company.
5. Fabricious.E, Introduction to VLSI Design, McGraw Hill.
6. Navabi.Z, VHDL Analysis and Modeling of Digital Systems, McGraw Hill.

7. Mohammed Ismail and Terri Fiez, Analog VLSI Signal and Information Processing, McGraw Hill.
8. Peter J Ashenden, the Designer's Guide to VHDL, Harcourt Asia Private Limited & Morgan Kauffman.

# Part IV

# General Elective Papers

# 27

# INS-HG-1016
# Basic Circuit Theory and Network Analysis

**Total Lectures : 60** **Credits : 6 (Theory : 04, Lab : 02)**

## 27.1 Theory (Lectures 60)

### 27.1.1 Unit I : *Circuit Concepts and Circuit Analysis* (Lectures 22)

Voltage and Current Sources.
Inductors: Fixed and Variable inductors, Self and mutual inductance.
Capacitors: Principles of capacitance, Parallel plate capacitor, Permittivity, Definition of Dielectric Constant, Dielectric strength, Energy stored in a capacitor, Air, Paper, Mica, Teflon, Ceramic, Plastic and Electrolytic capacitor, capacitors in series and parallel.
Kirchhoff's Current Law (KCL), Kirchhoff's Voltage Law (KVL), Node Analysis, Mesh Analysis.
RC Circuit, RL Circuit, RLC Circuits.
Sinusoidal Voltage and Current, AC/DC power source and power distribution. Definition of Instantaneous, Peak, Peak to Peak, Root Mean Square and Average Values. Voltage-Current relationship in Resistor, Inductor and Capacitor.
Passive Filters: Low Pass, High Pass, Band Pass and Band Stop.

### 27.1.2 Unit II : *Network Theorems* (Lectures 08)

Principal of Duality, Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Reciprocity Theorem, Millman's Theorem, Maximum Power Transfer Theorem.

### 27.1.3 Unit III : *Analog Electronics* (Lectures 15)

PN Junction diode and device power rating, Basic transistor action, Transistor current components and amplification. Transistor configurations: Common Base (CB), Common Emitter (CE) and Common Collector (CC) configuration, I-V characteristics.
Concept of feedback, negative and positive feedback, Negative feedback, advantages and disadvantages of negative feedback, Barkhausen criteria for oscillations.
Junction Field Effect Transistor (JFET), Construction of JFET, Construction of MOSFET.

### 27.1.4 Unit IV : *Digital Electronics* (Lectures 15)

Decimal, Binary, Hexadecimal and Octal number systems, base conversions, Truth Tables of OR, AND, NOT, XOR, XNOR, Universal (NOR and NAND) Gates, Basic postulates and fundamental theorems of Boolean algebra, Combinational Logic Analysis and Design, Adder, Subtractor, Encoder and Decoder, Multiplexers and Demultiplexers, Sequential logic design, Latches and Flip flops , S-R Flip flop, J-K Flip flop, T and D type Flip flops, Introduction to registers and counters.

## 27.2 Basic Circuit Theory and Network Analysis Lab

1. Familiarization with
   (a) Resistance in series, parallel and series - Parallel, Type, Wattage, Tolerance, and Temperature coefficient.
   (b) Capacitors- Tolerance, Voltage rating, Type of capacitor, Capacitors & Inductors in series & Parallel.
   (c) Multimeter (Analog and Digital) - Checking of components.
   (d) Voltage sources in series, parallel and series - Parallel.
   (e) Voltage and Current dividers.
2. To study the Half wave rectifier and Full wave rectifier.
3. To study power supply using zener diode andf regulated power supply.
4. To verify and design AND, OR, NOT and XOR gates using NAND gates.
5. Design a Half and Full Adder.
6. Design a Half and Full Subtractor.
7. Flip Flop Type and its uses

28

# INS-HG-2016
# Transducers and Sensors

**Total Lectures : 60 Credits : 6 (Theory : 04, Lab : 02)**

## 28.1 Theory (Lectures 60)

### 28.1.1 Unit I : *Basic Concepts of Instrumentation* (Lectures 15)

Generalized instrumentation systems block diagram representation, Scope of instrumentation in Industrial organization.
Static characteristics: accuracy, sensitivity, linearity, precision, resolution, threshold, range, hysteresis, dead band, backlash, drift.
Errors: systematic errors, instrumental errors, environmental errors, random errors, loading errors, random errors, source of errors in measuring instruments .
Uncertainties types, propagation of uncertainties.

### 28.1.2 Unit II : *Transducers* (Lectures 22)

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)
Optical Transducer: photo-conductive, photo emissive, photo voltaic, semiconductor, LDR Temperature Transducer: electrical and non-electrical.
Load cell pressure transducer.

### 28.1.3 Unit III : *Signal Conditioning* (Lectures 23)

Basic Operational Amplifier (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), Concept of differential amplifiers, Inverting, Non-inverting, Summing and difference amplifier, Basic comparator, Level detector, Sample and hold systems, Active filters, Instrumentation Amplifier.

## 28.2 Operational Amplifiers and Application Lab

1. Measurement of Temperature using Temperature Sensors/RTD
2. Measuring change in resistance using LDR
3. Designing of an amplifier of given gain for an inverting and non-inverting configuration using an opamp.
4. Designing of a First Order Low-pass filter using op-amp.
5. Designing of a First Order High-pass filter using op-amp.

# 29

# INS-HG-3016
# Electronic Instrumentation

**Total Lectures : 60 Credits : 6 (Theory : 04, Lab : 02)**

## 29.1 Theory (Lectures 60)

### 29.1.1 Unit I : *DC and AC Measurement* (Lectures 15)

DC and AC indicating Instruments: Accuracy and precision - Basic Measurement Instruments-DC Bridges and applications: Wheatstone, Kelvin, AC Bridges: General form of AC bridge balance, comparison bridges, Maxwell, Hay, Schering, Wien, DC measurement: DC voltmeter, ammeter, ohmmeter, multimeter, AC measurement: voltmeter, ammeter. Digital type voltmeters, digital multimeter, Digital LCR meter. Digital frequency meter.

### 29.1.2 Unit II : *Signal Generators and Displays* (Lectures 15)

***Signal Generators and Displays:*** Types of generators and their operation: Audio oscillator, Function generators, Pulse generators, RF generators. Cathode Ray Oscilloscope (CRO) and applications, Block diagram of a General Purpose Oscilloscope and its basic operation, electrostatic focusing and deflection, screens for CRT and graticules, CRT Connections, CRO probes. Types of CRO's: dual trace oscilloscope, digital storage oscilloscope, Sampling oscilloscope. Amplitude, Frequency, Phase measurements, Lissajous Figures.

### 29.1.3 Unit III : *Measurement of Flow, Speed and Acceleration* (Lectures 15)

Flow Meters (Introduction, definitions and Units, classification), Mechanical type flowmeters, Theory of fixed restriction variable head type flow meters, orifice plate, venturi tube, Tachometers(Mechanical, Electric, Contact less), Accelerometers (Elementary, Seismic and Practical accelerometers).

### 29.1.4 Unit IV : *Measurement of Humidity, Moisture and Pressure* (Lectures 15)

Basic principles, hygrometers, psychrometers, humidity charts, dew point, measurement systems for humidity. Units of pressure, manometers, different types, elastic type pressure gauges, Bourden type bellows, diaphragms.

## 29.2 Electronic Instrumentation Lab

1. Study and operation of Multimeters (Analog and Digital), Function Generator, Regulated Power Supplies, CRO.
2. Study the generation of Lissajous figures to find unknown frequency and phase shift.
3. Frequency measurement using Wein Bridge.
4. Experiment on working of thermocouple.
5. Experiment on control of various functions using RTD

# 30

# INS-HG-4016
# Analytical Instrumentation

**Total Lectures : 60 Credits : 6 (Theory : 04, Lab : 02)**

## 30.1 Theory (Lectures 60)

### 30.1.1 Unit I : *Molecular and Infrared Spectro-analytical Methods* (Lectures 20)

***Molecular Spectro-analytical Methods of Analysis:*** Colorimetry and Spectrophotometry: Introduction, theory: molecular energy levels, types of molecular transitions, Lambert-Beer's Law and limitations, types of sources, monochromators and detectors, Instrumentation of single beam and double beam instrument.
***Infrared Spectroscopy:*** Theory, diatomic molecules as a simple harmonic oscillator, instrumentation, sample handling techniques. Introduction to Fourier Transform Infrared Spectroscopy (FTIR).

### 30.1.2 Unit II : *Atomic Spectroscopy* (Lectures 15)

Principle, comparison of atomic and molecular spectroscopy, atomic transitions, atomic absorption, atomisation process, types of flames- fuel/ oxidant combinations, instrumentation of spectrophotometers; Interferences: spectral, chemical and ionization; applications. Atomic emission spectroscopy (AES): Flame photometer and its instrumentation, analysis using standard addition method, applications.

### 30.1.3 Unit III : *Chromatography* (Lectures 15)

***Separation methods:*** Theory of chromatography; instrumentation and applications of Thin layer chromatography (TLC).
***Column chromatography:*** Principle, process of elution through a column, chromatogram, band broadening, capacity factor, selectivity factor , Column efficiency, number of plates, plate height, column resolution.

### 30.1.4 Unit IV : *Gas Chromatography* (Lectures 10)

Carrier gases, different type of injection systems, columns, stationary phases and detectors. Isothermal mode, temperature programming mode, analysis by internal standard method, applications.

## 30.2 Analytical Instrumentation Lab

1. Determination of pKa value for a dye using double beam spectrophotometer.
2. Spectrometric determination of iron in water sample using double beam spectrophotometer.
3. Determination of concentrations of sodium, calcium, lithium and potassium in sample using flame photometer.
4. Determination of concentration of potassium ions in sample by standard addition method using flame photometer
5. Qualitative analysis of samples using Gas chromatography
6. Qualitative analysis of samples using High Performance Liquid Chromatography.

# 31

# INS-HG-4026
# Nuclear & Biomedical Instrumentation

**Total Lectures : 60** **Credits : 6 (Theory : 04, Lab : 02)**

## 31.1 Theory (Lectures 60)

### 31.1.1 Unit I : *Introduction* (Lectures 07)

Introduction to bioelectric potential, bio-amplifier, components of man Instrument system, design factors of biomedical instruments, types of biopotential electrodes.

### 31.1.2 Unit II : *Cardio Vascular System* (Lectures 21)

Origin of (Electrocardiography) ECG signals, Instruments of ECG, bipolar system lead system I, II, III, Eithoven triangle, Augmented lead system, unipolar chest lead system, types of display. Respiratory system: Types of volume, types of measurements, Instrumentations of respiratory system, pneumograph, principle & types of pneumograph, Spirometer, ventilators, heart lung machine.
Nervous system: Action potential of brain, brain wave, Instrumentation - Electro encephalography (EEG), analysis.

### 31.1.3 Unit III : *Medical Imaging System* (Lectures 20)

Ultra sound, properties, beam width, its generation & detection, types of transducers, diagnostic application - A Scan, B Scan, M Scan.
Radiography- conventional X ray, properties, generation of X-ray, X ray computed tomography (CT scanner) and computer-aided tomography (CAT).

### 31.1.4 Unit IV : *Nuclear Medicine System* (Lectures 12)

Introduction to nuclear medicine system: Nuclear detectors: Gas filled detectors: Ionization, Proportional, and Geiger Muller (GM) Counter, Scintillation counter - principle, operating condition.

## 31.2 *Suggested books*


1. Cromwell L., Wiebell F. J., Pfeiffer EA, Biomedical Instrumentation and Measurements, Prentice Hall, 2nd edition
2. Carr J. J, Brown J. M. Introduction to Biomedical Equipment Technology, Fourth edition, Pearson Education, Inc, 4th edition
3. Khandpur R.S., Handbook of Biomedical Instrumentation, Tata McGraw-Hill Publishing, India, 2nd edition.
4. Joseph D. Bronzino, The Biomedical Engineering Handbook, 2nd Edition, Volume 1, IEEE Press.


## 31.3 Nuclear & Biomedical Instrumentation Lab

1. Characterization of bio potential amplifier for ECG signals.
2. Study on ECG simulator
3. Recording of EEG
4. Measurement of heart sound using electronic stethoscope.
5. Study of pulse rate monitor with alarm system
6. Determination of pulmonary function.
7. Study on ultrasound transducers based on medical system

# 32

# INS-HG-4036
# Machine Intelligence

**Total Lectures : 60 Credits : 6 (Theory : 04, Lab : 02)**

## 32.1 Theory (Lectures 60)

### 32.1.1 Unit I : *Introduction* (Lectures 08)

Components of AI, human intelligence vs. machine intelligence, Knowledge Acquisition, Representation and organization: Structured Knowledge representation using Semantic Networks, Frames, Expert system architecture, functions of various parts, Mechanism and role of inference engine, Types of Expert system

### 32.1.2 Unit II : *Artificial Neural Networks* (Lectures 21)

Structure and function of a single neuron, artificial neuron models, Types of activation functions, Neural network architectures: Fully connected, layered, acyclic, feed forward, Neural learning: correlation, competitive, Supervised learning: Back propagation algorithm, Unsupervised learning, winner-take all networks, Application areas of neural networks

### 32.1.3 Unit III : *Fuzzy Logic* (Lectures 21)

Fuzziness vs. probability, Crisp logic vs. fuzzy logic, Fuzzy sets and systems, operations on sets, fuzzy relations, membership functions, fuzzification interface, knowledge/rule base, decision making logic, defuzzification interface, Applications of Fuzzy Logic in process Control and motion control.

### 32.1.4 Unit IV : *Genetic Algorithm* (Lectures10)

**Genetic Algorithm:** introduction and concept, coding, reproduction, cross-over and mutation Scaling, fitness, applications.
**Hybrid Systems:** Introduction to Neuro-fuzzy systems, Fuzzy-Expert system, Fuzzy-GA systems.

## 32.2 *Suggested books*

1. Timothy J. Ross, Fuzzy logic with Engineering Applications , McGraw Hill, New York, 3rd Edition

2. S. Rajasekaran, G. A. Vijayalakshmi Pai Neural Networks, Fuzzy Logic And Genetic Algorithm: Synthesis and Applications, PHI Learning Pvt. Ltd., 2003, 1st Edition
3. Martin T. Hagan, Howard B. Demuth, Mark H. Beale, Neural Network Design,PWS Publishing Company, Thomson Learning, 1st Edition
4. N.P. Padhy, Artificial Intelligence and Intelligent Systems, Oxford University Press, 1st Edition

## 32.3 Machine Intelligence Lab

Implement programs using Mat lab Fuzzy logic and Neural Network toolbox exemplifying

1. Implementation of perception learning model
2. Pattern recognition using Hopfield network
3. Pattern Identification using associative memories
4. Implementation of back propagation algorithm
5. Implement fuzzy logic operations on fuzzy sets
6. Implement conversion of given crisp variable into its equivalent fuzzy variable
7. Implement conversion of error of given control system into its equivalent fuzzy variable
8. Design model of fuzzy logic PID controller
9. Design fuzzy logic based temperature control system
10. Design fuzzy logic based washing machine/aircraft landing system