FACULTY OF SCIENCE

SYLLABI

FOR

M.Sc. INSTRUMENTATION

1ST TO 4TH SEMESTER

EXAMINATIONS 2011 - 2012

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<table>
<thead>
<tr>
<th>S.No</th>
<th>SUBJECT</th>
<th>SCHEDULE FOR TEACHING</th>
<th>THEORY MAX. MARKS</th>
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<td>100 (80+20)</td>
<td>50 (40+10)</td>
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<tr>
<td>1.</td>
<td>Sensors, Transducers and Actuators for Instrumentation SEM PO 1 1</td>
<td>3</td>
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<tr>
<td>2.</td>
<td>Signal conditioning, processing and inter-facing techniques SEM PO 1 2</td>
<td>3</td>
<td>-</td>
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<tr>
<td>3.</td>
<td>Instrumentation components, devices and assemblies SEM PO 1 3</td>
<td>3</td>
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<td>4.</td>
<td>Principles of Test and Measuring Instruments SEM PO 1 4</td>
<td>3</td>
<td>-</td>
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<tr>
<td>5.</td>
<td>Digital Electronics SEM PO 1 5</td>
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Total Marks : 750
## SECOND SEMESTER

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<tr>
<th>S.No</th>
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<td>1.</td>
<td>Microprocessor based Instrumentation &amp; System Design</td>
<td>3 - 3 6 6</td>
<td>80  20  100</td>
<td>40  10  50</td>
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<td>SEM PO 2 1</td>
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<td>2.</td>
<td>Control System Design</td>
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<td>3.</td>
<td>Power Electronics</td>
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<td>5.</td>
<td>Optical Instrumentation &amp; Photonics</td>
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<td>80  20  100</td>
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Total Marks: 750
## THIRD SEMESTER

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<td>Biomedical Instrumentation</td>
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<td>Advanced Fabrication Techniques</td>
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<td>Instrumentation Laboratory visit</td>
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### Schedule for Teaching

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<tr>
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<th>Subject</th>
<th>Theory Max. Marks</th>
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<tr>
<td>1.</td>
<td>Seminars <strong>SEM PO 4 1</strong></td>
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<td>2.</td>
<td>Comprehensive Viva <strong>SEM PO 4 2</strong></td>
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<td>3.</td>
<td>Project Work &amp; Project Report <strong>SEM PO 4 3</strong></td>
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Total Marks : 750

**Grand Total : 3000**

**Instructions to the Examiners/Paper-Setters**

1. Examiners are to set eight questions for the paper, equally distributing the whole syllabus for all questions.
2. All questions should carry equal marks.
3. Students would be required to attempt any five questions out of eight questions.
COURSE CONTENTS FOR M.SC. (INSTRUMENTATION)

SEMESTER –I

SEM PO 1 1 : SENSORS, TRANSDUCERS AND ACTUATORS FOR INSTRUMENTATIONS

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

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, annunciator, 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
11. Study of R-2R ladder network DAC and DAC IC 1408
12. Study of single slope ACD
13. And or experiments of similar kind

SEM PO 1 2: SIGNAL CONDITIONING PROCESSING AND INTERFACING TECHNIQUES

Objective: The signal sensed by sensor cannot be used directly for further control/analysis. This paper provides familiarization with various analog and digital signal conditioning techniques.

UNIT-I

(i) Signal conditioning elements:

Bridges: Whetstone’s bridge, Kelvin’s double bridge, DC bridge design considerations, AC bridges, concept of impedances and their representations, Maxwell’s bridge, Anderson’s bridge, Wein 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 INTERFACING TECHNIQUES:

Practicals based on the theory course.

SEM PO 13: INSTRUMENTATION COMPONENTS, DEVICES AND ASSEMBLIES

Objective: Enables the students to conceptualize the instrument design & its representations to laymans.

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 Teach: 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

Objective: Paper gives familiarization about different measuring equipments used in the laboratories for the design & analysis of the signals picked.

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
LABORATORY FOR PRINCIPLES OF TEST AND MEASURING INSTRUMENTS.

Practicals based on the theory course.

SEM PO 1 5: DIGITAL ELECTRONICS:

Objective: Digital Electronics provides the Principles and techniques of modern digital system and components.

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 Subfamilie, 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 substractor 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.
Objectives: The basic idea behind introduction of this subject is to introduce the applications of digital systems and microprocessors used for measurement system and control.

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:

3. Ghosh & Sridhar; 0000 to 8085 Introduction to Microprocessors for Engineers & Scientists; 2nd Edn. PHI, 1997
4. M.A.Mazidi, J.G. Maridi, 3nd Edn; Robin D. Mckinlay; The 8051 Microcontroller & Embedded systems; 2nd Edn; Pearson Prentice Hall; 2008

LABORATORY FOR MICROPROCESSOR BASED INSTRUMENTATION AND SYSTEM DESIGN.

Practicals based on the theory course.

SEM PO 2 2 : CONTROL SYSTEM DESIGN

Objective : Control system design enables the students to understand the concept of stability and analysis of a control system in both frequency and time domain.

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 Filter, 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:

Ed.(2002).
2 Goodwin CG Graebe SF and Salgado ME, “Control system Design”,
Pearson Education, first Indian Print-(2003).


LABORATORY FOR CONTROL SYSTEM DESIGN
Practicals based on the theory course.

SEM PO 23: POWER ELECTRONICS

Objective: Strengthen the students with the knowledge of the semi-conductor based power devices used in industries.

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 Invertors,
**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:

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

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

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 25: OPTICAL INSTRUMENTATION AND PHOTONICS

Objective: Provides the knowledge of basic optical fundamentals used in present day optical fiber communication and control.

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 system etc.

Reference Books:

2. A. Ghatak; Optical electronics; Cambridge University Press; 1999

LABORATORY FOR OPTICAL INSTRUMENTATION AND PHOTONICS.

Practicals based on the theory course.
Objective: Introduces the concepts of use of Instrumentation for Biomedical Studies.

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 Instrumention; 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
**Objective:** Introduces the concepts of Analytical instrumentation. Also introduces the basic techniques used in analytical instrumentation (such as UV-VIS, NMR, Mass Spectrometry etc.)

**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**
**Electrometric methods of Analysis:** Basics of Electrometric methods of analysis. Basic Techniques and related instrumentations of potentiometry. Voltammetry, coulometry and conductometry.

**Reference books:**
2. Willard, Merritt, Dean, Settle: Instrumental methods of Analysis, CBS, Publisher, 7th Edn., 1986

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**SEM PO 3 3: ADVANCED FABRICATION TECHNIQUES**

**Objective:** Deals with advanced fabrication Techniques used for advanced instrument design & analysis.
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:


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

Objective: Visit to Laboratory enables the students to visualize the theoretical concepts implemented in industry/R&D institutes.

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
Objective: Project work would make the students to put their theoretical knowledge to reality

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

**Objective**: Seminar presentation improves the interaction capability, understanding of topic and presentation skills of the students

**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

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

Objective: Would strengthen the students to deal with the industrial problems/queries.

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
Objective: Project work spans over 3rd and 4th Semester. In this paper they would also be submitting a Project 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.