Minutes of BOS Meeting regarding Name of Ph.D. Degree and Paper-2 of Pre-PhD course work

in the Department of

Electronics & Instrumentation Engg.

Submitted to

Faculty Board
Faculty of Engineering and Technology

महात्मा ज्योतिबा फुले
रुहेलखण्ड विश्वविद्यालय, बरेली

Department of Electronics & Instrumentation Engineering
Faculty of Engineering and Technology (FET)
MJP Rohilkhand University, Bareilly (UP)

September 2023

DEPARTMENT OF ELECTRONICS AND INSTRUMENTATION ENGINEERING

FACULTY OF ENGINEERING AND TECHNOLOGY
M.J.P. ROHILKHAND UNIVERSITY, BAREILLY

Minutes of the BoS Meeting

Agenda: Ph.D. Degree of the Department of Electronics and Instrumentation Engineering and paper-2 of Pre-Ph.D. course work.

A meeting of the BoS committee, in the Department of Electronics and Instrumentation Engineering, FET, M.J.P Rohilkhand University Bareilly was held on 25th September 2023 at 10am to discuss about the name of Ph.D. degree being conducted in the department and options for paper-2 of the Pre-Ph.D. course work.

Following members were present in this meeting:

(A) External Expert:

1. Prof. HK Tyagi, Department of Electronics, Kurukshetra University, Kurukshetra
2. Prof. Abhishek Tomar, Department of EC Engg, GBPUAT, Pantnagar

(B) Internal Members

1. Prof. Sanjeev, Head of the Department.
2. Prof. Yograj Singh Duksh
3. Prof. Anil Kumar Singh
4. Prof. Rakesh Kumar Maurya
5. Prof. Yatendra Kumar
6. Dr. (Mrs.) Reena Pant, Associate Professor
7. Dr. Ashish K. Jain, Associate Professor
8. Dr. Deepak Gangwar, Associate Professor
9. Dr. Mukul K. Gupta, Associate Professor

Recommendations of the BoS Committee:

1. The BOS meeting of Department of Electronics and Instrumentation dated 23/4/2023 has proposed the scheme, syllabus and Panel of experts for the Proposed Ph.D. Degree in Electronics Engineering (Annexure-A). The recommendation of BOS was sent to Directorate of Research/Registrar for further processing. The Directorate of Research (DoR) has moved the proposal to start Pre-PhD course work in several departments of

Faculty of Engineering and Technology, which was passed by the Academic Council meeting no. 01/2022 dated 25/11/2022 vide point no. 8(i) (Annexure-B). Although there is no mention of name of subject of Ph.D. Degree, but BOS committee clarify that Department of Electronics and Instrumentation Engineering will offer the Ph.D. in Electronics Engineering. Recently name of our B.Tech. (Electronics and Instrumentation) degree has also been changed to B.Tech. (Electronics Engineering) by the AICTE through its letter no. ***F.No. Northern/1-36523406545/2023/EOA dated 2nd June 2023*** (Annexure-C). **Hence, it is more logical to offer the Ph.D. degree in Electronics Engineering.**

2. The pre-Ph.D. course work subject was recommended by the BOS meeting dated. 04/03/2023. (Annexure-D). The matter was discussed in the BOS meeting and it is recommended that Pre-Ph.D. course work student can opt any one of the subjects (from semester 1 or 2) offered to Integrated M.Tech.-Ph.D. (Dual Degree) course in place of existing paper-2. The Pre-PhD course work students can study their paper-2 along-with the Integrated M.Tech.-Ph.D. (Dual Degree) course students. This system is adopted by almost all universities/institutes. The subject scheme of Integrated M.Tech.-Ph.D. (Dual Degree) is enclosed herewith as Annexure-E.

SCHEME OF COURSE

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

(Electronics & 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-105P	Embedded System and IoT Lab.	0	0	3	2
6.	EIM-117P	Python Programming Lab.	0	0	3	2
TOTAL						20

*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 : Intelligent Instrumentation

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	Nano-electronics Technologies	3	1	0	4
3.	EIM-106	Industrial Automation	3	1	0	4
4.	EIM-	Elective-II*	3	1	0	4
5.	EIM-106P	Industrial Automation Lab.	0	0	3	2
6.	EIM-108P	Simulation Lab	0	0	3	2
TOTAL						20

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

EIM -101	Instrument Design & Reliability	L	T	P	C
Sem -1		3	1	0	4

Course Outcomes

On completion of this course, the students will be able to

CO1: To understand grounding and shielding techniques for instruments.
CO2: To learn about the design steps and manufacturing process for instruments.
CO3: To describe about different nomenclature and standards for instruments in hazardous Environment.
CO4: To evaluate the instruments based on their reliability criterion.

Unit 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.

Unit 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.

Unit 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.

Unit 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,

EIM -103	Measurement Systems	L	T	P	C
Sem-1		3	1	0	4

Course Outcomes
On completion of this course, the students will be able to

CO1- Understand the concepts of measurement, error and uncertainty.
CO2 - Understand the static and dynamic characteristics of measuring instruments.
CO3 - Gain knowledge about the principle of operation and characteristics of different types of resistance, capacitance and inductance transducers.
CO4 - Acquire knowledge of analyzing different stages of signal conditioning units.

Unit 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 .

Unit 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, Synchro resolvers, Eddy Current Sensors, Electromagnetic Flowmeter, Switching Magnetic Sensors, SQUID Sensors.

Unit 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

Unit 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.

Unit 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.

EIM -105	**Embedded System and IoT**	L	T	P	C
SEM- 1		3	1	0	4

COURSE OUTCOMES:

On the completion of the course student will be able to learn

CO1-To develop basic understanding of embedded systems in general and their applications.
CO2- To comprehend the architecture and components of embedded systems.
CO3- To understand the onboard and external communication interfaces.
CO4- To understand the concepts of multiprocessing, multitasking and shared memory.

Unit 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.

Unit 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.

Unit 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.

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

Unit 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

EIM -105	**Embedded System and IoT Lab**	L	T	P	C
Sem -1		0	0	2	2

Course Outcomes

On completion of the course, student will be able to

CO1- Implement an architectural design for IoT for specified requirement
CO2- Solve the given societal challenge using IoT
CO3- Choose between available technologies and devices for stated IoT challenge

List of Experiments

1. Familiarization with 8051 microcontroller board and Its Interfacing cards.
2. Write a program for up counter 0-9 and display it on seven segment display using 8051 microcontroller.
3. Write a program for down counter from 9-0 using 8051 microcontroller and display it on seven segment display.
4. Interface LCD display with 8051 board and write program to display string HELLO WORD.
5. Write a program to move stepper motor in clock wise direction using 8051 microcontroller.
6. Familiarization with Arduino Uno microcontroller board and write a program for LED blinking.
7. Write a program to read analog voltage using Arduino Uno microcontroller board.

EIM -107	**Digital VLSI Circuits Design**	L	T	P	C
		3	1	0	4

COURSE OUTCOMES

On completion of the course, student will be able to

CO1: Identify the various IC fabrication methods.
CO2 : Express the Layout of simple MOS circuit using Lambda based design rules.
CO3 : Apply the Lambda based design rules for subsystem design
CO4 : Differentiate various FPGA architectures.

Unit 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.

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

Unit 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.

Unit 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

Unit 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.

EIM -109	**Linear System Theory**	L	T	P	C
SEM-1		3	1	0	4

Course Outcomes: At the end of the course, the student will have the ability to:

CO1: Analyze the solution of state equations using tools of Linear algebra.
CO2: Create state models using physical variables, mathematical variables and to solve the state equation.
CO3: Identify appropriate techniques to analyze the system for its controllability and observability.
CO4: Apply Lyapunov theorem of stability to linear and nonlinear systems.

Unit 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.

Unit 2 - Stability: 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.

Unit 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.

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

Unit 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

EIM -111	Artificial Neural Network & Fuzzy Logic	L	T	P	C
		3	1		4

Course Outcomes

At the end of the course, the student will have the ability to:

CO1- Apply biological inspired concepts/ techniques to solve engineering problems.
CO2- To design methods to optimize solution of complex problems
CO3- To analyze statistical data using fuzzy logic concepts.
CO4- To evaluate mathematical problems with vague or less information

Unit 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).

Unit 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).

Unit 3. 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.

Unit 4. 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.

Unit 5. 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.

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

EIM -113	Inteligent Instrumetnation	L	T	P	C
		3	1		4

Course Outcomes:
At the end of the course, the student will have the ability to

CO1- To discuss concepts of robotics, robot mechanism and its classification.
CO2- Practical analysis of robotic mechanism and its functioning at different abstraction levels.
CO3- To discuss real time systems and its scheduling.
CO4- Evaluation of expert system for real time control applications.

Unit 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.

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

Unit 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.

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

Unit 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

EIM -117P	**Python Programming Lab.**	L	T	P	C
		0	0	3	2

Course Outcomes

At the end of the course, the student will have the ability to

CO1: Understand Python code, develop medium-difficulty applications in Python.
CO2: Understand the pros and cons on scripting languages vs. classical programming languages.
CO3: Use Python data structure & develop Python programs by defining functions & calling them.
CO4: Understand object oriented programming

List of experiments

1- Introduction to python programming and python datatypes.
2- Python program to find the union of two lists.
3- Python program to find the intersection of two lists.
4- Python program to remove the "i" th occurrence of the given word in a list where words repeat
5- Python program to count the occurrences of each word in a given string sentence.
6- Python program to check if a substring is present in a given string.
7- Python program to map two lists into a dictionary.
8- Python program to count the frequency of words appearing in a string using a dictionary.
9- Python program to create a dictionary with key as first character and value as words starting With that character.
10- Python program to find the length of a list using recursion.
11- Python program to read a file and capitalize the first letter of every word in the file.
12- Python program to read the contents of a file in reverse order.
13- Python program to create a class in which one method accepts a string from the user and another prints it.
14- Study and Implementation of Database, Structured Query Language and database connectivity.

चरैवेति चरैवेति

महात्मा ज्योतिबा फुले
रुहेलखण्ड विश्वविद्यालय, बरेली

SEMESTER II

EIM -102	*Biomedical Instrumentation and Imaging System*	L	T	P	C
SEM -II		3	1	0	4

Course Outcomes
At the end of the course, the student will have the ability to

CO1. Understand and formulate the Automation Pyramid structure.
CO2. Sketch and demonstrate the different controllers
CO3. Draw ladder logic programming for different applications.
CO4. Understand distributed control system and SCADA process.

Unit 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.

Unit 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.

Unit 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.

Unit 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.

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

EIM -104	Nano-electronics Technologies	L	T	P	C
SEM -II		3	1	0	4

Course Outcomes
At the end of the course, the student will have the ability to

CO1. Understand and formulate the Automation Pyramid structure.
CO2. Sketch and demonstrate the different controllers
CO3. Draw ladder logic programming for different applications.
CO4. Understand distributed control system and scada process.

UNIT-1 Introduction and Preliminary Concepts: Macro-, Meso, Micro and Nanostructure of Materials and its preperation**,**. synthesis of nano materials(top dowan and bottam approch)
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.

UNIT-2 Introduction to Nanoelectronics , MOSFET Scaling & implications, Introductory concepts of Ballistic transport, Quamtam size effect and Quantum confinement, Differences in Few Electron Devices (as analog version) and Single Electron Devices (as digital version) of Nanoelectronic,

UNIT-3 Micro and Nano Fabrication: Basic Micro-fabrication Techniques, Lithography, Thin Film Deposition and Doping, Etching and Substrate Removal, Substrate Bonding, Nanofabrication Techniques, E-Beam and Nano-Imprint Fabrication, Epitaxy Engineering, Scanned Probe Technique.

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

UNIT-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.

Reference Texts .

1- Principles of Instrumental Analysis - Douglas A Skoog, F. James Holler and Timothy A. Nieman, 4th Edition ©1998.
2- An introduction to material Science – V Raghavan
3- Biosensors: A Practical Approach, J. Cooper & C. Tass, Oxford University Press, 2004.

EIM -106	Industrial Automation	L	T	P	C
SEM -II		3	1	0	4

Course Outcomes

At the end of the course, the student will have the ability to

CO1. Understand and formulate the Automation Pyramid structure.
CO2. Sketch and demonstrate the different controllers
CO3. Draw ladder logic programming for different applications.
CO4. Understand distributed control system and SCADA process.

UNIT 1- Introduction to Automation Technology: Concept and scope of automation, socio economic consideration, types of automation, low cost automation, automation pyramid, advantages and limitation of automation, sensor and actuator

Unit 2 – Controller Principle - Process Characteristics: Process Equation, Process Load, Process Lag, Self-Regulation. Control System parameters: Error, Variable Range, Control parameter Range, Control Lag, Dead Time, Cycling, Controller Modes. Discontinuous Controller Mode: Two Position Mode, Multiposition Mode, Floating Control Mode. Continuous Control Mode: Proportional Control Mode, Integral Control Mode, Derivative Control Mode. Composite Control Modes: PI Control, PD Control, PID Control

Unit 3- Programmable Logic Controllers (PLC): Block diagram of PLC – principle of operation – expansion modules – power supplies to PLC – modular PLCs - Applications , PLC Hardware Concepts, PLCs. Different Modules and Specifications, CPU, Memory Design, and recording/Retrieving Data, PLC Programming Symbols used – relays and logic functions and their application, Timer and Counters

Unit 4: Circuit Design & Hardware Interfacing - Design of pneumatic and hydraulic circuits & selection of components, different electro pneumatic and electro hydraulic circuits and related components, Different relays, Digital and Analog sensor interfacing, HMI Programming and interfacing, Hydraulic and pneumatic circuit control using PLC, Different application

Unit 5: Supervisory Control and Data Acquisition (SCADA) - Introduction to Supervisory Control and Data Acquisition, SCADA Functional requirements and Components, General features, Functions and Applications, Benefits, SCADA Communication protocols: Past Present and Future, SCADA Hardware and software

Recommended Text Books

1. Frank D. Petruzella, Programmable Logic Controllers, Glencoe McGraw Hill Second Edition,
2. Industrial instrumentation, control and automation, JAICO publication, S. Mukhopadhyay,Deb
3. Hydraulics and pneumatics, Butterworth Heinemann, 2nd edition, Andrew parr.
4.John W Webb & Ronald A Reis, “Programmable logic controllers: Principles andApplications”, Prentice Hall India, 2003.

EIM -106 P	Automation Lab	L	T	P	C
SEM -II		0	0	3	2

Course Outcomes
At the end of the course, the student will have the ability to

CO1- Understand the basics of PLC programming.
CO2- Understand the different parameters of PLC.
CO3- Design different process control applications through ladder logic.
CO4- Analyze & explain different functions of PLC

List of Experiments

Experiment 1 - Study hardware and software used in PLC
Experiment 2 -Implementation Logic Gates
Experiment 3 -Implementation Of DOL Starter
Experiment 4 -Implementation Of On-Delay Timer
Experiment 5- Implementation Of Off-Delay Timer
Experiment 6 - Implementation Of Up-Down Counter
Experiment 7 - Implementation Of PLC Arithmatic Instructions
Experiment 8 - Implementation Of PID Controller
Experiment 9-In certain process control application when the count reaches 25, a paint spray is to run for 40 seconds. Design, construct, and test PLC circuits for this process.
Experiment 10**:** Design and implement ladder logic to interface analog sensor with PLC.
Experiment 11 **:**To control the speed of the DC motor using analog input and PWM.

Text Books

1-Programmable logic controllers, Mc Graw Hill Publication, Frank D. Petruzella.
2-Starr Brian, Basics of Industrial Automation, by Brian Starr
3-Fiset Yves, Human-Machine Interface Design for Process Control Applications

Reference Books

1-Hackworth John R., Programmable Logic Controllers: Programming Methods and Applications
2- Kevin Collins, PLC Programming for Industrial Automation.

EIM -108P	Simulation Lab	L	T	P	C
SEM -II		0	0	3	2

Course Outcomes
At the end of the course, the student will have the ability to
CO1: Understand Basics of MATLAB coding.
CO2: Write the program for a given problem in MATLAB coding.
CO3: Simulate various electric circuits in MATLAB simulation tool.

List of Experiments
Exp 1- Study of basic matrix operations
Exp 2- To solve linear equation
Exp 3- Solution of Linear equations for Underdetermined and Overdetermined cases.

Exp 4-Determination of Eigen values and Eigen vectors of a Square matrix and Solution of Difference Equations
Exp 5- Solution of Difference Equations using Euler Method.
Exp 6- Solution of differential equation using 4th order Runge- Kutta method.
Exp 7- Determination of roots of a polynomial.
Exp 8 -Determination of polynomial using method of Least Square Curve Fitting.
Exp 9 -Determination of polynomial fit, analyzing residuals, exponential fit and error bounds from the given data.
Exp 10-Analyse the Simulink model of the RLC circuit

EIM -110	**Nonlinear Control**	L	T	P	C
SEM -II		3	1	0	4

Course Outcomes
At the end of the course, the student will have the ability to

CO1 - Design and implement simple feedback control systems for regulating a nonlinear system.
CO2 - Stability Analysis of nonlinear system
CO3 - Design and implement systems to improve nonlinear system performance in the presence of constraints.
CO4 - Design and implement observers and estimators for nonlinear systems.

Unit 1:Introduction: Nonlinear Control, Common Nonlinearities in Control systems, Differences in Linear and Nonlinear System characteristics.

Unit-2: Describing Function: Describing Functions of Common Nonlinearities-computing describing functions, describing functions analysis of non linear systems, stability analysis.

Unit-3:Fundamentals of Lyapunov Theory: Nonlinear Systems and Equilibrium Points, Concepts of Stability, Linearization and Local Stability, Lyapunov's Direct Method, Equilibrium Point Theorems, Krasovskii's method, variable gradient method.

Unit-4: Nonlinear Control System Design: Feedback Linearization and the Canonical Form, Input State Linearization, Input-Output Linearization.

Unit-5 Sliding Mode Control, Model Reference Adaptive Control, Backstepping control.

Reference text Books:

1. H. K. Khalil, Nonlinear Systems, 3rd edition, Prentice Hall, 2001.
2. H. K. Khalil, Nonlinear Control, Pearson, 2015.
3. J. J. E. Slotine and W. Li, Applied nonlinear systems, Prentice Hall, 1991.
4. A. Nijemjer and A. van der schaft, Nonlinear dynamical control systems, Springer, 1989.
5. M. Vidyasagar, Nonlinear Systems Analysis, Society for Industrial and Applied Mathematics, 2002
6. Alberto Isidori, Nonlinear Control Systems, Third Edition, Springer, 1995

EIM -112	Soft Computing Techniques	L	T	P	C
SEM -II		3	1	0	4

Course Outcomes

At the end of the course student will be able to learn to

CO1- Develop intelligent systems leveraging the paradigm of soft computing techniques.

CO2- Implement, evaluate and compare solutions by various soft computing approaches for finding the optimal solutions.

CO3 -Recognize the feasibility of applying a soft computing methodology for a particular problem

CO4-Design the methodology to solve optimization problems using fuzzy logic, genetic algorithms and neural networks.

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

Unit 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.

Unit 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 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.

Unit 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.

Unit 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.

Unit 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

EIM -114	**Robotics Technology**	L	T	P	C
SEM -II		3	1	0	4

Course Outcomes

On completion of this course, the students will be able to

CO1. Understand basic terminologies in robotics.
CO2. Evaluate the forward and inverse kinematics of robots.
CO3. Analysis of various control strategies for robots.
CO4. Develop trajectory planning for robots.

Unit 1. Introduction to Robotics: Evolution of Robots and Robotics, Progressive advancement in Robots, Robot component , Robot Anatomy, Robot Degree of Freedom, Robot Joints, Robot Co-ordinates, Robot Reference frames, Robot characteristics, Robot Workspace,

Unit 2. Kinematics and Dynamics of Robot : Robot as Mechanism, Conventions, Matrix representation, Homogeneous Transformation, Representation of transformation, Inverse of Transformation, Forward and Inverse Kinematic of Robots, Forward and Inverse kinematics equations: position and orientation, Jacobian, Lagrangian Mechanics, Dynamic Equation for multiple degree of freedom robots

Unit 3. Control Of Manipulators – State Space Analysis, Control of Manipulator in joint space, Characteristics of second order linear systems- Linear Second order-SISO model of a manipulator joint- Joint Actuator partitioned, PD control scheme –PID control scheme –computed torque control

Unit 4. Robust and Adaptive Control Of Robot: Feedback linearization, Robust Control of manipulator, Adaptive Control by computer torque approach, Robustness of Adaptive controller

Unit 5. Trajectory Planning: Path versus Trajectory, Joint space versus Cartesian space Descriptions, Basics of trajectory Planning, Joint space trajectory, Robot Applications,

Text Books

1.Introduction to Robotics , Saeed B Niku, Wiley publication
2.Introduction to Robotics: Mechanics and Control, John J Craig, Pearson Publication

Reference Books

1. Francis N. Nagy, Andras Siegler, Engineering foundation of Robotics, Prentice Hall Inc.,.
2. P.A. Janaki Raman, Robotics and Image Processing an Introduction, Tata McGraw Hill Publishing company Ltd..
3. Carl D. Crane and Joseph Duffy, Kinematic Analysis of Robot manipulators, Cambridge University press.

EIM -116	VLSI Technology	L	T	P	C
SEM -II		3	1	0	4

Course Outcomes

On completion of this course, the students will be able to

CO1- Understand the purification process of silicon.

CO2- Understand the fabrication process of IC technology

CO3- Understand the different instruments used in fabrication process.

CO4 - Analysis of the design rules and layout diagram

Unit 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.

Unit 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.

Unit 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.

Unit 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.

Unit 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.