FACULTY OF SCIENCE

SYLLABI

FOR

M.Sc. Instrumentation
(SEMESTER SYSTEM)


---:O:---
COURSE CONTENTS FOR M.SC. (INSTRUMENTATION ) 2020-2021

SEMESTER –I

SEM PO 1 1
SENSORS, TRANSUCERS AND ACTUATORS FOR INSTRUMENTATIONS

Time: 3 Hours
Max. Marks: 75(Exam) +25(Internal)
Hours: 45

Note: The theory question paper need to contain total of 9 questions. One compulsory question from whole syllabus. The remaining 8 questions will be 2 questions per unit. Student will have to attempt 5 questions i.e. one compulsory question and 4 questions out of remaining 8 questions (students are expected to attempt one question from each of the sections).

Unit-I (11 hours)

Transducer Classification, Performance & Characteristics:

Unit-II (12 hours)

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, Anemometer and ultrasonic

UNIT-III (11 Hours)

Temperature: RTD, Thermocouple, Thermisters, Semiconductor Sensors, Pyrometry.
Chemical Sensors: Measurement of Conductivity, pH and Humidity.
Optical sensors: PMT, Photodiodes, CCD, LDR,

UNIT-IV (11 hours)

Advanced sensors: Overview of optical fiber sensors for temperature, image, displacement, pressure, flow and liquid level sensors, biosensors and smart sensors.

Books Suggested:

Essential Books:

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

Time: 3 Hours
M.M.: 75(Exam) + 25(Internal)
Hours: 45

Note: The theory question paper need to contain total of 9 questions. One compulsory question from whole syllabus. The remaining 8 questions will be 2 questions per unit. Student will have to attempt 5 questions i.e. one compulsory question and 4 questions out of remaining 8 questions (students are expected to attempt one question from each of the sections).

UNIT-I (11 hours)

(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 feedback and negative feedback.

UNIT-II (11 hours)

**OP-Amp Circuits**: Basic amplifier configurations and applications: inverting and non-inverting amplifier, summing amplifier, subtractor etc.

**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 (12 hours)

**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 (11 hours)

(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.

Books Suggested:

Essential Books:

Reference Books:

LABORATORY FOR SIGNAL CONDITIONING, PROCESSING AND INTERFACING TECHNIQUES:

List of Experiments:
2. Calculating unknown inductance using Maxwell’s bridge.
3. Verifying capacitance value using Schering bridge.
5. Design and testing of Non - inverting amplifier circuit using Op-Amp.
10. Implement a Digital to Analog circuit.
11. Design a PCB for a given circuit.

SEM PO 1 3
INSTRUMENTATION COMPONENTS, DEVICES AND ASSEMBLIES

Time: 3 Hours
M.M.:75(Exam) +25(Internal)
Hours: 45

Note: The theory question paper need to contain total of 9 questions. One compulsory question from whole syllabus. The remaining 8 questions will be 2 questions per unit. Student will have to attempt 5 questions i.e. one compulsory question and 4 questions out of remaining 8 questions (students are expected to attempt one question from each of the sections).

UNIT-I (12 hours)
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 (11 hours)
Digital Electronics:

UNIT-III (11 hours)
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 (11 hours)

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.

Books Suggested:

Essential Books:

Reference Books:

LABORATORY FOR INSTRUMENTATION COMPONENTS, DEVICES AND ASSEMBLIES
1. Identification of different electronic and electrical components and knowing their specifications from data sheets.
2. Design of regulated power supply using standard regulator.
3. Design a variable power supply using regulator.
4. Design a multiplexer for a given equation and show its implementation using gates.
5. Design a demultiplexer for a given equation and show its implementation using gates.

Introduction to various types of the mechanical elements and their uses
6. Screws & Bolts and Washers
7. Belt Drives
8. Joints
SEM PO 1 4
PRINCIPLES OF TEST AND MEASURING INSTRUMENTS

Time: 3 Hours
M.M.: 75(Exam) + 25(Internal)
Hours: 45

Note: The theory question paper need to contain total of 9 questions. One compulsory question from whole syllabus. The remaining 8 questions will be 2 questions per unit. Student will have to attempt 5 questions i.e. one compulsory question and 4 questions out of remaining 8 questions (students are expected to attempt one question from each of the sections).

UNIT-I (11 hours)

Multimeters:

*Electromechanical Instruments*: Classification, Permanent Magnate Moving Coil instruments, Galvanometer, DC ammeter and volt meter, ohm meter, Instrument calibration.

*Digital Instruments*: Advantages of digital instruments, Digital voltmeter, digital millimeters and digital frequency meter.

UNIT-II (12 hours)

Oscilloscopes:
Cathode ray tube, Basic CRO circuits vertical and horizontal deflection system, synchronization amplifier, Direct probe, attenuator and active probes, frequency, phase angle and time delay measurements, dual beam and dual trace oscilloscope, Sampling and storage oscilloscopes, Lissajous figures.

UNIT-III (11 hours)

Display devices and recorders:
Display devices: Decade counter assembly, Light emitting diode display, liquid crystal display, nixie tube, dot matrix display, segmental gas discharge display.

Recorders: X-Y recorder, Magnetic tape recorder, plotters
Signal conditioning and acquisition: DC signal conditioning, AC signal conditioning, characterization and data acquisition system.

UNIT-IV (11 hours)

Instrument Performance Characteristics:

Static and dynamic characteristics, error in measurements,

*Errors in Measurements*: Gross errors, systematic errors, absolute, relative and random errors.
Combination of errors: sum, difference, product, quotient and raised to a power quantities.

Statistical analysis: Arithmetic mean, deviation, standard deviation, variance.

Probability of errors: Error distribution, probable error, limiting error
Books Suggested:

Essential Books:

Reference Books:
1. David A. Bell, Electronic Instrumentation and Measurements, Oxford University Press India; 3rd edition 2013

LABORATORY FOR PRINCIPLES OF TEST AND MEASURING INSTRUMENTS.

Suggested experiments:

Experiments around sensitivity of wheat stone bridge, Comparison of various types of indicating instruments, Single phase induction type energy meter, AC bridges, Storage type digital oscilloscopes, Measure various parameters viz. voltage, current, resistance using Digital Multimeter. I-V Characteristics of Diode Convert given galvanometer to DC/AC Volt-Meter Measure quality Factor of given Inductor and Capacitor using LCR QMeter. Measure Unknown frequency using Lissajous patterns.
SEM PO 1 5
DIGITAL ELECTRONICS:

Time: 3 Hours
M.M.: 75(Exam) + 25(Internal)
Hours: 45

Note: The theory question paper need to contain total of 9 questions. One compulsory question from whole syllabus. The remaining 8 questions will be 2 questions per unit. Student will have to attempt 5 questions i.e. one compulsory question and 4 questions out of remaining 8 questions (students are expected to attempt one question from each of the sections).

UNIT-I (11 hours)
(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 (12 hours)
(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 (11 hours)
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 (11 hours)
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.

Books Suggested:
Essential Books:
Reference Books:

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.
SEMPO 21
MICROPROCESSOR BASED INSTRUMENTATION AND SYSTEM DESIGN

Time: 3 Hours
M.M.: 75(Exam) + 25(Internal)
Hours: 45

Note: The theory question paper need to contain total of 9 questions. One compulsory question from whole syllabus. The remaining 8 questions will be 2 questions per unit. Student will have to attempt 5 questions i.e. one compulsory question and 4 questions out of remaining 8 questions (students are expected to attempt one question from each of the sections).

UNIT-I (11 hours)

Embedded Instrumentation:
Need and advantages of Microprocessors & Microcontrollers in Instrumentation: Basic concepts of embedded instrumentation, features, specifications and differences; different blocks of embedded instruments, ideal microprocessor/ microcontroller based Instrument, basics of processor/ controller, hardware resources, architectural details of microcontroller 8051.

UNIT-II (12 hours)

Microprocessor/ Microcontrollers 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, memory decoders, external memory interfacing for microcontroller 8051, internal memory map for 8051,
Input output devices: I/O mapping, memory mapped I/Os, advantages and disadvantages, programmable I/O devices, Programmable peripheral interface 8255.

UNIT-III (11 hours)

Programming techniques:
Addressing modes and study of instruction set, Stack pointer, stack memory and stack operation; introduction to assembly language programming, extensive programming exercises with 8051.

UNIT-IV (11 hours)

Modular development of embedded system:
Interfacing of ADC and DAC, I/O, Timers and counters in 8051, various modes of operation, Interrupts in 8051, priority of interrupts, vectored interrupts Implementation and applications of serial interface RS 232 using 8051 UART.

Books Suggested:

Essential Books:
3. M.A.Mazidi, J.G. Maridi, 3rd Edn; Robin D. Mckinlay; The 8051 Microcontroller & Embedded systems; 2nd Edn; Pearson Prentice Hall; 2013

Reference Books:
1. Ghosh & Sridhar; 0000 to 8085 Introduction to Mircoprocessors for Engineers & Scientists; 2nd Edn. PHI, 1997
LABORATORY FOR MICROPROCESSOR BASED INSTRUMENTATION AND SYSTEM DESIGN.
Practicals based on the theory course.

SEM PO 2 2
CONTROL SYSTEM DESIGN

Time: 3 Hours
M.M.:75(Exam) +25(Internal)
Hours: 45

Note: The theory question paper need to contain total of 9 questions. One compulsory question from whole syllabus. The remaining 8 questions will be 2 questions per unit. Student will have to attempt 5 questions i.e. one compulsory question and 4 questions out of remaining 8 questions (students are expected to attempt one question from each of the sections).

UNIT-I (11 hours)
(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 (11 hours)
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 (12 hours)
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 (11 hours)
Digital Control:
Preview, computer, A/D and D/A conversation, 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.

Books Suggested:
Essential Books:

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

SEM PO 2 3
POWER ELECTRONICS

Time: 3 Hours
M.M.:75(Exam) + 25(Internal)
Hours: 45

Note: The theory question paper need to contain total of 9 questions. One compulsory question from whole syllabus. The remaining 8 questions will be 2 questions per unit. Student will have to attempt 5 questions i.e. one compulsory question and 4 questions out of remaining 8 questions (students are expected to attempt one question from each of the sections).

UNIT-I (11 hours)

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

UNIT-II (11 hours)

Power Circuits:
Thyristor turn on and turn off methods, Controllers, Rectification: Effect of Resistive/Resistive-Inductive/ Inductive load on performance.
Inverters: Transistors and Thyristorised inverters; Applications of Invertors,
Choppers: Four-Quadrant operation of Choppers, Applications of Choppers,
Cyclo converters: Principle of operation and applications

UNIT-III (11 hours)

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 (12 hours)

(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.

Books Suggested:

Essential Books:
3. Mohan, Ned; Power Electronics; Converters, applications & Design, 3rd Edn, John Wiley; 2013

LABORATORY FOR POWER ELECTRONICS:
Practicals based on the theory course

SEM PO 2 4
PROCESS CONTROL AND AUTOMATION:

Time: 3 Hours
M.M.:75(Exam) +25(Internal)
Hours: 45

Note: The theory question paper need to contain total of 9 questions. One compulsory question from whole syllabus. The remaining 8 questions will be 2 questions per unit. Student will have to attempt 5 questions i.e. one compulsory question and 4 questions out of remaining 8 questions (students are expected to attempt one question from each of the sections).

UNIT-I (11 hours)
**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 (11 hours)
**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 (11 hours)
**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 (12 hours)
**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

Books Suggested:

**Essential Books:**
2. K. Ogata: Modern Control engineering, PEA, 4th Edn., 2002

**Reference Books:**
LABORATORY FOR PROCESS CONTROL AND AUTOMATION:

Design of electronic controllers and study their characteristics with standard input signal
1. Proportional Controller
2. Integral controller
3. Derivative controller
4. Proportional – Integral Controller
5. Proportional Integral Derivative Controller
6. Study and analysis of Routh-Hurwitz criteria for a given system equation.
7. Performing Nyquist criteria and stability calculations for given characteristic equation.
8. Introduction to ladder programming elements.

Implementation of GATE using ladder programming
9. AND Gate
10. OR Gate
11. NAND Gate
12. NOR Gate
SEM PO 2 5
OPTICAL INSTRUMENTATION AND PHOTONICS

Time: 3 Hours
M.M.:75(Exam) +25(Internal)
Hours: 45

Note: The theory question paper need to contain total of 9 questions. One compulsory question from whole syllabus. The remaining 8 questions will be 2 questions per unit. Student will have to attempt 5 questions i.e. one compulsory question and 4 questions out of remaining 8 questions (students are expected to attempt one question from each of the sections).

UNIT-I (12 hours)
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 (11 hours)
Optical Photoelectric System:
Types of optical detectors, characteristics, effect of spectral characteristics, Optical materials for UV, visible and IR regions;

UNIT-III (11 hours)
(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 (11 hours)
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.

Essential Books:
2. Chai Yeh, Applied Photonics, Elsevier, 2012

Reference Books:
2. A. Ghatak; Optical electronics; Cambridge University Press; 2017,
3. Laurent Vivien, Lorenzo Pavesi, Handbook of Silicon Photonics, Taylor & Francis, 2016
Suggested experiments:

Young’s double-slit interference experiment
To measure the light intensity of plane polarized light as a function of the analyzer position.
Calculate the numerical aperture of optical fiber cable.
To study the losses that occur in optical fiber cable.
To measure width of single slit using diffraction.
To measure diameter of thin wire using diffraction.
To measure wavelength of given laser using diffraction grating.
To study attenuation loss in an optical fiber.
To measure bending loss in multimode fiber.
Refractive index profiling by prism coupling method.
SEMESTER-III

SEM PO 3 1

BIOMEDICAL INSTRUMENTATION

Time: 3 Hours
M.M.:75(Exam) +25(Internal)
Hours: 45

Note: The theory question paper need to contain total of 9 questions. One compulsory question from whole syllabus. The remaining 8 questions will be 2 questions per unit. Student will have to attempt 5 questions i.e. one compulsory question and 4 questions out of remaining 8 questions (students are expected to attempt one question from each of the sections).

UNIT-I (11 hours)

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 (11 hours)

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 – Electrocardiogram, Electroencephalogram, and Electromyogram.

UNIT-III (11 hours)

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 : Pacemakers - external and internal pacemakers, Defibrillators - D.C. defibrillators, defibrillator electrodes.

UNIT-IV (12 hours)

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.

Books Suggested:

Essential Books:
3. R.S.Khandpur; Handbook of Biomedical Instrumentation; TMH, 3rd Edn, 2017;

Reference Books:
2. Joseph J. Carr, John M. Brown; Introduction to Biomedical Equipment Technology; Pearson Education Asia. 4th Edn; 2015;
LABORATORY FOR BIOMEDICAL INSTRUMENTATION

Introduction to universal bio amplifier.
Knowing different types of electrodes used for bio medical or bio electric measurements.
Performing electrocardiography measurement using universal bio amplifier.
Performing electroencephalography measurement using universal bio amplifier.
Performing electromyography measurement using universal bio amplifier.
Introduction to various imaging modalities like X-Ray, Ultrasound.

SEM PO 3 2

INSTRUMENTAL METHODS OF ANALYSIS

Time: 3 Hours
M.M.:75(Exam) +25(Internal)
Hours: 45

Note: The theory question paper need to contain total of 9 questions. One compulsory question from whole syllabus. The remaining 8 questions will be 2 questions per unit. Student will have to attempt 5 questions i.e. one compulsory question and 4 questions out of remaining 8 questions (students are expected to attempt one question from each of the sections).

UNIT-I (12)

Introduction to Spectroscopical Methods of Analysis:

Spectroscopic Methodologies: (A) Instrumentation for UV-Visible and IR Spectroscopies - Various light sources, Spectrometers, Detectors and Data Processing. Application of UV-Visible and IR spectroscopy.

UNIT-II (11)

Spectroscopic Methodologies: (B) Instrumentation (Sources, Detectors and Data Processing units) of Mass Spectrometry and Chromatography. Overview of XRD methods, XRF methods.

UNIT-III (11)

Introduction to instrumentation and working of NMR, SEM, TEM techniques and their applications.

UNIT-IV (11)


Essential 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

Time: 3 Hours
M.M.:75(Exam) +25(Internal)
Hours: 45

Note: The theory question paper need to contain total of 9 questions. One compulsory question from whole syllabus. The remaining 8 questions will be 2 questions per unit. Student will have to attempt 5 questions i.e. one compulsory question and 4 questions out of remaining 8 questions (students are expected to attempt one question from each of the sections).

UNIT-I (11)

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 (11)

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 (12)

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 (11)

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.

Books Suggested:

Essential Books:
2. Thin Film Technology by K.L. Chopra, 1983

Reference Books:
1. Rao, Ghosh, Chopra; Vacuum science & Technology; Allied Pub., 2008

Suggested experiments:
Experiments around Deposition of thin films by thermal evaporator, spin coating, DC sputtering, RF sputtering and optical characterization by spectrophotometer SEM, TEM and XRD.

SEM PO 3 4 (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 (12)

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 3rd and 4th semesters during which periodic progress reports will be monitored.
**SEMESTER-IV**

**SEM PO 4 1 (10)**

**SEMINARS**

a. Topic for seminar is to be decided in consultation with the teacher guide  
b. 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.  
c. Minimum gap between two seminars would be 8-10 days.  
d. As a part of Internal assessment each student is to attend all the seminars delivered by the students in his/her group.  
e. Internal assessment will be carried out on the basis of (Three)
   
   i. Seminar contents  
   ii. Presentation skills  
   iii. Understanding of the topic  
   iv. Report writing  
   v. 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 (24)**

**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 fundaments 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.
### SCHEME OF TEACHING M.SC. (INSTRUMENTATION)

#### FIRST SEMESTER

<table>
<thead>
<tr>
<th>S.No</th>
<th>SUBJECT</th>
<th>COURSE TITLE</th>
<th>SCHEDULE FOR Teaching</th>
<th>THEORY</th>
<th>PRACTICAL</th>
<th>Credit (T+P)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>L T P</td>
<td>TOTAL</td>
<td>Exams Marks</td>
<td>Sessional</td>
</tr>
<tr>
<td>1.</td>
<td>SEM PO 11</td>
<td>Sensors, Transducers and Actuators for Instrumentation</td>
<td>3 - 3</td>
<td>6</td>
<td>60</td>
<td>15</td>
</tr>
<tr>
<td>2.</td>
<td>SEM PO 12</td>
<td>Signal Conditioning, Processing And Inter-Facing Techniques</td>
<td>3 - 3</td>
<td>6</td>
<td>60</td>
<td>15</td>
</tr>
<tr>
<td>3.</td>
<td>SEM PO 13</td>
<td>Instrumentation Components, Devices And Assemblies</td>
<td>3 - 3</td>
<td>6</td>
<td>60</td>
<td>15</td>
</tr>
<tr>
<td>4.</td>
<td>SEM PO 14</td>
<td>Principles of Test and Measuring Instruments</td>
<td>3 - 3</td>
<td>6</td>
<td>60</td>
<td>15</td>
</tr>
<tr>
<td>5.</td>
<td>SEM PO 15</td>
<td>Digital Electronics</td>
<td>3 - 3</td>
<td>6</td>
<td>60</td>
<td>15</td>
</tr>
</tbody>
</table>

Total Marks: 500

---

**Total Marks: 500**

20
### SECOND SEMESTER

<table>
<thead>
<tr>
<th>S.No</th>
<th>SUBJECT</th>
<th>COURSE TITLE</th>
<th>SCHEDULE FOR Teaching</th>
<th>THEORY</th>
<th>PRACTICAL</th>
<th>Credit (T+P)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>L T P     TOTAL</td>
<td>Exams Marks</td>
<td>Sessional</td>
<td>Total</td>
</tr>
<tr>
<td>1.</td>
<td>SEM PO 21</td>
<td>Microprocessor based Instrumentation &amp; System Design</td>
<td>3–3 6       60</td>
<td>15</td>
<td>75</td>
<td>20</td>
</tr>
<tr>
<td>2.</td>
<td>SEM PO 22</td>
<td>Control System Design</td>
<td>3–3 6       60</td>
<td>15</td>
<td>75</td>
<td>20</td>
</tr>
<tr>
<td>3.</td>
<td>SEM PO 23</td>
<td>Power Electronics</td>
<td>3–3 6       60</td>
<td>15</td>
<td>75</td>
<td>20</td>
</tr>
<tr>
<td>4.</td>
<td>SEM PO 24</td>
<td>Process Control and Automation</td>
<td>3–3 6       60</td>
<td>15</td>
<td>75</td>
<td>20</td>
</tr>
<tr>
<td>5.</td>
<td>SEM PO 25</td>
<td>Optical Instrumentation &amp; Photonics</td>
<td>3–3 6       60</td>
<td>15</td>
<td>75</td>
<td>20</td>
</tr>
</tbody>
</table>

**Total Marks: 500**

20
### THIRD SEMESTER

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>SUBJECT No.</th>
<th>COURSE TITLE</th>
<th>SCHEDULE FOR Teaching</th>
<th>THEORY</th>
<th>PRACTICAL</th>
<th>Credit (T+P)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>L T P</td>
<td>TOTAL</td>
<td>Exams Marks</td>
<td>Sessional</td>
</tr>
<tr>
<td>1.</td>
<td>SEM PO 31</td>
<td>Biomedical Instrumentation</td>
<td>3 – 3</td>
<td>6</td>
<td>60</td>
<td>15</td>
</tr>
<tr>
<td>2.</td>
<td>SEM PO 32</td>
<td>Instrumental methods of Analysis</td>
<td>3 – 3</td>
<td>6</td>
<td>60</td>
<td>15</td>
</tr>
<tr>
<td>3.</td>
<td>SEM PO 33</td>
<td>Advanced Fabrication Technique</td>
<td>3 – 3</td>
<td>6</td>
<td>60</td>
<td>15</td>
</tr>
<tr>
<td>4.</td>
<td>SEM PO 34</td>
<td>Instrumentation Laboratory visit</td>
<td>- - 4</td>
<td>4</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>5.</td>
<td>SEM PO 35</td>
<td>Project Work</td>
<td>- - 12</td>
<td>12</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

**Total Marks: 500**
# FOURTH SEMESTER

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>SUBJECT</th>
<th>COURSE TITLE</th>
<th>SCHEDULE FOR Teaching</th>
<th>THEORY</th>
<th>PRACTICAL</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>L T P</td>
<td>TOTAL</td>
<td>Exams Marks</td>
<td>Sessional</td>
</tr>
<tr>
<td>1.</td>
<td>SEM PO 41</td>
<td>Seminars</td>
<td>- - 10</td>
<td>10</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2.</td>
<td>SEM PO 42</td>
<td>Comprehensive Viva</td>
<td>- - -</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>3.</td>
<td>SEM PO 43</td>
<td>Project Work &amp; Project Report</td>
<td>- - 24</td>
<td>24</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

**Total Marks: 500**

Grand Total Marks (Sem.I to IV): 2000
Grand Total Credits (Sem.I to IV): 80
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.