Department of Instrumentation Science
Jadavpur University, Kolkata-700 032

Revise Syllabus (CBCS) Structure for **M.Sc.(Instrumentation)**

Code	Paper	Classes	FM	Credit
1st year **Total marks : Theory 800 Lab 600 ; Total Credit 25+26=51**				
1st year 1st Semester				
FS/IS/MSc/T101	Advance Mathematics And Computer Programming	**4**	100 (80+20)	4
FS/IS/MSc/T 102	Analog, Digital And Power Electronics	**4**	100 (80+20)	4
FS/IS/MSc/T 103	Sensors, Transducers And Measurements:	**4**	100 (80+20)	4
FS/IS/MSc/T 104A	Linear Control System	**2**	50 (40+10)	2
FS/IS/MSc/T 104B	Bio Medical Science I	**2**	50 (40+10)	2
Total			**400**	**16**
1st year 2nd Semester				
FS/IS/MSc/T 201	Communication Systems	**4**	100(80+20)	4
FS/IS/MSc/T 202	Industrial Instrumentation And Das,	**4**	100(80+20)	4
FS/IS/MSc/T 203	Embedded System	**4**	100(80+20)	4
FS/IS/MSc/T 204A	Material Science I	**2**	50(40+10)	2
FS/IS/MSc/T 204B	Biomedical Science – II	**2**	50(40+10)	2
Total			**400**	**16**
2nd year **Total marks : Theory 600 Lab 500 ; Total Credit 16+8+10+15=49**				
2nd year 1st semester				
FS/IS/MSc/T 301	Process Control & DCS	**4**	100(80+20)	4
FS/IS/MSc/T 302	Analytical Instrumentation	**4**	100(80+20)	4
FS/IS/MSc/T 303	Opto-Electronics and Laser	**4**	100(80+20)	4
FS/IS/MSc/T 304A	Material Science II	**2**	50(40+10)	2
FS/IS/MSc/T 304B	Principles Of Digital Signal Processing	**2**	50(40+10)	2
Total			**400**	**16**
2nd year 2nd Semester				
FS/IS/MSc/T 401	Elective 1 **A.** Advanced Bio-Medical Instruments **B.** Power Plant Instrumentation & Control **C.** Microscopic Techniques	4	100(80+20)	4
FS/IS/MSc/T 402	Elective II A. Plasma Based Instrumentation B. Device Fabrication Technology C. Artificial Neural Network	4	100(80+20)	4
Total			**200**	**8**

1st year 1st Semesters laboratory/Sessional				
Code	**Paper**	**Classes**	**FM**	**Credit**
FS/IS/MSc/L 101	Object Oriented Programming	6	100(80+20)	3
FS/IS/MSc/L 102	Mechanical and Electrical Workshop	3	100(80+20)	3
FS/IS/MSc/L 103	Electronics & Electrical Measurements lab	6	100(80+20)	3
Total			300	9
1st year 2nd Semesters Laboratory/Sessional				
Code	**Paper**	**Classes**	**FM**	**Credit**
FS/IS/MSc/L 201	Sensor & Transducer Lab.	3	50(40+10)	2
FS/IS/MSc/L 202	Material Technology Lab	3	50(40+10)	2
FS/IS/MSc/L 203	Embedded System Lab.	6	100(80+20)	3
FS/IS/MSc/ L 204	Bio-Medical Lab.	6	100(80+20)	3
Total			300	10

2nd year 1st Semesters Laboratory/Sessional				
Code	**Paper**	**Classes**	**FM**	**Credit**
FS/IS/MSc/L 301	Process control and Control System Lab.	6	100(80+20)	3
FS/IS/MSc/L 302	Analytical Instrumentation Lab	6	100(80+20)	3
FS/IS/MSc/L 303	Material Technology Lab	3	50(40+10)	2
FS/IS/MSc/S 303	Industrial Training, Lab. Visit & Seminar	3	50(40+10)	2
Total			300	10
2nd year 2nd Semesters Laboratory/Sessional				
Code	**Paper**	**Classes**	**FM**	**Credit**
FS/IS/MSc/S 401	Project and dissertation	22	150	12
FS/IS/MSc/S 402	Grand Viva		50	3
Total			200	15

Details of Course Curriculum

1st Year 1st Semester

Paper Name: ADVANCE MATHEMATICS & COMPUTER PROGRAMMING
Paper code: FS/IS/MSc/T 101
Contact Hr: 60 Tutorial :10 Hrs

Functions of a complex variable, Limit, continuity and differentiability,
Partial Differential equations: Definition, Classification of second order linear Partial Differential equations in two independent variables. Solution of one dimensional wave equation, one dimensional heat conduction equation and two-dimensional Laplace's equation by the separation of variables method.
Laplace Transform: Definition and properties, inverse Laplace Transform, Convolution theorem, Application to ordinary differential equations.
Fourier Transform: Fourier integral theorem (statement only), Definition of Fourier Transform and properties, inverse Fourier Transform, Convolution theorem, Applications to PDEs, Finite Fourier sine and cosine transform.
Z-Transform: Definition and properties, Convolution, Application to differential equations.
Fourier series: Periodic functions, even and odd function, Dirichlet's conditions, Euler's formulae, half range sine and cosine series.
Statistical methods: Collection and graphical representation of data, Measures of central tendency and dispersions, Sampling theory, Basic concepts of Testing of Hypothesis.
Numerical Methods Approximation and Error in numerical computing: Truncation error, Round off error, Error propagation, Error estimation.
Solution of nonlinear transcendental and algebric equations: Bisection menthod, Regula-Falsi method, Newton-Raphson method.
Interpolation: Lagrange interpolation, Newton's forward and backward interpolations, Curve fitting.
Numerical Integration: Trapezoidal rule, Simpson's 1/3 rule, Gaussian quadrature method.
Solutions of Ordinary Differential equations: Euler's method, Runge-Kutta method, Milne-Simpson method.
Solutions of linear system of equations: Gauss elimination method, Gauss-Joardon method, Jacobi iteration method, Gauss-Sridel method
Programming in C/c++/java:
Number system: Decimal, Binary, Octal, Hexadecimal, Number representation. C character set, constants, variables, key words, C instructions, type declaration Arithmetic operations. Control instructions, Decision control structures: The if statement, if- else statement, nested if- else structure, Loop control structure: The while loop, the for loop, do-while loop, Relational and Logical operators. The case control structure: Switch, Functions and Pointers, Arrays, File input/output.

REFERENCE:

1. Complex Analysis- Schaum outline series.
2. Laplace Transforms- Schaum outline series.
3. Integral Transdorms- Andrews and Shivamoggi, Prentice Hall of India.
4. Mathematical Statistics- Kapoor and Saxana.

Paper Name: ANALOG, DIGITAL & POWER ELECTRONICS
Paper code: FS/IS/MSc/T102
Contact Hr: 60 Tutorial :10 Hrs

Review of Semiconductor Physics: P-N Junction, Diode specification, Zener diodes, Semiconductor photo-diode, Light emitting diode, Transistors
Review of Transistor Characteristics, Amplifiers, Large Signal Amplifiers- Class A, Class B, and Class AB
Operational Amplifier: Architecture, inverting and non-inverting amplifier, voltage follower, integrator, differentiator, summing amplifier, differential amplifier, phase shifter, voltage to current converter, active filters- low pass, high pass, band pass, band rejection, and all pass filters (Butterworth). Comparator, Schmitt trigger, astable multivibrator, monostable multivibrator, triangular wave generator, ramp generator, V/f and f/V converters.
Other Linear IC's: 555 Timer, architecture, applications, (Astable multivibrator, Monostable multivibrator, Schmitt trigger, ramp generator), phase locked loop, voltage controlled oscillators.

Field Effect Transistors: FETs, MOSFET, VMOS, CMOS
Number Systems & logic gates.
Arithmetic Circuits: EXOR and EXNOR gates; half adder; full adder; parallel binary adder, half subtractor, full subtractor
Data Processing Circuits: Multiplexers; demulitiplexers; decoders; BCD to decimal decoder; seven segment decoder; encoders; parity generators; parity checkers.
Flip-Flops: NAND gate latch; NOR gate latch; SR, and JK clocked flip-flops; edge triggered flip-flops.
Sequential Logic Circuits: Registers and counters, shift registers (left, right), ring counter, ripple counter, asynchronous down counters, synchronous counter, pre-settable counters. D/A and A/D Converters**.**
Power semiconductor devices: IGBT, Thyristors – switching character and Specs – Thyristor On-Off methods, controlled rectification, converters, inverters, choppers. Power supplies – UPS, SMPS, HV power supply, Pulsed power supply, Designing concepts, servo controlled specifications, protections, applications. AC power transmission & distribution- single phase, three phase systems- Transmission line constants, single phase, three phase Transformers, power factor calculation, load distribution.
REFERENCES:

1. Sedra A.S., & K.C. Smith- Micro Electronic Circuits, OUP, 1999.
2. Millman and Halkias- Integrated Electronics: Analog and Digital Circuits and Systems, TMH, 1992.
3. Boylestad and Nashelsky- Electronic Devices and Circuit Theory (Ed. 5), PHI, 1993.
4. Ramakant Gayakwad- Op Amps and Linear Integrated Circuits (Ed.2).
5. Ronald J. Tocci- Digital Systems- Principles & Applications.
6. Digital Design by M. Morris Mano (PHI).
7. M.H. Rashid, Power Electronics, PHI, India
8. P.C. Sen, Power Electronics, TMH, India.
9. N.K. De. & P.C.Sen, Electrodrives, PHI, India.
10. SCR Manuals
11. Modern Power Electronics by B.K. Doje, Jaico Publication

Paper Name: SENSOR, TRANSDUCER & MEASUREMENTS
Paper code: FS/IS/MSc/T 103
Contact Hr: 60 Tutorial :10 Hrs

Transducer Fundamentals: Transducer terminology, Transducer classification, performance Characteristics, criteria for transducer selection.
Principles of operation, specification and construction of following Transducers.
Temperature: RTD, Thermocouple, Thermisters, Pyrometer, Semiconductor Temperature Sensors.
Pressure: Bourdon Tube, Differential pressure measurement, strain gauges, Inductive, Capacitative, Vacuum pressure- Pirani and penning gauges.
Flow: Differential pressure type, variable area type, Rotameters, Electromagnetic, Mass flow, Turbine, Anemometer, ultrasonic etc.
Level: Mechanical, Capacitative, Ultrasonic, Radioactive systems etc.
Displacement: Potentiometric, Capacitative, LVDT, Optical encoders – Linear and Rotary, Tachometers etc.
Measurement of pH and Humidity.
Piezoelectric Transducers, PMT, Photodiodes, CCD, LDR
Transducer Performance: Electrical, Hydraulic, Pneumatic actuators, valves, relays, solenoids, annuciator, motorized valves, fluride gates.
Advances in sensors: Use of fibre in temperature, image, displacement, pressure, flow, liquid level sensors.

Electrical Measurement: Galvanometers and Allied instruments, Measurement of Resistance: AC and DC bridges, Instrument Transformers: CT and PT construction and operation for metering and protection applications
Measurement of Power and Energy: Electrodynamometer Wattmeter, Three-phase Power measurement, Single phase and three phase energy meters, errors and their compensation.
Oscilloscopes: Oscilloscope function, Working Principle, Measurements using CRO's Digital storage oscilloscope. Measurements using CRO.
Display Devices: Digital display units, segmental displays, Dot matrix display, LED, LCD and other display systems. Recorders: Principles of basic recording systems
Electronic Instruments:
Analog Voltmeters: DC & AC Voltmeter, True R.M.S. responding AC voltmeter, peak-reading voltmeter, Considerations in choosing an analog voltmeter, operational principles of digital frequency meter.
Digital Voltmeters: General Characteristics, DVMS based on single slope and dual slope integrating A/D converters, Potentiometric type digital voltmeter.

Digital Frequency Meter: Principle of operation, Basic circuit, Time base, Circuit for digital frequency meter, Time period measurement, Time interval measurement

REFERENCES:

1. Sedra A.S., & K.C. Smith- Micro Electronic Circuits, OUP, 1999.
2. Millman and Halkias- Integrated Electronics: Analog and Digital Circuits and Systems, TMH, 1992.
3. Boylestad and Nashelsky- Electronic Devices and Circuit Theory (Ed. 5), PHI, 1993.
4. Ramakant Gayakwad- Op Amps and Linear Integrated Circuits (Ed.2).
5. Ronald J. Tocci- Digital Systems- Principles & Applications.
6. Digital Design by M. Morris Mano (PHI).
7. Oliver and Cage- Electronic Measurements and Instrumentation- MGH, 1975.
8. Cooper W.D. & Helfrick A.D.- Electronic Instrumentation and Measurement Techniques (Ed.3)- MGH, 1975.
9. A.K. Sawhney- A Course in Electrical and Electronic Measurements and Instrumentation (Ed. 10) – Dhanpath Rai, 1994.
10. David A. Bell- Electronic Instrumentation & Measurements- Reston Publication, Varginia, 1983.
11. B.S. Sonde- Transducers and Display Systems- TMH, 1977

Paper Name: LINEAR CONTROL SYSTEM
Paper Code: FS/IS/MSc/T04A
Contact Hr: 30 Tutorial : 5 Hrs

Principles of Feedback control; Transfer function, Bode plots, Signal flow graphs; Control systems: Synchros, Servomotors, Accelerometers, Gyroscopes, etc.;
Control amplifiers - Electronic, Rotating and Magnetic; Analysis of Control systems - Time and Frequency domain; Stability of Control Systems: Routh-Hurwitz, Bode and Nyquist methods, Root Locus techniques; State variable analysis; Controllability and Observability. Compensation**.**

REFERENCES

1. Control System by Nagrath Gopal
2. Norman S. Nise, Control Systems Engineering, John Wiley & Sons, 2008
3. Automatic control systems. Book by Benjamin Kuo, Wiley; Ninth edition (2014)

Paper Name: BIO MEDICAL SCIENCE I
Paper code : MI104B
Contact Hr: 30 Tutorial : 5 Hrs

Concept of different cells.
Physiological Processes: function of heart, lung, kidney, blood, brain, pancreas, intestine, liver prostate etc. Pathogenic microorganisms (bacteria, viruses, fungus etc): Characteristics and identification. Basic biochemistry; enzymes, proteins, lipid, carbohydrate, hormones Biochemical Processes: Metabolisms, signaling, nerve conduction. Structure of biomolecules: DNA, RNA, hemoglobin, myoglobin. Identification of bacteria and their sensitivity test.

REFERENCES

1. Raghbir Singh Khandpur – Electronic Instrumentation in Medical Practice, Kothari Publications, 1975.
2. Leslie Cromwell, Fred J. Weibell and Erich A. Pfeiffer – Biomedical Instrumentations and Measurements (2e), PHI, 1991.
3. Bertil Jacobson & John G. Webster – Medicine and Clinical Engineering, PH, 1979.
4. Geddes L. A. & L. E. Baker – Principles of Applied Biomedical Instrumentation, Wiley, 1989.

1st year 2nd Semester Session

Paper Name: COMMUNICATION SYSTEMS
Paper code: FS/IS/MSc/T 201
Contact Hr: 60 Tutorial :10 Hrs

Analog Communication Systems: Principles of Amplitude modulation, double and single side band, suppressed carrier system, AM circuits, Angle modulation, Frequency modulation, VCO & PLL, Introduction to telemetry

Digital Communication: Sampling theorem, pulse modulation techniques – PAM, PCM encoder and decoder, multiplexing – time division multiplexing and frequency division, T1 Digital Carrier system.
Data Communication Techniques: Data transmission using analog carriers, MODEMS employing FSK, PSK, DPSK, QPSK, and QAM, power spectrum, S/N ratio.
Phase Locked Loop: Operating principles, lock rang, capture range, PLL as frequency multiplier, phase shifter and signal synchronizer.
Telemetry: Elements of Telemetry System; Subsystems of Telemetry System; Telemetry Classification Based on Signal Transmission Medium; Wire-Link Telemetry or Wire Telemetry & Radio Telemetry or Wireless Telemetry; Optical-Fibre Telemetry or Fibre-Optic Telemetry,
Analog Pulse Telemetry Systems, Direct-Current Telemetry System, Direct Voltage Telemetry System, FM Telemetry System, PWM Telemetry System,
PCM/Digital Telemetry System
,

REFERENCE:

1. Tomasi W. – Electronics Communications systems, Pearson, 2001.
2. Kennedy G. – Electronic Communication Systems, McGraw Hill, 1984.
3. Haykin S. – An Introduction to Analog and Digital Communications, 2nd ed. Wiley, 2007.
4. Telemetry Principles, by Patranabis, D, TMH

Paper Name: **INDUSTRIAL INSTRUMENTATION & DAS**
Paper code: FS/IS/MSc/T 202
Contact Hr: 60 Tutorial :10 Hrs

Temperature Measurement: Temperature and heat, Definitions, temperature scales, bimetallic thermometers, filled-bulb and glass stem thermometers. Resistance Temperature Detector (RTD), principle and types, measuring circuits, Linear and Quadratic approximation. Thermistors, principle and sensor types, linearization methods junction compensation techniques, thermocouple types, construction.Solid-state temperature sensors, radiation methods, optical pyrometers.
Pressure Measurement: Manometers, Elastic types, Bell gauges, Electrical types, Differential Pressure transmitters, Dead weight Pressure gauges. Low Pressure Measurement: Mc-Leod gauge, Knudsen gauge, Pirani gauge, Thermal conductivity gauges, Ionization gauges.
Level Measurement: Direct methods, indirect methods, Electrical conductivity, Capacitive, Radioactive, Ultrasonic, Nucleonic methods, Level measurement by capacitance probes, solid-state level measurements.
Moisture and Humidity Measurement: Moisture content of materials, method of measurement, Humidity measurements.
Measurement of Viscosity: Falling sphere viscometer, falling piston viscometer, rotation cylinder viscometer, capillary tube viscometer, orifice type viscometer.
Measurement of Thickness: Inductive, capacitive, ultrasonic methods.
Data Acquisition Systems: Introduction to Data acquisition systems, Analog switches, high and low level analog multiplexers, Sample and hold circuits and specifications, accuracy considerations and applications.

REFERENCE:

1. Doeblin E.O. – Measurement Systems: Application and Design, Fourth Edition, McGraw Hill, New York, 1992.
2. Patranabis D – Principles of Industrial Instrumentation, Second Edition, Tata McGraw Hill, New Delhi, 1997.
3. Noltingk B.E. – Instrumentation Reference Book, second Edition, Butter worth Heinemann, Oxford, 1996.

4. Liptak B.G – handbook of Process Measurement and Analysis, Third Edition, Chilton Book Company, Radnor, Pennsylvania, 1995.
5. Douglas M. Considine – Process/ Industrial Instruments & Controls Handbook, Fourth edition, McGraw Hill, Singapore, 1993.
6. Kerlin T. W. – Practical Thermocouple Thermometry, ISA Press, New York, 1999.
7. Gillum D. - Industrial Pressure, Level and Density Measurement, ISA Press, New York, 1995.
8. Smith. E – Principles of Industrial Measurement for control Applications, ISA Press, New York, 1984.
9. A. K. Sawhney – A course in Mechanical Measurement and Instrumentation, 12/e, DhanpatRai and Co, New Delhi, 2002.

Paper Name: MICROPROCESSOR & MICROCONTROLLER
Paper code: FS/IS/MSc/T 203
Contact Hr: 60 Tutorial :10 Hrs

Introduction to Computer Architecture and Organization: Architecture of 8-bit microprocessors, bus configurations, CPU module, introduction to assembly language and machine language programming, instruction set of a typical 8-bit microprocessor, subroutines and stacks, programming exercises.
Memory Technology: Timing diagrams, RAM, DRAM and ROM families, memory interfacing, programmable peripheral interface chips, interfacing of input-output ports, programmable interval timer. Memory map, peripheral I/O and memory-mapped I/O.
Data Transfer Schemes: Serial and parallel data transfer schemes, interrupts and interrupt service procedure. 8085 interrupts and vector locations, SIM and RIM instructions, RST instructions.
Introduction: To Microcontrollers, Architecture, RISC and CISC processors.
Instruction Set and Programming: Instruction set and programming 8051 microcontrollers.
Architecture: Instruction set and programming of 8 bit micro controllers.
Development Tools: Simulators, debuggers, cross compilers, in circuit emulators for the micro controllers.
ADC's and DAC's: Microprocessor compatible ADC's. Discussions on ADC 0816 and ICL 7109 monolithic ADC's. The concepts of Delta-Sigma converters. Selection criteria for ADC and DAC's.
Introduction of advance microcontroller and embedded System like AVR, ATMEGA, PIC Raspberry PI etc

REFERENCE:

1. Ramesh S. Gaonkar-Microprocessor Architecture, Programming and Applications (3e), Penram Pub., 1997.
2. Kenneth J Ayala – the 8051 Microcontroller architecture programming and applications, 2nd Edition Penram International publishing.
3. Hintz – Micro controllers, Architecture, implementation and programming McGraw Hill.
4. F.P. Volpe and S. Volpe- PICs in practice, Elector Electronic (publishing) Microchip Vol. 1 & 2 Embedded control handbook.

Paper Name: MATERIAL SCIENCE-I:
Paper code : MI204A
Contact Hr: 30 Tutorial :5 Hrs

Properties of material: Dielectric properties of solids: Static dielectric constant: electronic and ionic polarisation of molecules, Static dielectric constants of solids; Static dielectric constant of gases; Complex dielectric constant and dielectric losses, relaxation time; Classical theory of electronic polarisation and optical absorption
Magnetic properties of solids: Origin of magnetism; Diamagnetism: quantum theory of atomic diamagnetism; Landau diamagnetism (qualitative discussion); Paramagnetism: classical and quantum theory of paramagnetism; case of rare-earth and iron-group ions; quenching of orbital angular momentum; Ferromagnetism: Curie-Weiss law, temperature dependence of saturated magnetization, Heisenberg's exchange interaction, ferromagnetic domains; Ferrimagnetism and anti-ferromagnetism.

References:

1. Introduction to Solid State Physics, by Charles Kittel, Willey Publisher
2. Solid State Physics1 by Puri R.K. and Babbar V.K. S Chand publisher
3. Solid State Physics1 by S.O. Pillai Paperback New Age Publisher

Paper Name: BIOMEDICAL SCIENCE – II
Paper code: FS/IS/MSc/T 204B
Contact Hr: 30 Tutorial: 5 Hrs

Basic clinical instruments and their components; colorimeter, Spectrophotometer, auto analyser, microscopy, Elisa, Chemiluminescence, Immunohistochemistry, RIA, FACs etc. and their application. Components of Electrophoresis apparatus and estimation of protein, DNA etc.
Concept of PCR thermocycler, temperature control units, visualization of bands and advantage of digital imaging. Components of ECG, EEG, CT Scan, MRI etc. and their application. Dialysis, artificial respiratory unit and their application.

Blood: Biochemical evaluation of different blood parameters (pathogenic & Non-pathogenic condition).
Principles of electrophoresis: Artificial blood, haemoglobinopathies and its detection, abnormal DNA detection by PCR.
Principles of ELISA: Detection of immunoglobulin, Cytokines, Hormonal system and its analysis.
Principles of Microscopy: Light microscopy, fluorescence microscopy, application of microscopy in clinics, Microbial disease (bacterial, parasite, viral) detection.
Fluorescence activated cell sorter: detection of cell surface protein.

REFERENCES

1. Raghbir Singh Khandpur – Electronic Instrumentation in Medical Practice, Kothari Publications, 1975.
2. Leslie Cromwell, Fred J. Weibell and Erich A. Pfeiffer – Biomedical Instrumentations and Measurements (2e), PHI, 1991.
3. Bertil Jacobson & John G. Webster – Medicine and Clinical Engineering, PH, 1979.
4. Geddes L. A. & L. E. Baker – Principles of Applied Biomedical Instrumentation, Wiley, 1989.

2nd year 1st Semester Session

Paper Name: PROCESS CONTROL & DCS
Paper code: FS/IS/MSc/T 301
Contact Hr: 60 Tutorial :10 Hrs

Fundamental of Process Control: Introduction to Process Control, open loop and closed loop systems, Process Modeling : Reasons for modeling, Lumped parameter system models, Analytical approximation, Effect of parameter variation, The parameter estimation technique— Linear regression, least square regression technique. Process Dynamics: Different process control parameters, Characteristic parameters of process plant (Self-Regulation, Potential value, Process reaction rate, Process resistance, Process Capacitance, Process time lag). Design of process control system following various approaches: Self-operating Controller, Pneumatic controller, Electronic Controller, Supervisory controller, Adaptive Controller, Direct Digital Controller, Programmable Logic Controller, Distributed Control Systems. Dynamic model of chemical processes: Balance Equations, Material balance, material and energy balance, Form of Dynamic models—Linear models and deviation variables. Boiler, turbine units and its range systems, ideal steam cycles, feed water systems, steam circuits, combustion process, products of combustion process, fuel systems, treatment of flue gases, steam turbine, condensate systems, alternator, feed water conditioning, turbine bypass valves.
Distributed Control System: Local Control Units (Relay rack mounted equipment) : Multiplexers- Design, system configuration, Remote stations, Super-commutation and sub-commutation - The control console equipment, Graphic displays, Trend displays, Alarm reporting, generation and acceptance Communication between components: Data highway designs, highway compatibility, Network access protocols, Network topologies, Reliability, availability,
Single loop integrity, backup systems, Redundant and Fault tolerant systems Supervisory computer functions: Supervisory control and optimization, alarm access architecture, voice input machine interface Man Machine Interface – Sequencing, Supervisory control Computer interface with DCS- Hardware: Interface with PLC,

Field buses- fieldbus standardization, Smart transmitters- Rackbus: Bus access method, transmitter, gateways, availability MODBUS, PROFIBUS, FIPBUS, FIELDBUS standard-bus access method, other features, acceptance International; Overview of SCADA, LABVIEW for virtual instrumentation
Reference:

1. Principle Of Process Control- D. Patranabis, TMH
2. Process Control- Instrument Engineers Handbook by Bela G. Liptak, Chilton book co.Sam. G. Dukelow – The Control of Boilers, second edition, ISA Press, New York, 1991.
3. Gill A.B. – Power Plant Performance, Butterworth, London, 1984.
4. P.C. Martin, I.W Hannah – Modern Power Station Practice, British Electricity International Vol. 1 & VI, Pergamon Press, London, 1992.
5. David Lindsley – Boiler Control Systems, McGraw Hill, New York, 1991.
6. Jervis M.J – Power Station Instrumentation, Butterworth Heinemann, Oxford, 1993.

Paper Name: ANALYTICAL INSTRUMENTATION
Paper code: FS/IS/MSc/T 302
Contact Hr: 60 Tutorial :10 Hrs

Principles, Instrumentation design and application of , pH Meter, UV Visible, Fluorescence and IR spectroscopy, mass spectrometry, Mossbauer, NMR and ESR spectroscopy, X-ray methods of analysis including powder diffraction, wavelength and energy dispersive, X-ray fluorescence; electron microscopy and microprobe; ESCA and Auger techniques, photo electron spectroscopic methods, scanning tunneling and atomic force microscopy; chromatography, analysis including DTA, DSC and TGA; thermal wave spectroscopic techniques such as photo-acoustic, photo deflection and photo-pyro-electric methods.
REFERENCE:

1. Willard H.W. Merritt L.L., Dean J.A and Settle F.A. Instrument Methods of Analysis (VI edition), East West Publishers (1992).
2. Strong D.A. Holler F.J and Nieman T.A., Principles of Instrumental Analysis (V edition), Saunders (1998).
3. Wiston C, X-ray Methods, John WileyandSpms (1991).

Paper Name: OPTO-ELECTRONICS & LASER
Paper code: FS/IS/MSc/T303
Contact Hr: 60 Tutorial :10 Hrs

Interferometers-Fabry-perot and Michelson interferometers – Interference; Filters – Interferometeric method of measurement – Interference filters – Interferometeric ;Method of measurement of optical components – Optical spectrum and analyzer.; odulation of Light – Birefringence – Optical activity – Electron optic effect; Kerr modulators – magneto – optic devices – Acoustic optic modulators display devices- Luminescence – Electro luminescence – Injection Luminescence – Light emitting diode- Plasma display – Liquid crystal displays.
Lasers – Principles of operation – Einstein relations – Population inversion – ;Optical feedback – lasers modes – Classes of laser – Solid state, gas and liquid dye lasers – semiconductor lasers – Q- switching and mode locking – Properties of laser light.
Application of lasers – distance measurement – Holography – Principles and applications – Industrial, biomedical and Pollution monitoring applications –
Laser speckle and applications – optical fibers- light guidance through fibers- step index and graded index fibers- multimode and single mode fibers- fiber fabrication. Measurement of fiber characteristics- attenuation, dispersion and refractive, Index profile measurement – OYDER – fiber optic components- couplers, splicers and Connectors- applications of optical fibers- optical fiber communication- fiber optic
Sensors- measurement of temperature, pressure, displacement, acceleration, strain, fluid level, current and voltage.
Lens, prism, beam splitter, mirrors, filters, slit, aperture, Fresnel lens, polarizer, gratings, collimators, beam expanders, optical bench.
Instrument Assembly: Reading drawing, working layout of instrument, assembly of joints detachable, permanent, semipermanent, rotational and translational motion, converting mechanism and transmission.

REFERENCE:

1. OsheaCallen Rhodes: An Introduction to Lasers and their applications.
2. A.E. Signmen: Laser
3. B.B. Laud: Lasers & Non Linear Optics.
4. R.S. Sirohi: A course on Experiments with He-Ne Laser.
5. J.T. Verdeyen: Laser Electronics.
6. OsheaCallen Rhodes: An Introduction to Lasers and their applications.
7. A.E. Signmen: Laser
8. B.B. Laud: Lasers & Non Linear Optics.
9. R.S. Sirohi: A course on Experiments with He-Ne Laser.
10. J.T. Verdeyen: Laser Electronics.

Paper Name: MATERIAL SCIENCE II
Paper code : MI304A
Contact Hr: 30 Tutorial: 5 Hrs

Crystallography: External symmetry elements and concept of point groups, Reciprocal lattice and diffraction conditions, Brava is lattice, primitive vectors, primitive unit cell, Wigner-Seitz cell; Crystal structures of common crystals; Bragg-Laue formulation of X-ray diffraction by a crystal; Atomic and crystal structure factors; Experimental methods of X ray diffraction: Laue, rotating crystal and powder method; Accurate determination of lattice parameters – least-square method. Rietveld analysis, Application of powder method.
Nano technology: Properties of nanomaterial , synthesis and characterization,

REFERENCES:

1. Introduction to Solid State Physics, by Charles Kittel, Willey Publisher
2. Solid State Physics1 by Puri R.K. and Babbar V.K. S Chand publisher
3. Solid State Physics1 by S.O. Pillai Paperback New Age Publisher

Paper Name: PRINCIPLES OF DIGITAL SIGNAL PROCESSING
Paper code: FS/IS/MSc/T 304B
Contact Hr: 30 Tutorial :5 Hrs

Signal representation using unitary transforms, DFT, DCT, Haar and Walsh Hadmard transform, properties of DFT, circular convolution, linear convolution using DFT, overlap add and save methods, FFT, filter structures for IIR and FIR filters, direct form I and II, parallel and cascade forms, frequency sampling structure for FIR filters, linear phase FIR filters, digital filter design techniques, IIR filter design by impulse invariance and bilinear transformation, transformation of digital filters, FIR filter design using windows, MATLAB based examples, introduction to multirate DSP, decimation and interpolation, polyphase decomposition, uniform DFT filter banks, quadrature mirror filters and perfect reconstruction, introduction to finite register length effects on digital filter performance, spectral estimation.

REFERENCES

1. Digital Signal Processing" by S K Mitra, MH.
2. Digital Signal Processing: Principles, Algorithms, and Applications, John G. Proakis (Author),Dimitris G. Manolakis , PEARSON
3. "Digital Signal Processing" by A Anand Kumar, PHI
4. Schaum's Outline of Theory and Problems of Digital Signal Processing" by Monson H Hayes

2nd year 2nd Semester Session

Paper Name: ADVANCE BIO-MEDICAL INSTRUMENTATION:
Paper code: FS/IS/MSc/T401A
Contact Hr: 60 Tutorial :10 Hrs

Instrument related with Bone & Muscle: Muscle reaction, Electromyogram, Intensive care unit, bedside and central monitoring systems, X-ray instrumentation, Computerized axial tomography scanners.
Brain: Resting and Action Potentials, Neuron, Nervous systems, Synapse, Propagation of action potential, Reflexes, nerve stimulator, Electroencephalogram, Epilepsy, EEG recording techniques, MRI, Wave types, Brain Tumor, CT scan.
Instruments used in cardiovascular diseases: Blood circulation, blood flow measurements, ECG, Electrodes, Leads – Single and three channel ECG recorders,
Cardiac arrhythmias, Cardiac pacemakers and defibrillators, Doppler EEG, angiography analysis, Heart lung machine.
Biochemical evaluation of kidneys failures, artificial kidney and dialysis-Haemodialysis and peritoneal dialysis. Electrocardiogram. Function of kidneys and their failures-artificial kidney and dialysis-Haemodialysis and peritoneal dialysis, Respiratory system and skin and its functions.
Respiration Measurements: Respiratory systems, artificial respirator, oximeter, BP measurement-direct type, indirect type, colour Doppler systems, ultrasound scanner, diathermy.
Development of Biosensor: Principles of nanotechnology, nanocarrier, advantage of nanoconjugate detection system, application of biosensors in diseases detection.

REFERENCES:

5. Raghbir Singh Khandpur – Electronic Instrumentation in Medical Practice, Kothari Publications, 1975.
6. Leslie Cromwell, Fred J. Weibell and Erich A. Pfeiffer – Biomedical Instrumentations and Measurements (2e), PHI, 1991.
7. Bertil Jacobson & John G. Webster – Medicine and Clinical Engineering, PH, 1979.
8. Geddes L. A. & L. E. Baker – Principles of Applied Biomedical Instrumentation, Wiley, 1989.
9. Khandpur R.S. – Handbook of Biomedical Instrumentation, TMH, 1987

Paper Name: POWER PLANT INSTRUMENTATION & CONTROL
Paper code: FS/IS/MSc/T 401B
Contact Hr: 60 Tutorial :10 Hrs

Boiler and Turbine Units: Boiler, turbine units and its range systems, ideal steam cycles, feed water systems, steam circuits, combustion process, products of combustion process, fuel systems, treatment of flue gases, steam turbine, condensate systems, alternator, feed water conditioning, turbine bypass valves.
Measurement in Boiler and Turbine: Metal temperature measurement in boilers, piping system for pressure measuring devices, smoke and dust monitor, flame monitoring. Steam turbine instrumentation: Introduction to turbine supervising system, pedestal vibration, shaft vibration, eccentricity measurement. Installation of non-contracting transducers for speed measurement, rotor and casing movement and expansion measurement.
Controls in Boiler: Problems associated with control of multiple pulverizers.
Draught plant: Introduction, natural draught, forced draught, induced draught, Power requirements for draught systems. Fan drives and control, control of airflow. Combustion control: Fuel/Air ratio, oxygen, CO and CO_2 trimming, combustion efficiency, excess air, parallel and cross limited combustion control, control of large systems. Boiler drum level measurement methods, feed water control, following operation, turbine following mode operation, sliding pressure mode operation, selection between boiler and turbine following modes.
Nuclear Power Plant Instrumentation: Piping and instrumentation diagram of different types of nuclear power plant, radiation detection instruments, nuclear reactor control system and allied instrumentation.
REFERENCE:

1. Sam. G. Dukelow – The Control of Boilers, second edition, ISA Press, New York, 1991.
2. Gill A.B. – Power Plant Performance, Butterworth, London, 1984.
3. P.C. Martin, I.W Hannah – Modern Power Station Practice, British Electricity International Vol. 1 & VI, Pergamon Press, London, 1992.
4. David Lindsley – Boiler Control Systems, McGraw Hill, New York, 1991.
5. Jervis M.J – Power Station Instrumentation, Butterworth Heinemann, Oxford, 1993.

Paper Name: MIROSCOPIC TECHNIQUES
Paper code: FS/IS/MSc/T 401C
Contact Hr: 60 Tutorial :10 Hrs

Fundamentals of optics ; Optical microscope and its instrumental details ; Variants in the optical microscopes and image formation ; Phase contrast, Polarised light, Differential interference contrast, Fluorescence microscopy ; Sample preparation and applications ;Introduction to Scanning electron microscopy ; Instrumental details and image formation ;Various imaging techniques and spectroscopy ; Sample preparation and Applications ; Knowledge of the image contrast formation in scanning electron microscopy and application of analytical techniques: X-Ray spectroscopy (EDS) and Electron backscatter diffraction (EBSD).Knowledge of advanced SEM analytical techniques: transmission Kikuchi diffraction (TKD), defects imaging ECCI, stress measurements.

References :

1. Advances in Optical and Electron Microscopy – Elsevier
2. Barer, R. (1959). Lecture notes on the use of the microscope. Blackwell.
3. Slayter, E. M &Slayter, H. S. (1992). Light and electron microscopy. C. U. P.
4. Smith, R. F. (1994). Microscopy and photomicrography – a working manual 2nd edn. CRC
5. White, G. W. (1966). Introduction to microscopy. Butterworth.

Paper Name: PLASMA BASED INSTRUMENTATION
Paper code: FS/IS/MSc/T 402A
Contact Hr: 60 Tutorial :10 Hrs

Plasma based Instrumentation: Excitation and Ionization in a gas: Townsend's theory of collision, Breakdown Potential, Different methods of Ionization.

Fundamental concept pf plasma: Plasma Parameters, Criteria for plasmas, Plasma Application, diffusion and mobility, MHD equation.

Plasma Oscillation & Waves: Fluid equation, Drifts, Plasma oscillation, Electron acoustic waves, Ion acoustic waves, Plasma heating, Plasma Instabilities, Shock Waves, Radiation from plasmas, Plasma Diagnostic Techniques.

Thermonuclear Fusion: High density high temperature plasma, Principles of MCF and ICF Fusion, Principles of Laser and Common Laser System, ICF reactors and related diagnostics, Principles of TOKAMAK, ITER.

Industrial Application of Plasma: Plasma sources, Material processing, Surface alloying, Surface modification, Plasma Treatment.

REFERENCE:

1. A. Rath, Vacuum Technology, by McGraw Hill (1995), North Holland.
2. D.M.Hottma, B.Singh and J.H. Thomas, Handbook of Vacuum Science & Technology, Academic Press.
3. Nigel S. Harries, Modern Vacuum Practice, McGrow Hill
4. J.M. Laferty, Foundations of Vacuum Science & Technology, John Willey & Sons Inc
5. Meissel and Glang – Vacuum Science and Technology
6. M. Elwenspoek, R. Wiegerink – Mechanical Microsensors, Springer – Verlag Berlin Heidelberg, 2001.
7. Julian W. Gardner, Vijay K. Varadan – Microsensors, MEMS, and Smart Devices, John Wiley & Sons Ltd, 2001.
8. MassoodTabib-Azar – Microactuators – Electricaal, Magnetic, Thermal, Optical, Mechanical, Chemical and Smart structures, Kluwer Academic Publishers, New York, 1997.
9. Eric Udd – Fiber Optic Smart sturectures, John Wiley & sons, New York, 1995.
10. Kevin Chau – Analog Devices, Inc., Introduction to MEMS Technology and Devices 9SC266), SPIE education services, Bellingham WA.
11. Introduction to Plasma Physics and Controlled Fusion: Vol. F.F. Chen. PlenumPress, N.Y. (1990).
12. Introduction to Plasma Mechanics: B. Chakraborty, Willey Easte n (1990).
13. Plasma Physics: S.N. Sen, PragatiPrakasan, Meerut, (1999).
14. Plasma Physics : Krawl&Trivelpiece
15. Plasma Diagonostics: Huchinson.

Paper Name: DEVICE FABRICATION TECHNOLOGY
Paper code: FS/IS/MSc/T 402B
Contact Hr: 60 Tutorial :10 Hrs

Thin film deposition methods (CVD, Vacuum evaporation, sputtering, chemical).
Properties of thin films, structure dependence, effects of substrate temperature and rate deposition.
Electrical properties of thin films, experimental methods of measurements.
MICRO ELECTRO MECHANICAL SYSTEMS (MEMS)
Introduction: Historical background, development of microelectronics, evolution of micro sensors, MEMS, emergency of micro machine. Electronic materials and processing: Introduction, electronic materials and their deposition, pattern transfer, etching electronic materials, doping semiconductor.
MEMS Materials and Processing: Overview, metals, semiconductors, ceramic, polymeric and composite materials. Silicon micro machining- bulk: Introduction, etch-stop techniques, dry etching, buried oxide process, silicon fusion bonding, anodic bonding.
Silicon Micro Machining – Surface: Introduction, sacrificial layer technology, material systems in sacrificial layer technology, plasma etching, combined IC technology and anisotropic wet etching.
Micro Sensors: Introduction, thermal sensors, radiation sensors, mechanical sensors, magnetic sensors, biochemical sensors and flow sensors. SAW Devices: Introduction saw devices development and history, transducers in SAW devices, acoustic waves.

Paper Name: ARTIFICIAL NEURAL NETWORK
Paper code: FS/IS/MSc/T 403C
Contact Hr: 60 Tutorial :10 Hrs

Introduction of 'The Brain', Engineering of the brain, Fuzzy and Neural Networks, crisp and Fuzzy logic.
Human Physiology:-Neuron: Axon and Synapse, types of synapse, weighting factor, the brain and eye-explanation in sense of Neural Networks.
Artificial Neural Networks: Mathematics, modeling, basic model of a artificial Neuron, characteristic of ANN.
Learning in Artificial Neural Networks: supervised, unsupervised, Reinforced, Competitive, Hebbian and Delta rule learning. ANN learning and program, Learning Algorithm.
Linear, Multi-linear, Nonlinear ANN, adaptability and Stability of ANN models.
Neural Network Paradigms: McCulloch-Pitts Model, concept of Perceptron; Perceptron learning procedure, single layer Perceptron, Multilayer Perceptron, Delta learning Algorithm, ADALINE and MADALINE ,Mathematical analysis.
Winner-Takes-All algorithm, back propagation Learning- mathematical analysis and application.
Hopfield model and Competitive learning Model: Mathematical Analysis, Memory type Paradigm (RAM, CAM, BAM, TAM, LAM), Real time models.
Self Organizing Map, Probabilistic NN, Radial Basis Function.
Neuro-Fuzzy Networks: ANN and Fuzzy Logic Network, Example, Neuro-Fuzzy Control.
Application: Image Data Processing, Traffic control, Switching control in Communication field, Intelligent Control.

References

1. Kartalopoulos V S – Understanding Neural Networks and Fuzzy logic, PHI.
2. Haykins : Neural Network Analysis