MJP ROHILKHAND UNIVERSITY

BAREILLY

Course Structure and Syllabi

for

Integrated M.Tech.-Ph.D.

(Dual Degree Course)

in

Electronics and Instrumentation Engineering

With effect from

Academic Session 2022-23

Department of Electronics & Instrumentation Engineering

Faculty of Engineering and Technology (FET)

SCHEME OF COURSE

Integrated M.Tech.-Ph.D. (A Dual Degree Course)

Electronics Engineering

(Specialization in Instrumentation Engineering)

Semester-1 (odd)

Sr. No.	Subjects Code	Subjects	Teaching Schedule			Credits
			L	T	P	
1.	EIM-101	Instrument Design and Reliability	3	1	0	4
2.	EIM-103	Measurement Systems	3	1	0	4
3.	EIM-105	Embedded System and IoT	3	1	0	4
4.	EIM-	Elective-I*	3	1	0	4
5.	EIM-	Elective-II*	3	1	0	4
6.	EIM-105P	Embedded System and IoT Lab.	2	0	0	2
TOTAL						**22**

*In the case of elective subjects, students can opt for relevant online MOOC/nptel courses recognized by AICTE, New Delhi.

Elective Subjects:

EIM-107 : Digital VLSI Circuits Design
EIM-109 : Linear System Theory
EIM-111 : Artificial Neural network & Fuzzy Logic
EIM-113 : Nano-electronics Technologies
EIM-115 : Intelligent Instrumentation
EIM-117 : Python Programming

Semester-2 (even)

Sr. No.	Subjects Code	Subjects	Teaching Schedule			Credits
			L	T	P	
1.	EIM-102	Bio-medical Instrumentation and Imaging Systems	3	1	0	4
2.	EIM-104	Instrumental Methods of Analysis	3	1	0	4
3.	EIM-106	Industrial Process Instrumentation	3	1	0	4
4.	EIM-	Elective-III*	3	1	0	4
5.	EIM-	Elective-IV*	3	1	0	4
6.	EIM-108P	Simulation Lab	2	0	0	2
TOTAL						**22**

*In the case of elective subjects, students can opt for relevant online MOOC/nptel courses recognized by AICTE, New Delhi.

Elective Subjects:

EIM-110 : Process control
EIM-112 : Nonlinear Control
EIM-114 : Soft Computing Techniques
EIM-116 : Virtual Instrumentation
EIM-118 : VLSI Technology
EIM-120 : Internet of Things (IoT)

Semester-3 (odd)

Sr. No.	Subjects Code	Subjects	Teaching Schedule			Credits
			L	T	P	
1.	EIM-201	Dissertation-I*	0	0	20	20
2.	EIM-203	Seminar			2	2
TOTAL						**22**

*In the end of this semester student has to appear for their dissertation progress presentation in the department.

Semester-4 (even)

Sr. No.	Subjects Code	Subjects	Teaching Schedule			Credits
			L	T	P	
1.	EIM-202	Dissertation -II**	0	0	22	22
TOTAL						**22**

* It is desirable that candidate should publish at least 01 paper in national/international journal/ conferences. In the end of this semester student has to defend his/her dissertation as per the university rules.

SYLLABUS

SEMESTER-1 (odd)

Subject: Instrument Design & Reliability, ***Code: EIM-101*** ***Credit: 4***
Semester: Ist ***L T P: 3 1 0***

1. Grounding and Shielding: Grounding- The concept of earth ground, Typical power supply grounding error, some example of current return path symbols, Shock hazard protection using earth ground, Grounding considerations, basic grounding practices with examples. Shielding - Practical guidelines, examples Protection from electrostatic discharge.

2. Element of Design & Manufacturing: Introduction, product life cycle, Circuit design, Circuit layout, Assembly and inspection, testing and calibration, power distribution, wiring and cabling, enclosures, integrating Testing.

3. Instrumentation in Hazardous Areas:
Introduction, Hazardous area classification-protective concept, Enclosure classification designations- IP code, NEMA types, equipment design and construction, Intrinsically safe design-Safe energy level, Intrinsic safe circuit design, installing Intrinsic safe systems, Transformer isolation barrier (TIB), Relevant Indian standards.

4. Reliability of Instruments:
Introduction, Definition of component, modules and system, Components-Physics of failure, mathematics analysis, Mode of failure, failure rates. Modules- Failure rates, partial failure, design; Systems-Redundancy, Repair and availability- concept of MTTR, MTBF/MTTF and maintain ability Practical Implementations- Design and operation, environment, Diversity, Technical documentation.

Reference books:

1. Electronic Instruments and Instrumentation technology by M.M.S. Anand, Prentice hall of India, New Delhi, 2004.
2. B.E. Noltingk, “Reliability”, Chapter 8, Jone’s Instrument Technology Volume-4-Instrumentation Technology (Ed. B.E. Noltingk), pp. 166-174, 4e, Butterworth & Co. Publisher, London, 1987.
3. Reliability Engineering by Kailash C. Kapoor and Michael Pecht, John Wiley and Sons, 2014.

Subject: Measurement Systems, ***Code: EIM-103*** ***Credit: 4***
Semester: Ist ***L T P: 3 1 0***

1. Radiation Sensors: Introduction – Basic Characteristics – Types of Photo detectors– X-ray and Nuclear Radiation Sensors– Fiber Optic Sensors. Electro Analytical Sensors: Introduction – The Electrochemical Cell – The Cell Potential – Standard Hydrogen Electrode (SHE) – Liquid Junction and Other Potentials – Polarization – Concentration Polarization-– Reference Electrodes – Sensor Electrodes – Electro ceramics in Gas Media .

2. Thermal Sensors: Introduction, Gas thermometric Sensors, Thermal Expansion Type Thermometric Sensors, Acoustic Temperature Sensor, Dielectric Constant and Refractive Index Thermo-sensors, Helium Low Temperature Thermometer, Nuclear Thermometer, Magnetic Thermometer, Resistance Change Type Thermometric Sensors, Thermo-EMF Sensors, Junction Semiconductor Types, Thermal Radiation Sensors, Quartz Crystal Thermo-electric Sensors, NQR Thermometry, Spectroscopic Thermometry, Noise Thermometry, Heat Flux Sensors. Magnetic Sensors: Introduction, Sensors and the Principles Behind, Magneto-resistive Sensors, Anisotropic Magneto-resistive Sensing, Semiconductor Magneto-resistors, Hall Effect Sensors, Inductance and Eddy Current Sensors, Angular/Rotary Movement Transducers, Synchros, Synchroresolvers, Eddy Current Sensors, Electromagnetic Flowmeter, Switching Magnetic Sensors, SQUID Sensors.

3. Intensity Polarization and Inter ferometric Sensors: Intensity sensor, Microbending concept, Interferometers, Mach Zehnder, Michelson, Fabry Perot and Sagnac, Phase sensor: Phase detection, Polarization maintaining fibers. Force, Torque and Pressure sensors: strain gage beam force sensor, piezoelectric force sensor, load cell, torque sensor, Piezo-resistive and capacitive pressure sensor, optoelectronic pressure sensors, vacuum sensors.
Velocity and Acceleration sensors: Electromagnetic velocity sensor, Doppler with sound, light, Accelerometer characteristics, capacitive, piezo-resistive, piezoelectric accelerometer, thermal accelerometer, rotor, monolithic and optical gyroscopes

4. Flow, Temperature and Acoustic sensors: Flow sensors: pressure gradient technique, thermal transport, ultrasonic, electromagnetic and Laser anemometer. microflow sensor, coriolis mass flow and drag flow sensor. Temperature sensors- thermo-resistive, thermoelectric, semiconductor and optical. Piezoelectric temperature sensor. Acoustic sensors-microphones-resistive, capacitive, piezoelectric, fiber optic, solid state - electrect microphone.

5. Smart Sensors: Introduction, Primary Sensors, Excitation, Amplification, Filters, Converters, Compensation, Information Coding/Processing, Data Communication, Standards for Smart Sensor Interface, the Automation. Sensors Applications: Introduction, On-board Automobile Sensors (Automotive Sensors), Home Appliance Sensors, Aerospace Sensors, Sensors for Manufacturing, Sensors for environmental Monitoring.

TEXT BOOKS:
1. W. Bolton, “Mechatronics”, Pearson Education Limited.
2. Jacob Fraden, “Hand Book of Modern Sensors: physics, Designs and Applications”, 2015, 3rd edition, Springer, New York.
3. Jon. S. Wilson, “Sensor Technology Hand Book”, 2011, 1st edition, Elsevier, Netherland.

REFERENCE BOOKS:
1. Patranabis, “Sensors and Actuators”, 2nd Edition, PHI, 2013
2. Gerd Keiser,”Optical Fiber Communications”, 2012, 4th edition, McGraw-Hill Science, Delhi.

3. John G Webster, “Measurement, Instrumentation and sensor Handbook”, 2014, 2nd edition, CRC Press, Florida.
4. Eric Udd and W.B. Spillman, “Fiber optic sensors: An introduction for engineers and scientists”, 2013, 2nd edition, Wiley, New Jersey.

Subject: Embedded System and IoT,	***Code: EIM-105***	***Credit: 4***
Semester: Ist	***L T P: 3 1 0***	

COURSE OBJECTIVES:

- Acquire knowledge about the basic functions, structure, concepts and applications of embedded systems
- Learn the method of designing and program an Embedded Systems for real time applications
- Acquire knowledge about the development of embedded software using RTOS and implement small programs to solve well-defined problems on an embedded platform.

COURSE OUTCOMES:

- To develop basic understanding of embedded systems in general and their applications.
- To comprehend the architecture and components of embedded systems.
- To understand the onboard and external communication interfaces.
- To understand the concepts of multiprocessing, multitasking and shared memory.

1. Introduction: Formal definition of an Embedded System, Embedded system examples. Compare and contrast embedded system and conventional/generic computer system. Overview of elements of an Embedded system. Key parameters of Embedded System Design. Overview of the 8051 family, Pin description, input-output port and their functions, Memory organization.

2. Instruction Sets and Programming of 8051 Microcontrollers: Instruction set, Address modes, Assemblers and Compilers, 8051 assembly language programming, 8051 timer programming, Basic registers of the Timer and programming in different modes, 8051 Counters programming, basic registers of the counters and programming in different modes, serial port programming.

3. Real world interfacing of 8051 with: LCD, push button and Relay, Traffic Signal, Water level indicator and controller, keyboard, ADC and DAC, Stepper motor.

4. Introduction to Advanced Microcontrollers: Introduction and Architecture of PIC, ARM, AVR and AT 89C2051 Microcontroller.

5. Introduction to IoT: Architectural Overview of IoT, Design principles and needed capabilities, IoT Applications, IoT Technology Fundamentals- Devices and gateways, Role of Cloud in IoT

Text Books:

1. 8051 Microcontroller and Embedded System-M.A. Mazidi, Pearson Education.
2. Microcontrollers-A.J. Ayala, Penram International Publishing (1) Pvt. Ltd.
3. 8051 Microcontroller-I. Scott Mackenzie.
4. Embedded System Design: Embedded Systems Foundation of Cyber-Physical Systems and the Internet of Things. 3rd Edition. Peter Marwedel. ISBN 978-3-319- 56043-4. Springer.
5. Embedded Hardware: Know It All. Jack Ganssle et al. ISBN: 0750685840. Newnes.
6. Designing Embedded Hardware. 2nd Edition. John Catsoulis. ISBN: 0596007558. O'Reilly 4. Embedded Systems: World Class Designs. Jack Ganssle. ISBN: 0750686251. Newnes.

Subject: Embedded System Lab, ***Code: EIM-105P*** ***Credit: 3***
Semester: Ist ***L T P: 3 0 0***

ELECTIVE SUBJJECTS:

(Semester-Ist)

Subject: Digital VLSI Circuit Design, ***Code: EIM-107*** ***Credit: 4***
Semester: Ist ***L T P: 3 10***

1. **Review of MOSFET operation and CMOS process flow**: MOS Threshold voltage, MOSFET I-V Characteristics: Long and Short channel, MOSFET Capacitances, Lumped and Distributed RC model for interconnects, Transmission lines, CMOS Process Flow, Layout and Design rules.

2. **CMOS Inverter**: Static Characteristics, Dynamic and Static Power consumption.

3. **Combinational Logic**: Transistor sizing in static CMOS logic gates, static CMOS logic gate sizing considering method of logical effort, dynamic logic, pass-transistor logic, common mode and other cross-coupled logic.

4. **Sequential Logic**: Static latches and flip-flops (FFs), Dynamic Latches and FFs, Sense-Amplifier based FFs, NORA-CMOS, Schmitt Trigger, Monostable and Astable Circuits

5. **Timing issues**: Timing fundamentals, Clock distribution, Jitter, Self-timed Circuit Design, Synchronizers and Arbiters, Clock Synthesis and Synchronization using PLLs-Basic building blocks of PLLs.

Reference Books:

1. Jan M. Rabaey, Anantha Chandrakasan, Borivoje Nikolic, “Digital Integrated Circuits: A Design Perspective,” Prentics Hall, 2003.
2. Sung-Mo Kang, Yusuf Liblebici, “CMOS Digital Integrated Circuits,” Tata Mc Graw Hill, 2003.
3. R. Jacob Baker, “CMOS Mixed-Signal Circuit Design,” Wiley India Pvt. Ltd., 2009.
4. Ivan Sutherland, R. Sproull and D. Harris, “Logical Effort: Designing Fast CMOS Circuits”, Morgan Kaufmann, 1999.

Subject: Linear Systems Theory,	***Code: EIM-109***	***Credit: 4***
Semester: Ist	***L T P: 3 1 0***	

1. **Fundamentals of linear Algebra** Review of matrix algebra, state variable modeling of continuous and discrete time systems, linearization of state equations, solution of state equations of linear time-invariant and time varying systems, Minimal realization of linear systems and canonical forms.

2. **Stability** Internal or Lyapunov stability, Lyapunov stability theorem, Eigen value conditions for Lyapunov stability, Continuous and Discrete time cases, Input-Output stability: BIBO stability, Time domain conditions for BIBO stability. Frequency domain conditions for BIBO stability. BIBO versus Lyapunov stability.

3. **Controllability** Controllable and reachable subspaces, Physical examples and system interconnections, Reachabilty and controllability Grammians, Open loop minimum energy control, Controllabilty matrix(LTI), Eigen vector test for controllability, Lyapunov test for controllability, Controllable decomposition and block diagram interpretation, State Feedback controller design.

4. **Observability** Constructabilty Grammians, Gramian based reconstruction, Duality (LTI), Observable decompositions, Kalman decomposition theorem, Detectability, detectability tests, State estimation and Observer design.

5. **Control Design** Lyapunov based control design problems

References:

1. Chi-Tsong Chen : Linear System Theory and Design, Oxford
2. Thomas Kailath : Linear Systems, Prentice-Hall
3. Biswa Nath Dutta: Numerical Methods for Linear Control Systems (Academic Press, Elsevier)
4. J. P. Hespanha : Linear Systems Theory, Princeton University Press

Subject: Artificial Neural Network & Fuzzy Logic,	***Code: EIM-111***	***Credit: 4***
Semester: Ist	***L T P: 3 1 0***	

COURSE OUTCOMES

1. Students will be able to apply biological inspired concepts/ techniques to solve engineering problems.
2. Students will be able to design methods to optimize solution of complex problems
3. Students will be able to analyze statistical data using fuzzy logic concepts.
4. Students will be able to evaluate mathematical problems with vague or less information

1. Artificial Neural Networks: Biological Neural Network-structure of human brain, Characteristics of ANN, Artificial neurons, Types of ANN-single layer and multilayer, Hopkinsons, counter propagation, back propagation, feed forward etc., Recurrent Neural Network, active functions, supervised, unsupervised learning algorithms, case study (application).

2. Fuzzy Logic: Uncertainty and Information, Fuzzy sets & Membership functions, chance versus Fuzziness. Features of membership function, various forms of fuzzification, defuzzification to crisp sets, λ-cuts for fuzzy relations, defuzzification to scalars (methods of defuzzification), case study (application).

Classical Sets and Fuzzy Sets: Operations on classical sets, Properties of classical sets, Mapping of classical sets to functions, Operations and properties of Fuzzy sets, Non- interactive fuzzy sets.

3. Classical relations and fuzzy relations: Cartesian Product, Crisp Relations: cardinality, operations, properties, Fuzzy Relations: cardinality, operations, properties, Fuzzy Cartesian Product & comparison, tolerance and equivalence relations, value assignment: cosine amplitude, max-min method, other forms of composition operation.

4. Optimization Techniques: Genetic algorithm, Basic fundamental of optimization algorithm, Different steps for Genetic Algorithm, optimization, Mutation, crossover, PSO (Particle Sworn Optimisation), Case study on PSO, GA.

5. Introduction of MATLAB

Reference Books:

1. Neural Networks, Fuzzy Logic and Genetic Algorithms-Synthesis and Applications, Rajajsekharan & Vijayalakshmi Pai, Prentice Hall of India Private Limited, New Delhi, 2003.

2. Fuzzy Logic with Engineering Applications: Ross T.J, John Wiley, 1996.

Subject: Nano-electronics Technologies, ***Code: EIM-113*** ***Credit: 4***
Semester: Ist ***L T P: 3 1 0***

1. Introduction and Preliminary Concepts: Macro-, Meso, Micro and Nanostructure of Materials**,** Fundamentals of crystallography and Crystal structures.
X-Ray Diffraction Methods: X-ray production, Bragg's Law, Laue's Equation, Diffraction Methods, Single Phase analysis, Multi-Phase Analysis, Particle size and strain, Orientation and Texture, Residual Stress.
Optical Microscopy: Geometry of Optics, Resolution, Construction of a Microscope, Image Contrast, Phase Contrast

2. Introduction to Nanoelectronics Limitations of the conventional MOSFETs at Nanoscales, MOSFET Scaling & implications, Introductory concepts of Ballistic transport and Quantum confinement, Differences in Few Electron Devices (as analog version) and Single Electron Devices (as digital version) of Nanoelectronic

3. MICRO AND NANO FABRICATION Basic Micro-fabrication Techniques, Lithography, Thin Film Deposition and Doping, Etching and Substrate Removal, Substrate Bonding
MEMS Fabrication Techniques, Bulk Micromachining, Surface Micromachining, HighAspect-Ratio Micromachining
Nanofabrication Techniques, E-Beam and Nano-Imprint Fabrication, Epitaxy and Strain Engineering, Scanned Probe Techniques, Self-Assembly and Template Manufacturing

4. Nanosensors: Introduction to sensors. Characteristics and terminology - static and dynamic characteristics.Micro and nano-sensors, Fundamentals of sensors, biosensor, micro fluids, Packaging and characterization of sensors, Sensors for aerospace and defense. Organic and inorganic nanosensors

5. NANOTECHNOLOGY APPLICATIONS AND DEVICES MEMS devices and applications: Pressure sensor, Inertial sensor, Optical MEMS and RF-MEMS
NEMS devices and applications , Nanotechnology for data storage applications, Millipede Concept of storage.

References Books:

1- Biosensors: A Practical Approach, J. Cooper & C. Tass, Oxford University Press, 2004.

2- An introduction to material Science – V Raghavan

3- Principles of Instrumental Analysis - Douglas A Skoog, F. James Holler and Timothy A. Nieman, 4th Edition ©1998.

Subject: Intelligent Instrumentation,	***Code: EIM-115***	***Credit: 4***
Semester: Ist	***L T P: 3 1 0***	

Course Outcomes:

1: To discuss concepts of robotics, robot mechanism and its classification.
2: To describe mechanical and electrical elements involved in robotics.
3: Practical analysis of robotic mechanism and its functioning at different abstraction levels.
4: To discuss real time systems and its scheduling.
5: Evaluation of expert system for real time control applications.
6: Brief overview of artificial intelligence and its requirement in instrumentation.

1. Introduction to Robotics: Robot classification, Robot mechanism, Mechanical & Electrical elements. Kinematics: Forward & Inverse Kinematics. Dynamics: Kinetic energy, potential energy, motion equation. Robot Sensors: Range, Proximity, Force, Torque, Ultrasonic, Optical sensors. Vision system: High level, Low level, Medium level vision, Edge detection method, Region growing method. Various Actuators: Hydraulic, Pneumatic, Electrical actuators. Principles of programmable robots, multiple robot control & Adaptive robots. Field applications of robot manipulator, Robot simulation & computer control.

2. Smart Systems: Various techniques of Interfacing with Smart instrumentation systems, Stepper motor Interfacing, Smart cards, Smart buildings, Smart cars etc.

3. Real time system: Hard & Soft RT‘S, static & dynamic scheduling of RT‘S e.g. of RT‘S like railway reservation system, rocket launching system, pacemaker etc., Programmable Controller & their use in Instrumentation. S.G.S.I.T.S/E & I/ UG Syllabus/ 2022-23 w. e. f. 2022 Department of Electronics and Instrumentation Engg.

4. Expert system for real time control application: Knowledge base system: facts, rules, frames, inheritance. Fuzzy Logic: crisp logic, fuzzification, defuzzification, mamdani‘s method.

5. Artificial Intelligence & its requirement in Instrumentation: state space problem water jug problem, chess problem, production system, Problem characteristics, searching a tree: Uninformed search, informed search, Prolog programming: Marcus problem, family tree problem.

Text Books:

1. Robotics: Fu, Lee & Gonzalez.
2. Artificial Intelligence: Elaine Rich & Knight.
3. Turbo prolog: Townsend.

References Books:

1. Intelligent Instrumentation: Barney.
2. Patterson, Artificial Intelligence & Expert system, Pearson Education

Subject: Python Programming, ***Code: EIM-117*** ***Credit: 4***
Semester: Ist ***L T P: 3 1 0***

Course Objectives:

- To acquire programming skills in core Python.
- To acquire Object Oriented Skills in Python
- To develop the skill of designing Graphical user Interfaces in Python
- To develop the ability to write database applications in Python

Course Outcomes:

After the completion of course the student will able to:

- Define the syntax and semantics of python programming language and Understand control flow statements, strings and functions.
- Determine the methods to create and manipulate python programs by utilizing the data structures like lists, dictionaries, tuples and sets.
- Understand the concepts of files, exception handling and also apply the object oriented programming concept by creating classes and objects.
- Applying the problem-solving concepts to various applications using python.

1. BASICS OF PYTHON PROGRAMMING: Introduction to Python – Literals – Variables and Identifiers – Data Types – Input Operation – Comments – Reserved words – Indentation – Operators and Expressions - Conditionals: Boolean values and operators - conditional if - alternative if - chained conditional - Iteration - Illustrative programs: Evaluation of expressions - String Operations - Circulate the values of n variables - Square root (Newton's method), Sum an Array of Numbers.

2. STRING, LISTS, TUPLES, DICTIONARIES, SETS: Strings: String slices - Immutability - String functions and methods - String module - Lists: List operations - List slices - List methods - List loop – MutabilityAliasing - Cloning lists - List parameters.

3. Dictionaries: Operations and Methods - Advanced list processing - List comprehension - Sets: Creating Sets – Operations and methods – Set comprehension - Illustrative programs: Linear search - Binary search - Selection sort - Insertion sort - Merge sort.

4. FUNCTIONS, MODULES, PACKAGES: Functions - definition and use - Flow of execution - Parameters and argumentsFruitful functions: Return values - Parameters - Local and global scope - Function composition - Recursion - Modules – from import statement – Name of Module – Making your own modules – Packages, Standard Library Modules. Illustrative programs: Fibonacci series using functions - Arithmetic operations using module - Area of different shapes using packages.

5. FILES, EXCEPTIONS, CLASSES AND OBJECTS: Files and exception: Text files, Reading and writing files, Format operator, Command line arguments, Errors and exceptions. Handling exceptions - Classes and Objects: Defining classes - Creating Objects, Class constructor: Class variables and Object variables, Public and Private data members. Illustrative programs: Word count - Copy file - Creating user defined exception - Creating student class and object.

TEXT BOOKS:

1. Reema Thareja, “Python Programming Using Problem Solving Approach”, Oxford University Press 2018.
2. Anurag Gupta, G.P. Biswas, “Python Programming: Problem Solving, Packages and Libraries”, McGrawHill, 2020.

REFERENCE BOOKS:

1. Allen B. Downey, “Think Python: How to Think Like a Computer Scientist”, Second edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016.
2. Guido van Rossum and Fred L. Drake Jr, “An Introduction to Python – Revised and updated for Python 3.2", Network Theory Ltd., 2011.
6. Kenneth A. Lambert, “Fundamentals of Python: First Programs”, CENGAGE Learning, 2012.

SEMESTER-II (Even)

Subject: Biomedical Instrumentation and Imaging System,	***Code: EIM-102***	***Credit: 4***
Semester: IInd	***L T P: 3 1 0***	

1. Hospital Management

Overview of Hospital Administration: Challenges in Hospital Administration – Hospital Planning- Equipment Planning – Functional Planning - Current Issues in Hospital Management – Telemedicine - Bio-Medical Waste Management.

2. Anatomy and Physiology

Blood and Body Fluids : Body fluids- Composition and functions of blood- Plasma proteins- Red blood cells, White blood cells and platelets- Blood groups and blood clotting.

Respiratory System: Organs of respiratory system – Structure of lungs, Mechanics of breathing, Lung volume and capacities- Transport of Oxygen in the blood, Transport of carbon-di-oxide in the blood Regulation of respiration- Hypoxia, Dyspnoea.

3. Magnetic Resonance Imaging: NMR - Principles of MRI, Relaxation processes and their measurements, Pulse sequencing and MRimage acquisition, Image reconstruction, Functional MRI, Diffusion imaging, EPI.

Ultrasonic Systems: Wave propagation and interaction in Biological tissues - Acoustic radiation fields, continuous and pulsed excitation - Transducers and imaging systems - Scanning methods, Imaging Modes, Principles and theory of image generation - lap top style units – Applications.

4. Analytical & Diagnostic Instruments: Common analytical equipment used in hospitals and those in Biochemistry laboratories - Blood Flow meters - Pulmonary function analyzers - Blood gas analyzers - Different types of Oximetry systems - Blood pressure measurement - Blood cell counters.

5. Advanced Medical Instrumentation

Specialized Therapeutic and diagnostic equipment - Cardiac pacemakers, heart lung machines, Hemodialysis - design, clinical laboratory instrumentation, Audiometer, Phonocardiogram, Emerging trends in medical diagnostics and therapy Clinical laboratory instrumentation - Blood cell counter and associated hematology system, blood gas analyzers,.

Reference Books:

1. Anne Waugh and Allison Grant, Ross and Wilson Anatomy and Physiology in Health and Illness, Elsevier Health Sciences, 11th edition, 2010.
2. Guyton & Hall, ―Textbook of Medical Physiology‖, 12th edition, Elsevier publication.
3. Wilson and Wangh, ―Anatomy and Physiology‖, 11th edition, Elsevier publication.
4. R.C.Goyal, Hospital Administration and Human Resource Management‖, PHI –4th Edition, 2006

Subject: Instrumental Methods of Analysis, ***Code: EIM-104*** ***Credit: 4***
Semester: IInd ***L T P: 3 1 0***

1. The Raman Spectrometer:
The Raman Effect, Raman Spectrometer, PC-Based Raman Spectrometer, FT Raman Spectrometer, Infrared and Raman Micro-spectrometry

2. Nuclear Magnetic Resonance Spectrometer:
Introduction to Nuclear Magnetic Resonance (NMR) Spectroscopy, Principle of NMR, Types of NMR Spectrometers, Constructional Details of NMR Spectrometer, Computer Controlled NMR Spectrometer, Sensitivity Enhancement for Analytical NMR Spectroscopy, Spin Decoupler, Fourier Transform NMR Spectroscopy

3. Electron and Ion Spectroscopy:
Surface Spectroscopic Techniques, Electron Spectroscopy, Instrumentation for Electron Spectroscopy, ION Spectroscopy: Instrumentation for Ion Spectroscopy

4. Scanning Electron Microscope and Scanning Probe Microscopes:
Background, Scanning Electron Microscope (SEM), Types of Signals in SEM, Components of SEM, Digital SEM, Scanning Transmission Electron Microscopy (STEM), Scanning Probe Microscopy, Scanning Tunnelling Microscope (STM): principle, component and construction, Atomic Force Microscope (AFM):component and instrumentation.

5. Liquid and Gas Chromatographs:
Chromatography, Basic Definitions, Gas Chromatography, Basic Parts of a Gas Chromatograph, Methods of Measurement of Peak Areas, Gas Chromatograph-Mass Spectrometer (GC-MS), Gas Chromatography–Infrared Spectroscopy; Liquid Chromatography, Types of Liquid Chromatography: Coloum, thin layer and paper partition; High Pressure Liquid Chromatograph (HPLC), Liquid Chromatograph-Mass Spectrometer (LC/MS).

Textbook:
1.Handbook of Analytical Instrumentation, RS Khandpur, McGraw Hill Education (India) Pvt. Ltd. 3e 2017.

Subject: Industrial Process Instrumentation, ***Code: EIM-106*** ***Credit: 4***
Semester: IInd ***L T P: 3 1 0***

1. **Level Measurement:** Direct methods: Hook-type level indicator, Float type level Indicator; Indirect Methods: Hydrostatic pressure type-pressure gauge method, Air bellows, Air purge system; Electrical Methods-Capacitance level indicator, Radiation level detector; Microwave level switches, Optical Level detectors, Ultrasonic level detector. 08
2. **Flow Measurement:** Variable Head Flow Meters: Venturi Meter, Orifice Meter, Nozzle Meter; Variable Area Flow Meter: Rotameter; Variable Head and Variable Area Flow Meters: Pitot-Static Tube, Target Flow Meter, Turbine Flow Meter, Vortex-Shedding Flow Meter; Special Methods: Ultrasonic Flow Meters, Electromagnetic Flow Meters, Hot Wire Anemometer, Laser Doppler Anemometer. 12
3. **Temperature measurement:** Mechanical Temperature Sensors, Resistance-type Temperature Sensors, Platinum Resistance Thermometer: Construction of Platinum Resistance Thermometer Elements, Resistance Thermometer Circuits, Thermistors, Thermocouples: Construction of Thermocouple Probes, Thermocouple Circuits, Effect of Reference Junction, Thermocouple Indicators. 10
4. **Industrial Safety Instrumentation:** Flame Arresters, Conservation & Emergency Vents, Flame, Fire & Smoke Detectors, Leak Detectors, Metal Detectors. 08
5. **Special Purpose Instrumentation:** Air Pollution Monitoring Instruments: Representation of Concentration of Gases, Types and Concentration of Various Gas Pollutants, Instrumental Techniques and Measurement Range, Air Pollution Monitoring Stations.
   Water Pollution Monitoring Instruments: Types of Pollutants and Techniques. 10

Reference Books:

1. Industrial Instrumentation and Control by S.K. Singh, Tata McGraw Hill Education Private Limited, New Delhi.
2. Principles of Industrial Instrumentation by D. Patranabis, Tata McGraw Hill Publishing Limited, New Delhi,
3. Instrumentation, Measurement and Analysis by Nakra & Chaudhry, Tata McGraw Hill Education Private Limited, New Delhi.
4. Instrumentation Devices & Systems by C.S. Rangan, G.R. Sarma, V.S.V. Mani, Tata McGraw Hill Education Private Limited, New Delhi.
5. Instrument Engineers' Handbook (Fourth Edition): Process Measurement and Analysis, Volume –I, by Bela G. Liptak, CRC Press.
6. Handbook of Analytical Instruments by R S Khandpur, Third Edition, McGraw Hill Education (India) Private Limited, Chennai, 2015.

Subject: Simulation Lab, ***Code: EIM-108P*** ***Credit: 3***
Semester: IInd ***L T P: 3 0 0***

ELECTIVE SUBJJECTS:
(Semester IInd)

Subject: Process Control,	***Code: EIM-110***	***Credit: 4***
Semester: IInd	***L T P: 3 1 0***	

1: Dynamic Behaviors of Systems: Review of first and higher order systems, closed and open loop response, Response to step, impulse and sinusoidal inputs, Transient response.

2: Process Control: Design aspects – Hardware elements of process control system. Mathematical modeling of processes: Fundamental laws and equations – level, thermal, flow, gas and mixing process. Interacting and non – interacting process – self regulation – inverse response – degrees of freedom – linearization – transfer function representation of process – variable gain, variable time constant.

3: Feedback Control actions and their tuning: Basic control actions – characteristics of ON/OFF, P, P+I, P+D, P+I+D control modes, selection of control modes for different processes – control schemes for flow, level, pressure and temperature. Methods of controller tuning, Ziegler – Nichols continuous cycling, damped oscillations, process reaction curve method – Cohen and Coon method, time – integral criteria.

4: Analysis of Advanced Control Systems: Feedback control of systems with large dead time, dead time compensation, cascade control, feed forward and ratio control, adaptive and inferential control systems.

5: Multiple Input Output Process: Design equations – degrees of freedom – poles and zeros – number of controlled and manipulated variables – generation of alternative loop configurations – extension to systems with interacting units. Interaction of control loops – relative gain array – selection of loops – design of non-interacting control loops, Decoupling control.

REFERENCES:

1. Ramesh C Panda and T. Thyagarajan, An Introduction to Process modelling,Identification and control for Engineers, Narosa Publishing House, First edition, 2017.
2. B. Wayn Bequette, Process Control: Modeling, Design and Simulation, Prentice HallInternational series, Third edition, 2003.
3. George Stephanopoulos, Chemical Process Control, An Introduction to the Theory and Practice, Prentice Hall International Inc., First edition, 2008.
4. Donald R. Coughanowr, Process Systems Analysis and Control, Third Edition, McGraw Hill Inc., 2013.
5. Peter Harriott, Process Control, Tata McGraw Hill 26th Reprint, 2005.
6. D. Patranabis, Principles of Process Control, Tata McGraw Hill, Third Edition, 2013.
7. William L. Luyben, Michael L. Luyben, Essentials of Process Control, Tata McGraw Hill, 1997.

Subject: Nonlinear Control, ***Code: EIM-112*** ***Credit: 4***

Semester: IInd ***L T P: 3 1 0***

Subject: Soft Computing, ***Code: EIM-114*** ***Credit: 4***

Semester: IInd ***L T P: 3 10***

1. Soft Computing: Introduction to soft computing, soft computing vs. hard computing, various types of soft computing techniques, applications of soft computing.

2. Artificial Intelligence: Introduction, Various types of production systems, characteristics of production systems, breadth first search, depth first search techniques, other Search Techniques like hill Climbing, Best first Search, A* algorithm, AO* Algorithms and various types of control strategies. Knowledge representation issues, Prepositional and predicate logic, monotonic and non monotonic reasoning, forward Reasoning, backward reasoning, Weak & Strong Slot & filler structures, NLP.

3. Neural Network: Structure and Function of a single neuron: Biological neuron, artificial neuron, definition of ANN, Taxonomy of neural net, Difference b/w ANN and human brain, characteristic and applications of ANN, single layer network.

Perceptron: Perceptron training algorithm, Linear separability , Widrow & Hebb's learning rule/Delta rule, ADALINE, MADALINE, AI v/s ANN. Introduction of MLP, different activation functions, Error back propagation algorithm, derivation of BBPA, momentum, limitation, characteristics and application of EBPA.

4. Counter propagation network: architecture , functioning & characteristics of counter Propagation network, Hop field/ Recurrent network, configuration, stability constraints, associative memory, and characteristics, limitations and applications. Hopfield v/s Boltzman machine. Adaptive Resonance Theory: Architecture, classifications, implementation and training. Associative Memory.

5. Fuzzy Logic: Fuzzy set theory, Fuzzy set versus crisp set, Crisp relation & fuzzy relations, Fuzzy systems: crisp logic, fuzzy logic, introduction & features of membership functions.

Fuzzy rule base system : Fuzzy propositions, formation, decomposition & aggregation of fuzzy Rules, fuzzy reasoning, fuzzy inference systems, fuzzy decision making & Applications of fuzzy logic.

6. Genetic algorithm: Fundamental, basic concepts, working principle, encoding, fitness function, reproduction, Genetic modeling: Inheritance operator, cross over, inversion & deletion, mutation operator, Bitwise operator ,Generational Cycle, Convergence of GA, Applications &
advances in GA, Differences & similarities between GA & other traditional methods.

Text Books:

1. S.N. Sivanandam & S.N. Deepa, *Principles of Soft Computing,* Wiley Publications, 2 Edition, 2011.

2. S, Rajasekaran & G.A. Vijayalakshmi Pai, *Neural Networks,Fuzzy Logic & Genetic Algorithms, Synthesis & applications,* PHI Publication, 1st Edition, 2009.

References:

1. N.K. Bose, Ping Liang, *Neural Network fundamental with Graph, Algorithms & Applications*, TMH, 1 Edition, 1998.

2. Bart Kosko, *Neural Network & Fuzzy System*, PHI Publication, 1st Edition, 2009.
3. Rich E, Knight K, *Artificial Intelligence*, TMH, 3 Edition, 2012.
5. Martin T Hagen, *Neural Network Design*, Nelson Candad, 2

Subject: VLSI Technology, ***Code: EIM-116*** ***Credit: 4***

Semester: IInd ***L T P: 3 1 0***

1. **Crystal growth**: Source of silicon; Single crystalline and Poly crystalline; Requirement of purity for electronics industry; Electronics grade silicon production; Crystal growth techniques: Bridgeman method, float zone method, Czocharalski method, refining; Silicon Wafer Preparation & Crystal Defects.
2. **Oxidation, Diffusion and Ion Implantation**: Types of oxidation and their kinematics; factors affecting the growth mechanisms; Deal-Grove model, dry & wet oxidation; oxidation systems; Diffusion mechanisms; diffusion profile; diffusion kinetics; parameters affecting diffusion profile; Dopants and their behavior, Ion Implantation-impurity distribution profile, properties of ion implantation, low energy and high energy ion implantation.
3. **Epitaxial Process**: Need of epitaxial layer; vapors phase epitaxy, chemistry of epitaxial process, transport mechanism doping & auto doping; epitaxial process induced defects, molecular beam epitaxy, merits and demerits among epitaxial processes.
4. **Etching**: Types of etching- wet and dry etching; dry etching techniques-ion beam or ion-milling, sputter ion plasma etching and reactive ion etching (RIE); merits and demerits of etching; etching induced defects.
5. **Lithography**: Basic steps in lithography; lithography techniques-optical lithography, electron beam lithography, x-ray lithography, ion beam lithography; resists and mask preparation of respective lithographies, printing techniques-contact, proximity printing and projection printing; merits and demerits of lithographies.

Reference Books:

1. Plummer, J.D., Deal, M.D. and Griffin, P.B., “Silicon VLSI Technology: Fundamentals, Practice and Modeling”, 3rd Ed., Prentice-Hall. 2000.
2. Sze, S.M., “VLSI Technology”, 4th Ed., Tata McGraw-Hill. 1999.
3. Chang, C.Y. and Sze, S.M., “ULSI Technology”, McGraw-Hill. 1996.
4. Gandhi, S. K., “VLSI Fabrication Principles: Silicon and Gallium Arsenide”, John Wiley and Sons. 2003.
5 Campbell, S.A., “The Science and Engineering of Microelectronic Fabrication”, 4th Ed., Oxford University Press. 1996

Subject: Virtual Instrumentation, ***Code: EIM-118*** ***Credit: 4***

Semester: IInd ***L T P: 3 1 0***

Course Objective:

Student will be able to

- Develop virtual instruments for specific application using LabVIEW software.
- Ease the programming required to make computer interact with real world.
- To acquire, analyze and display the throughput of any compactible system.
- Knowledge to connect with third party software and hardware.

1. An introduction Historical perspective, advantages, blocks diagram and architecture of a virtual instrument, data-flow techniques, graphical programming in data flow, comparison with conventional programming.

2. VI programming techniques VIs and sub-VIs, loops and charts, arrays, clusters and graphs, case and sequence structures, formula nodes, local and global variables, string and file I/O, Instrument Drivers, mathscript.

3. Instrument Control using RS-232C and IEEE488, Development of Virtual Instrument using GUI, Real-time systems, Embedded Controller, OPC, Active X programming, Publishing measurement data in the web.

4. VI toolsets Distributed I/O modules, Control Design and Simulation, Digital Signal processing tool kit, Image acquisition and processing, Motion control

5. Applications and Case study of Virtual Instrumentation:

Text Books:

1. Rick Bitter, Lab VIEW advanced programming technique, 2nd Edition, CRC Press, 2005
2. Jovitha Jerome, Virtual Instrumentation using LabVIEW, 1st Edition, PHI, 2001.
3. Kevin James, PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control, Newnes, 2000.

Subject: Internet of Things (IoT),	***Code: EIM-120***	***Credit: 4***
Semester: IInd	***L T P: 3 1 0***	

Course Objectives:

- To introduce the terminology, technology and its applications
- To introduce the concept of M2M (machine to machine) with necessary protocols
- To introduce the Python Scripting Language which is used in many IoT devices
- To introduce the Arduino/Raspberry PI platform, that is widely used in IoT applications
- To introduce the implementation of web-based services on IoT devices

Course Outcomes:

- Understand IoT value chain structure (device, data cloud), application areas and technologies involved.
- Understand IoT sensors and technological challenges faced by IoT devices, with a focus on wireless, energy, power, and sensing modules
- Market forecast for IoT devices with a focus on sensors
- Explore and learn about Internet of Things with the help of preparing projects designed for Arduino/Raspberry Pi

1. Introduction to Internet of Things- Definition and Characteristics of IoT, Sensors, Actuators, Physical Design of IoT – IoT Protocols, IoT communication models, IoT Communication APIs, IoT enabled Technologies – Wireless Sensor Networks, Cloud Computing, Embedded Systems, IoT Levels and Templates, Domain Specific IoTs – Home, City, Environment, Energy, Agriculture and Industry.

2. IoT and M2M- Software defined networks, network function virtualization, difference between SDN and NFV for IoT, Basics of IoT System Management with NETCONF, YANG- NETCONF, YANG, SNMP NETOPEER

3. IoT Physical Devices and Endpoints- Introduction to Arduino and Raspberry Pi- Installation, Interfaces (serial, SPI, I2C)
Controlling Hardware- Connecting LED, Buzzer, Switching High Power devices with transistors, Controlling AC Power devices with Relays, Controlling servo motor, speed control of DC Motor, unipolar and bipolar Stepper motors

4. Sensors- Light sensor, temperature sensor with thermistor, voltage sensor, ADC and DAC, Temperature and Humidity Sensor DHT11, Motion Detection Sensors, Wireless Bluetooth Sensors, Level Sensors, USB Sensors, Embedded Sensors, Distance Measurement with ultrasound sensor

5. IoT Physical Servers and Cloud Offerings– Introduction to Cloud Storage models and communication APIs Web Server – Web server for IoT, Cloud for IoT, Python web application framework designing a RESTful web API

TEXT BOOKS:

1. Internet of Things - A Hands-on Approach, Arshdeep Bahga and Vijay Madisetti, Universities Press, 2015, ISBN: 9788173719547
2. Getting Started with Raspberry Pi, Matt Richardson & Shawn Wallace, O'Reilly (SPD), 2014, ISBN: 9789350239759
3. Raspberry Pi Cookbook, Software and Hardware Problems and solutions, Simon Monk, O'Reilly (SPD), 2016, ISBN 7989352133895

REFERENCE BOOKS:

1. Peter Waher, 'Learning Internet of Things', Packt Publishing, 2015 3. Editors Ovidiu Vermesan
2. Peter Friess,'Internet of Things – From Research and Innovation to Market Deployment', River

Publishers, 2014
3. N. Ida, Sensors, Actuators and Their Interfaces, SciTech Publishers, 2014.