# SCHEME OF TEACHING M.Sc. (INSTRUMENTATION)

### FIRST SEMESTER

<table>
<thead>
<tr>
<th>S.No.</th>
<th>SUBJECT COURSE TITLE</th>
<th>SCHEDULE FOR TEACHING</th>
<th>THEORY</th>
<th>PRACTICAL</th>
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<tbody>
<tr>
<td></td>
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<td>L T P TOTAL</td>
<td>Exam. Sess. Total Marks</td>
<td>Exam. Sess. Total Marks</td>
</tr>
<tr>
<td>1.</td>
<td>Sensors, Transducers and Actuators for Instrumentation</td>
<td>3 - 3 - 6</td>
<td>80</td>
<td>20</td>
</tr>
<tr>
<td>2.</td>
<td>Signal conditioning, processing and interfacing techniques</td>
<td>3 - 3 - 6</td>
<td>80</td>
<td>20</td>
</tr>
<tr>
<td>3.</td>
<td>Instrumentation components, devices and assemblies</td>
<td>3 - 3 - 6</td>
<td>80</td>
<td>20</td>
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<tr>
<td>4.</td>
<td>Principles of Test and Measuring Instruments</td>
<td>3 - 3 - 6</td>
<td>80</td>
<td>20</td>
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<tr>
<td>5.</td>
<td>Digital Electronics</td>
<td>3 - 3 - 6</td>
<td>80</td>
<td>20</td>
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**Total Marks: 750**
## SECOND SEMESTER

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<tr>
<th>S.No.</th>
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<tr>
<td>1</td>
<td>2 1</td>
<td>Microprocessor based Instrumentation &amp; System Design</td>
<td>3 - 3 - 6</td>
<td>80</td>
<td>20</td>
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<tr>
<td>2</td>
<td>2 2</td>
<td>Control System Design</td>
<td>3 - 3 - 6</td>
<td>80</td>
<td>20</td>
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<tr>
<td>3</td>
<td>2 3</td>
<td>Power Electronics</td>
<td>3 - 3 - 6</td>
<td>80</td>
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<tr>
<td>4</td>
<td>2 4</td>
<td>Process Control and Automation</td>
<td>3 - 3 - 6</td>
<td>80</td>
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<tr>
<td>5</td>
<td>2 5</td>
<td>Optical Instrumentation &amp; Photonics</td>
<td>3 - 3 - 6</td>
<td>80</td>
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Total Marks: 750
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<tr>
<td>1.</td>
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<td>Biomedical Instrumentation</td>
<td>3 - 3 - 6</td>
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<td>Instrumental methods of Analysis</td>
<td>3 - 3 - 6</td>
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<td>3.</td>
<td>SEM PO 3 3</td>
<td>Advanced Fabrication Technique and Materials</td>
<td>3 - - - 3</td>
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<td>SEM PO 3 4</td>
<td>Instrumentation Laboratory visit</td>
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<tr>
<td>5.</td>
<td>SEM PO 3 5</td>
<td>Project Work</td>
<td>- - 12 -12</td>
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Total Marks: 750
## FOURTH SEMESTER

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<td>L T P TOTAL</td>
<td>Exam. Sess. Total Marks</td>
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<tr>
<td>1.</td>
<td>SEM PO 4</td>
<td>1 Seminars</td>
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<td>SEM PO 4</td>
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<td>3.</td>
<td>SEM PO 4</td>
<td>3 Project Work &amp; Project Report</td>
<td>- - 20 20</td>
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Total Marks: 750

Grand Total Marks Sem I to IV: 3000
Instructions to the Examiners/Paper-Setters

1. Examiners are to set nine questions for the paper, comprising one short answer type compulsory question, equally distributing the whole syllabus for all questions.

2. All questions should carry equal marks.

3. Students would be required to attempt one compulsory question and any four questions out of the rest eight questions.
SEMESTER –I

SEM PO 1 1
SENSORS, TRANSDUCERS AND ACTUATORS FOR INSTRUMENTATIONS

UNIT-I
Transducer Classification, Performance & Characteristics:
Transducer terminology, Transducer classification, Performance Characteristics.
Electrical tests, measurement units, measurement of voltage, current, frequency, impedance, noise, loading errors, resolution, threshold, calibration, dynamic, environmental and life test.

UNIT-II
Transducer and Sensors:
Principles of operation, specification and construction of following Transducers.
Capacitive, Piezoelectric Transducers, Vacuum – Pirani and Penning gauges

Flow : Differential Pressure type, Variable area type, Rotameters, Electromagnetic, Mass flow, Turbine, Anemometer, ultrasonic

UNIT–III
Temperature: RTD, Thermocouple, Thermisters, Semiconductor Sensors, Pyrometry.

Chemical Sensors: Measurement of Conductivity, pH and Humidity.

Optical sensors: PMT, Photodiodes, CCD, LDR,

UNIT-IV
Actuators:
Principles and applications of mechanical, electrical, hydraulic, pneumatic, actuators, valves, relays, solenoids, actuators, motorized valves, fluidic gates etc.
**Advanced sensors:** Optical fiber sensors for temperature, image, displacement, pressure, flow and liquid level sensors, biosensors and smart sensors.

**Reference Books:**


**LABORATORY FOR SENSORS AND TRANSDUCERS INTERFACING TECHNIQUES**

**List of Experiments:**

1. Study of electronic and electrical components. (active and passive devices)
2. Study of active filters using operational amplifier IC 741
3. Study of digital ICs, and digital frequency counter. (Digital ICs TTL and CMOS family – MSI/LSI type)
4. Study of linear displacement transducer and precision rectifier using operational amplifier IC 71
5. Study and characterization of Instrumentation amplifier using quad opamp IC 324 and study of Schmitt trigger/comparator circuit
6. Mechanical workshop practices
7. Study and calibration of temperature sensor: Pt – 100
8. Comparative study of various types of regulated power supplies
9. Study of capacitive level sensor
10. Study of optical sensors: LDR and photo diode
SEM PO 12
SIGNAL CONDITIONING PROCESSING AND INTERFACING TECHNIQUES

UNIT-I
(i) Signal conditioning elements:
Bridges: Whetstone’s bridge, Kelvin’s double bridge, DC bridge design consideration, AC bridges, concept of impedances and their representations, Maxwell’s bridge, Anderson’s bridge, Wien Bridge etc.
(ii) Analog signal conditioning:
Basics of operational amplifier, ideal and practical characteristics, Input and output impedances, offset voltage and current, bias current, slew rate, CMRR, gain-bandwidth product, concept of positive feed back and negative feed back, basic amplifier configurations and applications: inverting and non-inverting amplifier, summing amplifier, subtractor etc.

UNIT-II
Applications of Conditioning circuits:
Instrumentation amplifiers, precision rectifiers, active filters, differentiator, integrator, Schmitt trigger wave shaping circuits, milli-volt to current converter, F to V and V to F conversion, phase lock loop etc.

UNIT-III
Analog and Digital Interface:
System – module interfacing considerations: Analog and digital representation of data, comparisons and relative merits, sampling and quantization, sample and hold circuits,
Analog to digital converters: Successive approximation, Single Slope and Dual slope ADC, Study of typical ADC ICs, specifications, merits and demerits,
Digital to analog converters: R – 2R type, specifications, merits and demerits, Applications of DACs like Programmable power supplies, waveform generation and synthesis,
Digital data transmission: Advantages of digital communication, need of multiplexing, SDM, FDM, TDM, PCM etc.

UNIT-IV
(i) Digital Signal Processing:
Concept of signals and systems, time domain and frequency domain signal representation, impulse response, linearly time invariant (LTI) system.

(ii) **Analog and digital system co-housing:** EMI effects and EMC measures, Analog and Digital PCB design guidelines, shielding and grounding techniques, Enclosure design guidelines.

**Reference Books:**
3. Millman and Halkias: integrated electronics, TMH, 2002

**LABORATORY FOR SIGNAL CONDITIONING, PROCESSING AND INTERFACE TECHNIQUES:**
Practicals based on the theory course.

**SEM PO 1 3**
**INSTRUMENTATION COMPONENTS, DEVICES AND ASSEMBLIES**
**UNIT-I**
Electronic Components and Devices:
- **Passive and Active devices:** Resistors, Capacitors, Inductors, Transformers, Relays, Switches, wires and cables etc. specifications, data sheets referencing, testing, Diodes, Zener diodes, Light emitting diodes, BJTs, FETs, MOSFETs specifications, data sheets referencing, characteristics and testing, Class A, Class B, Class AB, Push pull and Class C amplifiers, Transistor as a switch etc.
- **Linear regulated power supplies:** Power supply basics, rectifiers, filters, Simple Zener regulator, Zener regulator with series pass transistors, Voltage regulator IC 723, Three terminal regulators, testing of power supplies, specifications, line load regulation, efficiency of power supplies, stability etc.

**UNIT-II**
Digital Electronics:

UNIT-III

Fundamental of geometrical optics:
Reflections, refraction, refractive index, sign convention, total internal reflection, Optical Components and devices – Lens, prism, mirrors, slit, aperture, Fresnel lens, collimators, beam expanders, optical bench, basic principles and applications, aberrations: monochromatic and chromatic.

UNIT-IV

Mechanical Components:
An overview of Screws, Power Screws, Bolts, Nuts, Washers, Foundation Bolts, Locking Arrangements, Forms of Threads, Thread Nomenclature, Thread Representations, Various types of springs, Pulleys, levers, gears; belts and gears; belts and chain drives – basic structures and applications, Shafts, Keys, Couplings, Joints, Bearings, Brackets, Boxes, Hangers, Flat tables,
Types of rivets: Bolted, riveted, and welded joints, welding processes and equipments,
Mechanisms for motion conversions: Cam and followers, Materials and Material properties, Instrument Assembly: Reading drawing, working layout of instrument, assembly of joints detachable, permanent, semi permanent etc.

Reference Books:
2. Malvino and Leach: Digital Principles, TMH

LABORATORY FOR INSTRUMENTATION COMPONENTS, DEVICES AND ASSEMBLIES
Practicals based on the theory course.
SEM PO 1 4
PRINCIPLES OF TEST AND MEASURING INSTRUMENTS

UNIT-I
Multimeters:
*Analog multimeters:* Basic permanent magnet moving coil movement construction and working, Sensitivity of PMMC meters and their loading effects.
*Digital Multimeters:* Block diagram and Working of DMM, types of ADCs used, Auto Zeroing and Auto – ranging concepts, various circuit details of DMM.

UNIT-II
Oscilloscopes:
Working principle of general purpose (Real Time) Oscilloscope with block diagram, circuit diagrams and timing diagrams, Details of Y amplifier, X amplifier, CRT section, Details of stability of waveform, triggering modes and facilities, multi trace operation, delayed time base operation, delay line, X-Y mode.
*Oscilloscope probes:* Specifications characteristics and probe tuning;
*Storage oscilloscope:* Working principle of Storage Oscilloscopes, Digital Storage Oscilloscope block diagram, Sampling techniques, Merits and demerits of DSO.

UNIT-III
(i) Other Test and Measuring Instruments:
*Recorders:* Block schematic and working of strip chart, potentiometric, galvanometric, X – Y – t recorders and plotters,
*Frequency Counters:* Working principles, Study of block diagrams and timing diagrams for Frequency Counters / Universal Counters, applications, measurements
*Special purpose Instruments:* Signal/Function Generators, LCR meters, Lock in amplifiers, Working principles and applications.

(ii) Reliability Engineering:
Concept of Reliability, quality, failures and causes of failures, Maintainability, designing for higher redundancy, system reliability modes, reliability management, reliability and cost.

UNIT-IV
Instrument Performance Characteristics:
Accuracy, precision, tolerance, range, bias, sensitivity, hysteresis, resolution, repeatability, reliability, loading effect and other parameters, calibration of instrument,
**Errors in Measurement and statistical data analysis:** Types and sources of errors, error reduction techniques, Graphical representation of data, curve fitting, Statistical concepts, mean and median values, standard deviation, frequency distribution, normal and Gaussian distribution, confidence level,

**Reference Books:**
1. Oliver and Cage: Electronic Measurement and Instrumentation
2. W. Cooper: Electronic Instrumentation and measuring techniques, PHI, 3rd Edn., 1987
4. Norman B. Fuqua; Reliability Engineering for Electronic Design; Marcel Dekker, Inc, 1987
5. Birolini; Reliability engineering, Theory & Practicce, 3rd Edn. Springer, 1999

LABORATORY FOR PRINCIPLES OF TEST AND MEASURING INSTRUMENTS.
Practicals based on the theory course.

SEM PO 1 5
DIGITAL ELECTRONICS:

UNIT-I
(i) **Number System and Boolean Algebra:**
Review of Number System, Radix conversion, Complements 9’s & 10’s Subtraction using 1’s & 2’s complements, Binary codes, Error detecting and correcting codes, Theorems of Boolean Algebra, canonical forms, Logic gates.

(ii) **Digital Logic Families:**
Introduction to bipolar Logic families, RTL,DCTL, DTL,TTL,ECL,I L and MOS Logic families: NMOS, PMOS, CMOS, Details of TTL Logic family Totem pole, open collector outputs, TTL Subfamily, Comparison of different logic families.

UNIT-II
(i) Combinational Logic:
Representation of logic functions, Simplification using Karnaugh Map, Tabulation method, Implementation of combinational logic using standard logic gates, Multiplexers and Demultiplexers, Encoders and Decoders, Code Converters, Adders, Subtractors, Parity Checker and Magnitude Comparator.

(ii) Sequential Logic:
Concepts and Components, Flip flops-SR, JK, D and T flip flops, Level triggering and edge triggering, Excitation tables-Counters-Asynchronous and type Modulo counters, design with state equation state diagram, Shift registers, type of registers, circuits diagrams, timing wave form and operations, Introduction to finite state machines

UNIT-III
D/A and A/D Converters:
Weighted resistor type D/A Converter, Binary ladder D/A converter, Steady accuracy test, D/A accuracy and resolution, Parallel A/D Converter, counter type A/D converter, Successive approximation A/D converter, single and Dual slope A/D converter, A/d accuracy and resolution.

UNIT-IV
Semiconductor Memories:
Memory organization, Classification and characteristics of memories, sequential memories, ROMs, R/W memories, Content Addressable memories, Charged-Coupled Device memory, PLA, PAL and Gate Array, Magnetic core memories.

Reference Books:
1. Malvino and Leach “Digital principals and applications” Tata McGraw-Hill
LABORATORY FOR DIGITAL ELECTRONICS.

1. Verification of the truth tables of TTL gates, e.g. 7400, 7402, 7404, 7408, 7432, 7486
2. Verify the NAND and NOR gates as universal logic gates.
3. a) Verification of the truth table of the Multiplexer 74150 
   b) Verification of the truth table of the De-Multiplexer 74154
4. Design and verification of the truth tables of Half and Full adder circuits.
5. Design and verification of the truth tables of Half and Full subtractor circuits
6. Design and test of an S-R flip-flop using NOR/NAND gates
7. a) Verify the truth table of a J-K flip-flop(747)
   b) Verify the truth table of a D flip-flop(7474)
8. Operate the counters 7490, 7493 and 74194, Verify the frequency division at each stage and with a low frequency clock (say 1 Hz) display the count on LEDs
9. Verify the truth table of decoder driver 7447/7448, Hence operate a 7 segment LED display through a counter using a low frequency clock.
10. Repeat the above with the BCD to Decimal decoder 7442 and an array of LEDs
11. Design and test D/A converter using R-2R Ladder Network
12. Study and test of A/D converter Experimentation work to be supported by simulated results.
SEMESTER-II

SEM PO 2 1
MICROPROCESSOR BASED INSTRUMENTATION AND SYSTEM DESIGN

UNIT-I
Embedded Instrumentation:

*Need and advantages of using Microprocessors in Instrumentation:* Basic concepts of embedded instrumentation, features, specifications and differences; different blocks of embedded instruments, ideal microprocessor/microcontroller based Instrument, case study; basics of processor/controller, hardware resources, comparison of 8085 and 8051 and other processors/controllers, architectural details of microprocessor 80-85 and microcontroller 8051.

UNIT-II
Microprocessor support devices:

*Memories:* Latches, Shift registers, RAM, NVRAM, ROM, PROM, UVPROM, EAPROM, FLASH, SRAM and DRAM, Serial EEPROMS, Serial RAM, Differences and general specifications, various memory devices, interfacing of memory devices with microprocessor/microcontroller. Memory mapping scheme for microprocessor 8085, memory decoders, folded memory, external memory interfacing for microcontroller 8051, internal memory map for 8051,

*Input output devices:* I/O mapping, I/O mapped I/Os, memory mapped I/Os, advantages and disadvantages, non programmable I/O devices, Programmable peripheral interface 8255, Programmable timer counter 8253.

UNIT-III
Programming techniques:

*Addressing modes and study of instruction set,* Stack pointer, stack memory and stack operation; introduction to assembly language programming, simple programs; extensive programming exercises with using assembly language for 8085 and 8051.

UNIT-IV
Modular development of embedded system:

*Interfacing of Keyboards and Displays, Interfacing of ADC and DAC, I/O Expansion for 8051 using serial interface,* Timers and counters in 8051, various modes of operation, generation of PWM signal, Interrupts in 8085 and 8051, priority of interrupts, vectored interrupts Implementation and applications of serial interface RS 232 using 8051 UART,

Reference Books:
LABORATORY FOR MICROPROCESSOR BASED INSTRUMENTATION AND SYSTEM DESIGN.

Practicals based on the theory course.

SEM PO 2 2
CONTROL SYSTEM DESIGN

UNIT-I
(i) Introduction:
The feedback concept and modeling, T.F. and stability, concept of Block diagram representation and reduction, Sf-graph, Types of control system design.

(ii) Root Locus Analysis and Design:

UNIT-II
State Space Modelling and Design:
State feedback and pole placement, Limitations of state feedback, tracking problems, observers design, control law using observer, Observer T.F., Reduced order observer design, Trade-offs in state feedback and observers.

UNIT-III
Advanced State Space Methods:
Design via optimal control techniques, the linear quadratic regulator problem, properties of LOR design, optimal observer Kalman Fliter, Robustness, robust stability, root T.F. recovery (LTR), uncertainty modelling.
UNIT-IV
Digital Control:
Preview, computer, A/D and D/A conversion, discrete time signals, Sample and hold circuits, Z-transformation and properties, inverse Z-transform sampling, reconstruction of signals from samples, stability and Bilinear transformation, state space description of discrete-time systems, response and stability, controllability and observability, Direct digital design, some examples Decoupling.

Reference Books:

LABORATORY FOR CONTROL SYSTEM DESIGN

Practicals based on the theory course.

SEM PO 2 3
POWER ELECTRONICS

UNIT-I
Power Semiconductor devices:
Diodes, Transistors, MOSFETs, IGBTs and Thyristors, Switching characteristics, specifications and performance comparison of power devices

UNIT-II
Power Circuits:
Thyristor turn on and turn off methods,
Inverters: Transistors and Thyristorised inverters; Applications of Inverters,
**Choppers:** Fourt-Quadrant operation of Choppers, Applications of Choppers, **Cyclo converters:** Principle of operation and applications

**UNIT-III**

Power supplies:

*Uninterrupted Power supplies:* ON LINE AND OFF LINE UPS, Specifications, testing and applications

*Switch Mode Power Supplies (SMPS):* Need and Concept of SMPS, Principle of operation, specifications, integrated solutions for LDOs and SMPS

*HV power supply:* Pulsed power supply, Specifications, Designing concepts, Protections and Applications.

**UNIT-IV**

(i) Motors and Motor Drives:

*Types of Motors:* DC Motors, AC Motors, Induction Motors, Single and Three Phase Motors, Synchronous Motors, Stepper Motors, Servo Motors etc. Constructional details, Specifications, Characteristics of motors, Motor Driving circuits and their applications

(ii) AC power transmission and distribution:

Single phase, three phase systems Transmission line constants, single phase, three phase transformers and power factor calculation, load distribution.

**Reference Books:**

1. *P.C. Sen: Power Electronics; TMH, 2006*
3. *Mohan, Neal; Power Electronics; Converters, applications & Design, 3rd Edn, John Wiley; 2004*

**LABORATORY FOR POWER ELECTRONICS:**

Practicals based on the theory course

SEM PO 2 4

PROCESS CONTROL AND AUTOMATION:
UNIT-I
Fundamental of process control:
Introduction to process control, open loop and closed loop systems, Process parameters, Control systems parameters, Different controller modes, Composite controllers

UNIT-II
Discontinuous and continuous controllers:
Study of On – off controller, Proportional controller, PI controller, PID controller, Study of electronic and pneumatic controllers, control loop characteristics, control system configuration, single variable, multi variable, cascade controllers,

UNIT-III
Process stability:
Routh’s stability criteria, Nyquist criteria, Process loop tuning, Open loop transient response method, Ziegler Nichols method, Frequency response method, Auto tuning PID.

UNIT-IV
Discrete state process control:
Discrete state system characteristics, process specifications, sequential control, Programmable Logic controllers, Ladder diagrams, PLC programming and operation, Computer in process control, Data logging, Supervisory controllers, Factory automation

Reference Books:
3. K. Ogata: Modern Control engineering, PEA, 4th Edn., 2002
LABORATORY FOR PROCESS CONTROL AND AUTOMATION:

Practicals based on the theory course.

SEM PO 2 5
OPTICAL INSTRUMENTATION AND PHOTONICS

UNIT-I
Confining Ray bundle in Optical System:
Aperture, field of view, entrance/exit window effects of Aperture, Energy flow in optical instrumentation: Light flux, Radiometry and Photometry, Radiative transfer in optical system, heterodyne and phase shifting interferometry, Types of Optical filters, specifications, interference, diffraction, polarization and types of gratings

UNIT-II
Optical Photoelectric System:
Types of optical detectors, characteristics, effect of spectral characteristics, Optical materials for UV, visible and IR regions;

UNIT-III
(i) Introduction to Optical Systems in LASER:
Properties of Laser, Basics of Laser Principles: active medium, laser pumping, optical feedback, laser output: line shape broadening, laser modes: optical resonance, pump rate, power output;
(ii) Laser Exposition:
Working principle and construction of Gas lasers, Solid-state lasers, Semiconductor lasers and Dye lasers, Applications of lasers

UNIT-IV
Optical Fiber:
Introduction to Optical fiber, principle in optical fiber, numerical aperture, multimode and single mode fibers, losses in fiber: dispersion, absorption, scattering losses, types of couplers and connectors, losses due to couplers, splicing techniques, fabrication techniques, Applications of optical fiber viz. Fiber Optic sensors, Communication sytem etc.
Reference Books:
2. A. Ghatak; Optical electronics; Cambrige University Press; 1999
3. Michael Bass; Handbook of Optics Vol.-II; Mc graw Hill Inc. 1995

LABORATORY FOR OPTICAL INSTRUMENTATION AND PHOTONICS.

Practicals based on the theory course.

SEM PO 3 1
BIOMEDICAL INSTRUMENTATION

UNIT-I
Introduction to Biomedical basics
Introduction to Bio-Medical Instrumentation and Associated problems regarding measuring the living systems. Design considerations of a medical instrument, Electric Hazards and methods of prevention from electric shocks.

UNIT-II
Transducers and Electrodes
Physiological Transducers such as resistive, Inductive, Capacitive, piezoelectric, photoelectric transducers. Electrode theory and Different types of electrodes.

Biopotentials-generation of biopotentials, Different sources of the biopotentials such as – ECG, EMG, EEG.

UNIT-III
Biopotential Recording
Electrocardiograph – ECG Block diagram, leads system, ECG machine, ECG electrodes.
Electroencephalograph (EEG) Block diagram and Electrodes for EEG.
Electromyograph (EMG) Block diagram and electrodes for EMG.
Introduction to therapeutic devices such as pacemakers – external and internal pacemakers, defibrillators, D.C. defibrillators, defibrillator electrodes.

UNIT-IV
Imaging Techniques
Basic Introduction to the Principles of Imaging methods such as - X-Rays, CAT scan, PET scan, MRI and Ultrasound employed in medical imaging systems, block diagram of imaging systems such as X-Ray and Ultrasound.

Reference Books:
1. Electronics in Medicine and Biomedical Instrumentation; Nandini K.Jog; 2006, PHI.
2. Biomedical Instrumentation & Measurements; Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer; 2nd Edn; 2005; Pearson Education.
3. Handbook of Biomedical Instrumentation; R.S.Khandpur; 2nd Edn; 2006; TMH

LABORATORY FOR BIOMEDICAL INSTRUMENTATION
Practicals based on the theory course.
SEM PO 3 2
INSTRUMENTAL METHODS OF ANALYSIS

UNIT-I
Introduction to Spectroscopical Methods of Analysis:

UNIT-II
UV-Visible, & IR Spectroscopy
Instrumentation for UV-Visible and IR Spectroscopies; Various light sources, Spectrometers, Detectors and Data Processing. Application of UV-Visible and IR

UNIT-III
An Overview of:
XRD methods, XRF methods, SEM, TEM, NMR, Mass Spectrometry and Chromatography.

UNIT-IV

Reference books:
2. Willard, Merritt, Dean, Settle: Instrumental methods of Analysis, CBS, Publisher, 7th Edn., 1986
LABORATORY FOR INSTRUMENTAL METHODS OF ANALYSIS

Practicals based on the theory course.

SEM PO 3 3
ADVANCED FABRICATION TECHNIQUES

UNIT-I
Semiconductor Devices:
Drift and diffusion of carriers, Generation and recombination of charges, Direct and indirect bandgap semiconductors. p-n junction, Capacitance of p-n junctions, switching diodes, Metal-semiconductor junctions; Ohmic and rectifying contacts, Photodiodes, solar cell, Light emitting diodes, Liquid crystal displays, FET ,MOSFET,UJT, IMPATT diodes, Tunnel diode,

UNIT-II
Vacuum systems:
Production of Vacuum - Mechanical pumps, Diffusion pump, Turbo pumps, Getter and Ion pumps; High Vacuum, Turbo Pumps , Measurement of Pressure, Vacuum deposition system.

UNIT-III
Thin films and Hybrid technology:
Thin film deposition methods like Thermal evaporation, DC and RF Sputtering, Chemical vapor deposition spin coating technique, MBE technique. Properties of thin films, Structure dependence, Electrical properties of thin films, experimental methods for measurements of various thin film parameters using AFM & Ellipsometry.

UNIT-IV
Integrated IC fabrication circuit technology:
Brief introduction to crystal growth, Lithography, Oxidation, Etching, Dielectric film deposition, Diffusion, Metallization, fabrication of IC consisting of Resistor, transistor & Decide.
Reference Books
1. Rao, Ghosh, Chopra; Vacuum science & Technology; Allied Pub.
2. Jacob Millman, Christos C Halkias; Integrated Electronics, Tata Mcgraw-Hill
4. Thin Film Technology by K.L. Chopra.
5. Vacuum Technology by Roth.

SEM PO 3 4
INSTRUMENTATION LABORATORY VISIT

Visit to Sophisticated Instrumentation Laboratories in Industry or research laboratory.
Candidate will be required to give a viva or present a presentation based on his visit to concerned laboratory.

SEM PO 3 5
PROJECT WORK

To be carried out at the University Instrumentation Laboratory/R&D organization.

Each student will be required to work on the major project approved and evaluated by the departmental faculty. The project work will span over 3\textsuperscript{rd} and 4\textsuperscript{th} semesters during which periodic progress reports will be monitored.
SEMESTER-IV

SEM PO 4 1
SEMINARS

1) Topic for seminar is to be decided in consultation with the teacher guide
2) Total 3(Three) seminars are to be delivered by the student during the semester on the approved topic, each of minimum duration of 45 minutes.
3) Minimum gap between two seminars would be 8-10 days.
4) As a part of Internal assessment each student is to attend all the seminars delivered by the students in his/her group.
5) Internal assessment will be carried out on the basis of (Three)
   a) Seminar contents
   b) Presentation skills
   c) Understanding of the topic
   d) Report writing and
   e) Written examination
6) During the external examination student will be assessed on the basis of Seminar contents, Presentation skills, Understanding of the topic and Report writing.

SEM PO 4 2
COMPREHENSIVE VIVA

The evaluation will be based on objective type/short answer type/multiple choice questions along with the comprehensive viva. The comprehensive viva will be conducted in deptt. by a panel of three or four faculty members of the deptt.

SEM PO 4 3
PROJECT WORK AND REPORT
To be carried out at the University Instrumentation Laboratory/R&D organization.

At the end of 4th semester, the student will submit the report based on his project work.

**Objective of the contents/papers of the Syllabus of M.Sc.(Instrumentation)**

**Semester-I**

**SEM PO 1 1**Provides the detailed knowledge about various sensors/ transducers employed in real world as the 1st stage of Instrumentation system.

**SEM PO 1 2**The signal sensed by sensor cannot be used directly for further control/analysis. This paper makes provides familiarization with various analog and digital signal conditioning techniques.

**SEM PO 1 3**Enables the students to conceptualize the instrument design & its representations to laymans.

**SEM PO 1 4**Paper gives familiarization about different measuring equipments used in the laboratories for the design & analysis of the signals picked.

**SEM PO 1 5**Digital Electronics provides the Principles and techniques of modern digital system and components.

**Semester-II**

**SEM PO 2 1**The basic idea behind introduction of this subject is to introduce the applications of digital systems and microprocessors used for measurement system and control.

**SEM PO 2 2**Control system design enables the students to understand the concept of stability and analysis of a control system in both frequency and time domain.
SEM PO 2.3 Strengthen the students with the knowledge of the semi-conductor based power devices used in industries.

SEM PO 2.4 Enables the students to apply the concepts of control and stability of analysis in industrial environment, also helps to introduce the automation fundamentals.

SEM PO 2.5 Provides the knowledge of basic optical fundamentals used in present day optical fiber communication and control.

**Semester-III**

SEM PO 3.1 Introduces the concepts of use of Instrumentation for Biomedical Studies.

SEM PO 3.2 Introduces the concepts of Analytical instrumentation. Also introduces the basic techniques used in analytical instrumentation (such as UV-VIS, NMR, Mass Spectrometry etc.)

SEM PO 3.3 Deals with advanced fabrication Techniques used for advanced instrument design & analysis.

SEM PO 3.4 Visit to Laboratory enables the students to visualize the theoretical concepts implemented in industry/R&D institutes.

SEM PO 3.5 Project work would make the students to put their theoretical knowledge to reality.

**Semester-IV**

SEM PO 4.1 Seminar presentation improves the interaction capability, understanding of topic and presentation skills of the students.

SEM PO 4.2 Would strengthen the students to deal with the industrial problems/queries.

SEM PO 4.3 Project work spans over 3rd and 4th Semester. In this paper they would also be submitting a Project report.