MALNAD COLLEGE OF ENGINEERING, HASSAN

(An Autonomous Institution Affiliated to VTU, Belgaum)

Autonomous Programmes

Bachelor of Engineering

DEPARTMENT OF ELECTRONICS AND INSTRUMENTATION ENGINEERING

SYLLABUS

VII& VIII Semester (2020 Admitted Batch)

(175 Credits Scheme)

(4th Year)

Academic Year 2023-24

MALNAD COLLEGE OF ENGINEERING, HASSAN
(An Autonomous Institution Under VTU, Belagavi)

Department of Electronics & Instrumentation Engineering

VISION of the Department

The Department will be a center of excellence for Electronics and Instrumentation studies driven by research in association with industry and society

MISSION of the Department

1. To augment infrastructure in emerging technologies .
2. To provide student centered environment for effective learning by giving hands-on experience.
3. To develop research culture and create facilities for transforming idea into products to cater to society and industrial needs.
4. To collaborate with industry, academia and research organizations for contribution to the higher order learning and research.
5. To prepare students to meet the challenges of dynamic industrial requirements and higher education.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

The Students are expected to Possess:

1. Capacity to undertake automation jobs having competency in design of controllers, installation, commissioning, operation and maintenance of process plants in coordination with interrelated domain team.
2. Social responsibility, leadership capability and integrity in their professional career.
3. Acumen to pursue higher education in interrelated domains of instrumentation.
4. Ability to design and implement projects relevant to industry and community taking into account social, ethical and environmental considerations.
5. Knowledge of computational platforms and software applications related to domain needs.

PROGRAM OUTCOMES (POs)

1. **Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem Analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/Development of Solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct Investigations of Complex Problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern Tool Usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The Engineer and Society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and Sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and Team Work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project Management and Finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long Learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PSOS)

PSO1: Adopt concepts of measurement and transduction for instrumentation.
PSO2: Employ knowledge of instrumentation for process automation.

Scheme of Evaluation (Theory Courses)

Assessment	Marks
THREE CIE's conducted for a total of 40 marks	40
Activities as decided by course faculty	10
SEE	50
Total	100

Scheme of Evaluation (Laboratory Courses)

Assessment	Marks
Continuous Evaluation in every lab session by the Course coordinator	**10**
Record Writing	**20**

Laboratory CIE conducted by the Course coordinator	**20**
SEE	**50**
Total	**100**

Examination	Maximum Marks	Minimum marks to qualify
CIE	**50**	**20**
SEE	**50**	**20**

VII Semester

Course Category	Course Code	Course Title	L	T	P	C	Contact Hours
PC 25	20EI701	PLCs and DCS in Process Control Automation	3	0	1	4	5
PC 26	20EI702	Artificial Neural Networks and Applications	3	0	1	4	5
PE 3	20EI75X	Elective – Group III	3	0	0	3	3
PE 4	20EI76X	Elective – Group IV	3	0	0	3	3
OE 2	20OEEI7X	Open Elective II	3	0	0	3	3
SW	20SW02	SWAYAM Course-II (Mandatory Audit Course)	3	0	0	0	3
		Total Credits				**17**	**22**

Professional Electives			
Group III		**Group IV**	
20EI751	Nano Sensors	20EI761	Computer Vision
20EI752	VLSI Technology and Design	20EI762	Speech Signal Processing
20EI753	Wavelet Transforms	20EI763	Advanced Biomedical Instrumentation
20EI754	Biomedical DSP	20EI764	DSP Architecture
20EI755	Visual Basic	20EI765	Pattern Recognition
20EI756	Artificial Intelligence for Instrumentation	20EI766	Medical Imaging
20EI757	Cyber Physical Systems	20EI767	Digital Twin Technology
Open Electives			
20OEEI71	Industrial Process Control	20OEEI73	Foundations of Innovations
20OEEI72	Micro and Smart System Technology		

VIII Semester

Course Category	Code	Course Title	L	T	P	C	Contact Hours
SR 1	20EI801	Seminar on Advanced Topics	0	0	0	2	-
PW 3	20EI802	Project Work	0	0	18	9	18
HSM 8	20EI803	Entrepreneurship & Management	4	0	0	4	4
-	20EI804	Internship (four weeks)	0	0	2	2	-
PE 5	20EI85X	Elective Group V	3	0	0	3	3
		Total Credits				**20**	**25**

Professional Electives			
Elective – Group V			
20EI851	Intellectual Property Rights	20EI852	R Programming for Data Science
20EI853	Lasers & Optical Instrumentation	20EI854	Java Programming
20EI855	Machine Learning	20EI856	Virtual & Augmented Reality
20EI857	Industry 4.0 and IIoT	20EI858	Digital Image Processing

Note: HSM: Humanities, Social Sciences & Management Course, BS: Basic Science Course, ES: Engineering Science Course, PC: Professional Core Course, PE: Professional Elective Course, OE: Open Elective Course; PW: Project/Mini Project Work, SR: Seminar Technical

Course Title:	**PLCs AND DCS IN PROCESS CONTROL AUTOMATION**	**L**	**T**	**P**	**C**
Course Code:	**20EI701**	**3**	**0**	**2**	**4**
Hours / week: 5	**CIE: 50 Marks SEE: 50 MarksExam hours: 3 Total hours: 40+12**				

Prerequisites: Logic design, Control Systems, Process Control and Data Converters.
Course Outcomes: Upon completion of this course, students should be able to:
CO1: Explain issues of plant automation
CO2: Distinguish various programming devices and techniques
CO3: Identify various I/O modules and their addressing modes
CO4: Develop PLC program using ladder diagram approach and execute the same.
CO5: Explain the features of SCADA and DCS in process automation.
*Note: Evaluation of lab component of this course is done based on the rubrics which will be shared with the students by course faculty.

MODULE-1

1.Overview of plant Automation Concepts and Introduction to PLC: Aim of plant automation, Classical approaches of Plant Automation, Computer based Plant Automation Concepts, Distributed Computer

Control. Introduction to PLCs: Basics of PLCs, Innovations incorporated in to the programmable Controller, Introduction to fixed and modular PLC hardware, and the central Processing Unit. **Introduction to programming Techniques and Logic:** Hand held Programming Terminals, desktop PCs and PLC programming, the IEC 1131-3 programming standard; ladder diagram, Functional Block diagram, sequential flow Chart. Introduction to Logic: Conventional Ladder versus PLC Ladder logic, what is Logic? Implementation and analysis of logic functions; AND, OR, NOT and EX-OR using Ladder diagram and Functional Block diagram techniques, Conventional Logic and priority of logic elements.

10 Hours

MODULE-2

2. **Introduction to Digital and Analog PLC Interface:** The digital Concept, the input and output status files and fixed PLCs, 16 point I/O Modules with Decimal Addressing, Fixed PLC I/O Addressing when I/O is expanded, 32 bit control Logic PLC, Analog I/O interface to the PLC. **Input and Output Modules of PLCs:** Input Modules: Discrete input AC Module, DC input Module, Sinking and sourcing, Solid state interface to DC input Modules. Output Modules: Discrete output Modules, Relay output Modules, model selection consideration, criteria to choose the proper output module, isolated output module, Interposing Relays, surge suppression and Output modules, analog output modules.

10 Hours

MODULE-3

3. **PLC Instructions:** The Basic Relay Instructions, The Normally OPEN and normally CLOSED Instructions, the one shot Instruction, The output latching Instruction, the negated output Instruction. Understanding Relay instructions and the programmable controller Input Modules: Interfacing a Start-Stop Push Button station and Motor to a PLC. Construction of Ladder diagram for analytical problems.Timer instructions: Timer instructions, the ON – delay Timer and OFF delay Timer instructions, the retentive timer Instruction, The RESET Instruction. Counter Instructions: the Count Up and Countdown Instruction, The counter Reset and Clear Instruction, Combining Counters and Timers. Construction of Ladder diagram for analytical problems.

10 Hours

MODULE-4

4. **PLC Instructions continued:** Comparison and Data handling Instructions: comparison, Data handling and Logical Instructions. Sequencer Instructions: The Sequencer Instructions, Programming the output Sequencer Instructions. Construction of Ladder diagram for analytical problems. **Introduction to SCADA and DCS:** Supervisory Control and data Acquisition System: Channel Scanning, Data Processing, distributed SCADA Structure; Star and daisy Chain configuration. Distributed Control Systems: Distributed dedicated, Centralized and decentralized Computer Control Concept. Functional Requirements of DCS, System architecture, Functional Levels of DCS, Sub Systems; Presentation and Monitoring Devices, Communication links in DCS.

10 Hours

Lab Component:

1. Develop the Ladder diagram for various discrete state systems and simulate using PLC.
2. Develop the ladder diagram for Bottle filling process and conduct an experiment using PLC.
3. Develop the ladder diagram for elevator system and conduct an experiment using PLC.
4. Develop the ladder diagram for Level control and conduct an experiment using PLC.
5. Develop the ladder diagram for cylinder forward-reverse operation and conduct an experiment usingPLC.
6. Develop PLC programs using virtual lab platform and simulate.

Text Books:

1. **Introduction to Programmable Logic Controllers**, Garry Dunning, 3nd edition, Centage learning. (Chapters:1, 3 &6, 5, 7 & 8, 13 &14, 16, 17 & 18).
2. **Computer based Industrial Control**, Krishna Kant, PHI.(Chapters 1, 3 & 6)

Reference Book:

1. Process Control Instrumentation technology, Curtis Johnson, 4th Edition PHI.(Chapter 8 – for analytical problems)

E Books:

1. http://www.learnerstv.com/Free-engineering-Video-lectures-ltv689-Page1.htm
2. http://nptel.ac.in/courses/103105064/

MOOCs:

1. https://www.mooc-list.com/tags/process-management
2. http://freevideolectures.com/Course/2345/Industrial-Automation-and-Control/3

CO-PO, PSO Mapping

EI 702	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1.	3													
CO2.		3												
CO3.	2			2	2							1		
CO4.			3		3			1	2	1			1	3
CO5.	3				2							1		

Course Title:	ARTIFICIAL NEURAL NETWORKS AND APPLICATIONS	L	T	P	C
Course Code:	20EI702	3	0	2	4
Hours / week: 5	CIE: 50 Marks SEE: 50 Marks Exam hours: 3 Total hours: 40+12				

Course Outcomes: Upon completion of this course, student should be able to:

CO1: Explain fundamental concepts of biological and artificial neurons
CO2: Analyse various ANN learning algorithms
CO3: Elaborate functional aspects of single layer and multilayer perceptron
CO4: Explain functionalities of RBF and SOM network
CO5: Develop ANN based learning system using MATLAB

*Note: Evaluation of lab component of this course is done based on the rubrics which will be shared with the students by the course faculty.

MODULE-1

Introduction: Human Brain, Models of a Neuron, Neural Networks viewed as directed graphs, Feedback, Network architectures. **Learning Processes:** Introduction, Error correction algorithm, Memory based learning, Hebbian Learning, Competitive learning, Boltzmann learning, learning with a teacher,

Self-Learning Component: Knowledge Representation, learning without a teacher.

10 Hours

MODULE-2

Single Layer Perceptrons: Learning tasks, Memory, Adaptation, Introduction to Perceptron and perceptron convergence theorem, Relation between the Perceptron and Bay's classifier for a Gaussian environment. **Multilayer Perceptron:** Some preliminaries, Back Propagation Algorithm, Summary of the Back Propagation Algorithm, Virtues and limitations of Back-propagation learning,

Self-Learning Component: accelerated convergence of Back-propagation learning.

10 Hours

MODULE-3

Radial Basis Function Networks: Architecture, Generalized Radial Basis function networks (RBF), Approximation properties of RBF networks, Comparison of RBF networks and Multi-layer Perceptron, learning strategies. **Self-organizing Maps (SOM):** Introduction, Basic feature mapping models, Summary of the SOM algorithm, properties of feature map, Applications. Hopfield Networks (Architecture only).
Self-Learning Component: Applications of RBF networks.

10 Hours

MODULE-4

MATLAB(An Overview) and Programming: Features and capabilities of MATLAB, Programming in MATLAB to Generate activation functions used in neural networks, Realize Mc-Culloch-Pitts model of neural network, simulation of Hebb network, Programs to simulate single layer perceptron (Continued from the previous unit). Feed forward networks and their simulation using MATLAB.
Self-Learning Component: Elementary programs for single layer perceptron.

10 Hours

Text Books:

1. **Neural Networks-A Comprehensive Foundation**, Simon Haykin, Prentice-Hall India, Second Edition, 2005. (For Units 1 to 4)
2. **Introduction to Neural Networks using MATLAB**, S.N. Sivanandam, S. Sumathi and S.N. Deepa, Tata McGraw hill, First Edition. (For Units 5 to 8)

Reference Books:

1. **Artificial Neural Networks**, B. Yegnanarayana, Prentice-Hall India, First edition, 1999.
2. **Introduction to Artificial Neural Networks**, S. N. Sivanandam and M Paulraj, Vikas Publishing, First edition, 2003.

E Books:

1. Neural Network and Pattern Recognition, Christopher M Bishop, Aston University, UK, 1995 (http://cs.du.edu/~mitchell/mario_books/Neural_Networks_for_Pattern_Recognition_-_Christopher_Bishop.pdf)
2. Neural Network Design, Oklahoma University (http://hagan.okstate.edu/NNDesign.pdf)

MOOCs:

1. https://www.coursera.org/learn/machine-learning/home/welcome
2. http://nptel.ac.in/courses/117108048

Laboratory Component: Hours/week: 2 hours/batch

1. Calculate the output of a simple neuron.
2. Create and view custom neural networks.
3. Generate ANDNOT function using McCullosh-Pitts neural net by a MATLAB program.
4. Generate XOR function using McCullosh-Pitts neural net by a MATLAB program.
5. Classification of linearly separable data with a perceptron.
6. Classification of an XOR problem with a multilayer perceptron.
7. Radial basis function networks for function approximation.
8. Radial basis function networks for classification of XOR problem.
9. Write a MATLAB program for Hebb net to classify two-dimensional input patterns in bipolar with their given targets.
10. 1D and 2D Self Organized Map.

Evaluation Criteria: In place of activity for 10 marks, Lab component is evaluated using Continuous Evaluation (5 marks) and Record writing (5 marks).

CO-PO, PSO Mapping

EI 703	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
	3											1		
		1			2									
	3													
					3									2
				2	2									
			3		2									

Course Title:	NANOSENSORS	L	T	P	C
Course Code:	20EI751	3	0	0	3
Hours / week: 3	CIE: 50 Marks SEE: 50 Exam hours: 3Total hours: 40				

MODULE 1

Introduction to Nanotechnology: Introduction, Definition, Surface Area to Volume Ratio, Nanostructures, 0-D nanostructures,1-D nanostructures, 2-D nanostructures,3-D nanostructures, Atomic force microscopy (AFM), AFM modes, AFM images and Scanning Electron microscopy (SEM).

Introduction to Sensor's Science and Technology: Transmission electron microscopy (TEM), Nano scale structure fabrication, Top-Down Fabrication, Bottom-up Fabrication, Senses, Vision, Hearing and Smell Sensors ,Classification of sensors ,Optical sensors ,Chemical sensors ,Electrochemical sensors ,Mass sensitive sensors ,Biosensors ,Parameters for characterizing sensors ,Electronic nose, Optoelectronic nose ,Sensors for Electronic Applications and Machine learning.

10Hours

MODULE 2

Metal Nanoparticle-Based Sensors: Nanoparticles/Quantum Dots, Types of Metal Nanoparticles, Shapes of Metal Nanoparticles ,Molecular Modifications of Metal Nanoparticles ,Controlled Binding Between Adjacent Metal Nanoparticles, Characteristics of Molecularly Modified Metal Nanoparticles, Production of Metal Nanoparticles, Production of Nanoparticles by Laser Ablation, Production of Nanoparticles by Chemical Route, Production of Encapsulated Metal Nanoparticles, Shape Control of Produced Nanoparticles, Programmed Assembly of Functionalized Nanoparticles, Chemiresistors Based on Molecularly Modified Metal, Effect of Chain Length, Sensing Mechanism in Chemiresistors of Nanoparticles, Effect of Cross-Linking on Chemiresistors of Nanoparticles, Effect of Nanoparticle Shape on the Related Chemiresistors, Medical and Biological Applications of Gold Nanoparticles, Attachment of Gold Nanoparticles to Cell Surfaces, Gene and siRNA Delivery, Drug Delivery ,Nanoparticles as Cancer Diagnostic & Therapeutic Agents ,Nano shells for Cancer Treatment ,Imaging and Hyperthermia using (Au/SiO2) Nano shells.

Quantum Dot Sensors: Definition and Main Properties, Quantum Size Effect ,Functionalization of Quantum Dots ,Synthesis of Quantum Dots ,Synthesis of Quantum Dot, Heterostructures, Self-Organized Quantum Materials, Surface Modification of Quantum Dots ,Sensing and Imaging Application With Quantum Dots, Temperature Sensors Based on Quantum Dots, Chemical Sensors based on Quantum Dots, Biosensors Based on Quantum Dots, Quantum Dots and Imaging.

10Hours

MODULE 3

Nanowire-based Sensors : Nanowire, Properties of Nanowires ,Fabrication of Nanowires ,Top-Down ,Bottom-Up ,Fabrication of Nanowire, Devices by e-beam Lithography ,Roll-Transfer of Nanowires ,Nanowires in Sensing Application, in Liquid or *In-vivo* Environments ,Electrical Transport in Si NWs ,Surface Modification of Si NWs ,Chemically Sensitive Field Effect Transistors ,Si NW pH Sensors ,3D Kinked Nanowire Probes ,Optical Detection of Relative Humidity ,Semiconducting Nanowire Sensors for Gas Sensing Applications ,Gas Sensor based on FET with Single Si NW , Elimination of Trap States by Attaching Dense Receptors via Si-O-Si Bond ,Polar and Nonpolar Sensing using Si, NW FETs ,Effect of Functional (End) Group on the Gas Sensing of Si NW FETs ,Effect of Chain Length on the Gas Sensing of Si NW FETs and Sensing Mechanism.

Carbon Nano tube-based Sensors: Structure and Properties of Carbon Nanotubes, Electrical Properties of CNTs ,CNT Strength and Elasticity ,CNTs Thermal Conductivity and Expansion ,CNT High Aspect Ratio ,Carbon Nanotubes Synthesis ,Chemical Vapor Deposition (CVD) ,Arc Discharge ,Laser Ablation ,Functionalized Carbon Nanotubes, Carbon Nanotubes for Sensing Applications ,CNT-based Electrical Sensors ,DNA Sensing by FETs Based on Networks of Carbon Nanotubes ,Detection of Explosives & Toxins in Water by CNT FETs ,CNT- based Biosensors ,CNT-based Electrochemical Sensors ,CNT-based Optical Sensors ,Magnetic Particle-Based Sandwich Sensors with CNTs ,Nano scale Mass Sensor based on CNTs ,CNTs as Sensors for Gaseous Species ,Sensing Mechanism of Bare CNT-based Electrical Gas Sensors ,CNT-based Electrical Gas Sensor , A Single-Walled Carbon Nano tube Network Gas Sensing Device ,Sensors Based on Composites of CNTs and Non-Polymeric Materials ,Minimizing the Humidity Effect on CNT-based Electrical Sensors ,A Tunable Photo sensor based on CNTs ,An ultrasensitive Nano mechanical Mass Sensor based on a single CNT.

10Hours

MODULE 4

Sensors based on Nanostructures of Metal Oxide and Polymers: Production and Classification of Metal Oxide Nanostructures, Classifications of Metal Oxide , Nanostructures ,Production of Metal Oxide Nanostructures ,Sensing Mechanisms of Metal Oxide Gas Sensors ,The Effect of Chemisorption on the Metal Oxide Sensors ,NO2 Reaction Mechanism ,PO8 Reaction Mechanism ,Resistive Oxygen Sensors ,Improvements in Sensitivity of Metal Oxide Sensors ,Thin Film Gas Sensors ,Sacrificial Microsphere Templates ,Nanowire and Nano fiber (1D) Metal Oxide Sensors ,Properties of Polymeric Nanostructures ,Conducting Polymers, Synthesis and Production Approaches of Polymeric Nanostructures ,Hard Template Approach ,Soft Template Approaches ,Electro spinning Technique ,Polymeric Nanostructure-based Sensors ,Electrical Sensors ,Biosensors (Liquid Phase) , Mechanical Sensors in a Liquid Solution.

Electronic Skin based on Nanotechnology: Polymeric Nanostructures for Gas Sensing Applications, Molecularly Imprinted Polymers ,Polycyclic Aromatic Hydrocarbons ,Properties of the Human Skin ,Flexible Electronics ,Electronic Skin for Robots , Touch Sensors for Prosthetics ,Surgical Robotics ,Electronic Skin for Health Monitoring, Electronic Skin Based on Nanowires and Organic Field Effect Transistors ,Organic FETs for Electronic Skin Applications , Strategies To Enable Tactile Sensing for Organic Electronics ,Nanowire Active Matrix ,Gold Nanoparticles and Carbon Nanotubes based Pressure Sensors ,Nanoparticle-based Strain Sensors ,Nanoparticle-based Multi-Purpose Sensors ,Carbon Nano tube Strain Sensor for Human-Motion Detection ,CNT Skin-like Pressure and Strain Sensors.

10Hours

Text Book:

1. Nanotechnology and Nanosensors, HossamHaick, Technion, Israel Institute of Technology, 2013 Edition

Reference Books:

1. Nanosensors: Materials and Technologies, Nada F. Atta, International Frequency Sensor Association (IFSA) Publishing, 2013 Edition
2. Nanosensors for Chemical and Biological Applications, Sensing with Nanotubes, Nanowires and Nanoparticles, *K. C. Honeychurch*, Elsevier, 2014 edition

Course Title:	VLSI TECHNOLOGY AND DESIGN	L	T	P	C
Course Code:	19 EI752	3	0	0	3
Hours / week: 3	CIE: 50 Marks SEE: 50 MarksExam hours: 3 Total hours: 40				

Prerequisites: Logic design, Electronics Devices and Circuits

Course Outcomes: Upon completion of this course, students should be able to:

CO1. Explain the clean room environment and technology required for fabrication process.
CO2. Explain design rules for all types of VLSI circuits.
CO3. Illustrate the fabrication steps of nMOS, CMOS and BiMOS technology.
CO4. Design CMOS based combinational logic circuits and chips.

MODULE-1

Introduction to VLSI: Introduction, Clean room classification, Clean room Design concept, Clean room operations, Summary and future trends.

Wafer cleaning technology: Introduction, Basic concepts of wafer cleaning, Wet cleaning technology, Dry cleaning technology, Summery and future trends.

10 Hours

MODULE-2

Basic MOS Structure: Introduction, Basic MOS transistor operation, MOS transistor switches, nMOS fabrication, `Basic CMOS technology, CMOS process enhancements, BiCMOS technology

MOS Device characteristics: Introduction, Static behavior of the MOS Transistor, Dynamic behavior of MOS transistor, Actual MOS transistor – Secondary effects, nMOS Inverter, pass transistor and determination of pull- up to pull down ratios.

10 Hours

MODULE-3

CMOS inverter design: Introduction, CMOS inverter - DC characteristics, Design parameter of CMOS inverter, switching characteristics of CMOS inverter, CMOS – gate transistor sizing stage ratio, Power dissipation.

MOS circuit design processes: Introduction to Design rules, MOS layers, Stick diagrams, Design rules and layout.

10 Hours

MODULE-4

CMOS combinational logic circuits: Static CMOS Design, Dynamic CMOS design, Complex logic gates in CMOS.

CMOS chip design: Design strategies, CMOS chip design options.

10 Hours

Text Books:

1.ULSI technology:-International Edition, C.V CHANG and S.M SZE, McGRAW-HILL International editions, 2006.

2.VLSI Design: A.Albert Raj and T.Latha, PHI Learning Private Limited. 2008.

Reference Book:

1. Basic VLSI design, 3rd Edition, Douglas A Pucknell and Kamran Eshragaian, PHI.

Course Title:	WAVELET TRANSFORMS	L	T	P	C

Course Code:	20EI753	3	0	0	3
Hours / week: 3	CIE: 50 Marks SEE: 50 MarksExam hours: 3 Total hours: 40				

MODULE-1

Mathematical Preliminaries: Linear spaces, Vector and vector spaces, basic functions, matrix algebra & linear transformations, Fourier series, properties And examples of Fourier transforms

Time Frequency Analysis: Window function, STFT, Discrete STFT, discrete Gabor representation, Continuous wavelet transform, discrete wavelet transform, wavelet series, WVD and its properties.

10 Hours

MODULE 2

Continuous Wavelet Transforms: Continuous time wavelets, CWT as correlation, filter and time resolution operation. Inverse CWT.

Discrete Wavelet Transform: Introduction, vector approximations in nested linear vector subspaces, multi resolution analysis.

10 Hours

MODULE 3

MRA, Orthonormal Wavelets: Introduction, Definition of MRA, Construction of orthonormal MRA, wavelet basics for MRA, digital filter interpretation, examples of orthogonal basics generating wavelets, MRA interpretation for discrete time signals.

Wavelet Applications: Data compression; introduction, transform coding, DTWT for image compression, Audio compression, 1-D signal processing.

10 Hours

MODULE 4

Wavelet Denoising: speckle removal, edge detection & object isolation, image fusion.

Wavelet Packets: Wavelet packet algorithms, Thresholding, 2D wavelets, wavelet packet algorithms for 2D signals, 3D medical image visualization.

10 Hours

Text Books:

1. **Fundamentals of Wavelets: theory-algorithms & applications**, Goswami and Chan, John Wiley & Sons, 1999.
2. **Introduction to theory and applications** – **Wavelet transforms**, Raghuveer M Rao, Ajit S Bopardikar, Pearson LPE, 2006.

Reference Book:

1. **Introduction to wavelets and wavelet transforms-**A Primer – C Sidney Burrus, Ramesh A
2. Gopinath, Guo, Prentice Hall Inc, 1998.

Course Title:	BIOMEDICAL DSP	L	T	P	C
Course Code:	19 EI754	3	0	0	3
Hours / week: 3	CIE: 50 Marks SEE: 50 MarksExam hours: 3 Total hours: 40				

MODULE 1

1. Introduction to Biomedical Signals: Nature of biomedical signals, examples of biomedical signals, objectives of biomedical signal analysis, difficulties encountered in biomedical signal acquisition and analysis .

2. Filtering for Artifacts Removal I: Random noise, structured noise and physiological interference, stationary and non stationary processes, typical case study, time domain filters with application: averaging, moving average filters.

10 Hours

MODULE 2

3. Filtering for Artifacts Removal II: Frequency domain filters with examples, removal of high frequency noise by Butterworth low pass filters, removal of low frequency noise by Butterworth high pass filter, removal of periodic artifacts by notch and comb filters.

4. Event Detection I: P,Q,R,S & T waves detection in ECG, first and second heart sound detection, EEG rhythms, waves and transients, detection of events and waves, derivative based methods for QRS detection.

10 Hours

MODULE 3

5. Event Detection II: Cross spectral techniques: Coherence analysis of EEG channels with application, P wave detection, homomorphic filtering and homomorphic de-convolution.

6. Analysis of Wave Shapes and Waveform Complexity: Wave shapes analysis of ECG with typical applications, morphological analysis of ECG waves using correlation coefficient and ECG waveform analysis.

10 Hours

MODULE 4

7 Neurological Signal Processing I:ECG signal and its characteristics, EEG analysis using PSD, Parametrical model, Phenomenological model, linear prediction theory, correlation canceller realization, first order prediction filter, autoregressive method.

8 Neurological Signal Processing-II: Definition of sleep, data acquisition and classification of sleep stages, dynamic sleep-wake transition hypnogram model parameters.

10 Hours

Text Books:

1. Biomedical signal analysis- A case study approach, RangayyanRangaraj, Wiley Interscience (IEEE Press)-2005 [Units-1,2,3,4,5,6]

2. Biomedical signal processing- Principles and techniques, D.C.Reddy, TMH Co. Ltd. (2005) [Units-7,8]

Reference Books:

1. Digital signal processing- signals, systems and filters by Andreas Antoniou published by TMH Co. Ltd. (2006)
2. Biomedical Digital signal processing by Willis. J. Tompkins published by PHI (Fourth Indian Reprint 2002)

E-Books:

1. www.crcpress.com › Biomedical Science › Biomedical Imaging
2. downloads.hindawi.com/journals/special issues/129194.pdf

MOOCs:

1. www.ocw.mit.edu › Courses › Health Sciences and Technology MIT Open Course War http://ocw.mit.edu
2. www.vub.ac.be/en/study/fiches/30340/biomedical-signals-and-images

Course Title:	VISUAL BASIC	L	T	P	C
Course Code:	20EI755	3	0	0	3
Hours / week: 3	CIE: 50 Marks SEE: 50 MarksExam hours: 3 Total hours: 40				

MODULE 1

Introduction to VB: VB's background, understanding the program maintenance, evenly driven programming.

Working with VB: basic environment, tool bar, form window, form layout window, properties window, getting used to the screen.

10 Hours

MODULE 2

Managing controls: introduction to controls, label control, text box control, command button control, image control, control focus, event procedure, common control unit.

Creating menus: menu editor, adding pull down menu, complementing the menu's message submenu.

10Hours

MODULE 3

Analyzing VB data: data in VB, variables, VB operators, variables and expressions conditional operators

VB programming: calling general procedures, dialog box control, handling, cancel button, producing file service dialog box, printing dialog box.

10 Hours

MODULE 4

Adding power with the mouse and controls responsing to the mouse, list box control, time control, working with arrays.

Reading and writing files, scroll bar, VB projects.

10 Hours

Text Book:

1. Visual Basic 6,Gragperry, Techmedia.

Reference Book:

1. Microsoft Visual Basic 2010 Step by Step, Michael Halvorson, Microsoft Press.

Course Title:	ARTIFICIAL INTELLIGENCE FOR INSTRUMENTATION	L	T	P	C
Course Code:	19 EI756	3	0	0	3
Hours / week: 3	CIE: 50 Marks SEE: 50 Exam hours: 3Total hours: 40				

MODULE 1

1. **Artificial Intelligence:** What is AI? acting humanly, thinking humanly, thinking rationally, and acting rationally. The foundations of artificial intelligence: philosophy, mathematics, economics, neuroscience and psychology, the State-of-the art.Intelligent Agents: Agents and environments, good behavior: the concept of rationality, rationality.

2. **Intelligent Agents (*Contd...*):** omniscience, learning and autonomy. The nature of environments: specifying the task environment, properties of task environments. The structure of agents: agent program, simple reflex agents, model based reflex agents, goal based agents, utility-based and learning agents.

10 Hours

MODULE 2

3. **Solving Problems by Searching:** Problem-solving agents, example problems, searching for solutions, uninformed search strategies: Breadth first search, depth first search, iterative deepening depth-first search, bidirectional search. Searching with partial information.
4. **Logical Agents:** Knowledge –based agents, the wumpus world, propositional logic, reasoning patterns in proportional logic, agents based on propositional logic.

10 Hours

MODULE 3

5. **First Order Logic:** Syntax and semantics of first-order logic, Using first order logic, Knowledge engineering in first-order Logic.
6. **Uncertainty:** Acting under uncertainty: Handling uncertain knowledge, uncertainty & rational decisions, basic probability notation, The axioms of probability, Bayes rule and its useProbabilisticReasoning:representing knowledge in uncertainty domain, semantics of Bayesian networks, extending probability to first order representations, rule based methods for uncertainty reasoning, representing ignorance, representing vagueness.

10 Hours

MODULE 4

7. **Learning from Observations:** Forms of learning, Inductive learning, learning decision trees, computational learning theory.
8. **Statistical Learning Methods:** Statistical learning, learning with complete data, Instance-based learning, unsupervised clustering, Neural Networks: units in neural networks, Network structures, perceptrons and kernel machines.

10 Hours

Text Book:

1. **"Artificial Intelligence A Modern Approach"**, Stuart Russel, Peter Norvig: 2nd Edition, Pearson Education, 2003.

Reference Books:

1. **"Principles of Artificial Intelligence"**, Nils J. Nilsson: Elsevier, 1980.
2. **"Artificial Intelligence",** Elaine Rich, Kevin Knight:, 3rd Edition, Tata McGraw Hill, 2009.

Course Title:	**CYBER PHYSICAL SYSTEMS**	**L**	**T**	**P**	**C**
Course Code:	**20EI757**	**3**	**0**	**0**	**3**
Hours / week: 3	**CIE: 50 Marks SEE: 50 Exam hours: 3Total hours: 40**				

Module 1

1. **What is a Cyber-Physical System? Introduction:**

Our Planet, Our Knowledge, Our Destiny, Observe, Understand, Innovate, Developing New Products, New things in Cyber-Physical Systems, Reconnecting with the Physical World, Conservation Laws, Elements in Mechanical Systems, Lab: Warm up Exercises.

2. **Modeling Physical Systems**

Working in 2D and 3D, Elements in Electrical Systems, The Absence or Presence of Time in a Model, Arithmetic Equations, and Linear and Non-linear Systems of Equations, Time-Dependent and Differential Equations, Prototypes of Equations, Basic Machinery for Solving DifferentialEquations.**10 Hours**

Module 2

3. Hybrid Systems

Introduction, Hybrid Automata, Reset Maps, Zero-Crossing, Zeno Behaviour, Modelling Elastic Collision, Lab: Discrete Bouncing.**5 Hours**

4. Modeling Computational Systems

Introduction, Quantization, Discretization, Boundedness of Digital Memory, The Effect of Quantization and Discretization on Stability, Abstract Modeling of Computational Effects, Modeling Discretization, Discretization, Sampling Rates, and Loss of Information, The Effects of Quantization and Discretization Easily Compound.

10 Hours

Module 3

5. Coordinate Transformation (Robot Arm)

Introduction, Coordinate Transformation, Study Problems, Spherical-Actuation for Ping Pong Robot.

6. Game Theory

The Role of Game Theory in CPS Design, Games, Players, Strategies, Utilities, and Independent Maximization, Rationality, Independence and Strictly Dominant Strategies, Coordination, Intelligence, and Nash Equilibrium, Competitiveness, Privacy, Mixed Strategies.**10 Hours**

Module 4

7. Communications

Communication, Certainty, Uncertainty, and Belief, Messages: From Information to Representation, Belief, Knowledge, and Truth, Carrier Signal, Medium, and Link, Link Characteristics, Limits: Component Dynamics, Noise, Energy Dissipation, Other Sources of Limitations.

8. Sensing and Actuation

Everyday Input and Output, Symmetry: LEDs and Photo-Voltaic Cells, Sensing Temperature, Sensing Position, Actuating Mechanical Systems, Study Problems.**10 Hours**

Text book:

Cyber-Physical Systems: A Model-Based Approach, Walid M. Taha ,Abd-Elhamid M. Taha,Johan Thunberg, Springer 2020

Reference books:

1. Cyber-Physical Systems: Concepts, Technologies and Implementation Principles, Imre Horvath, Bart H. M. Gerritsen, DUT, 2017
2. An introductory textbook on cyber-physical systems, Edward A. Lee, Sanjit A. Seshia, UC Berkeley, 2014

Course Title:	**COMPUTER VISION**	**L**	**T**	**P**	**C**
Course Code:	**19 EI761**	**3**	**0**	**0**	**3**
Hours / week: 3	**CIE: 50 Marks SEE: 50 Marks Exam hours: 3 Total hours: 40**				

MODULE 1

1. Shape Representation and Description: Region identification, contour based shape representation and description, region based shape representation and description, shape classes.

2. Object Recognition: Knowledge representation, statistical pattern recognition, neural nets, syntactic pattern recognition, recognition as graph matching, optimization techniques in recognition, fuzzy systems.

10 Hours

MODULE 2

3. Image Understanding: Image understanding control strategies, active contour models-snakes, point distribution models, pattern recognition methods in image understanding, scene labeling and constrain propagation, semantic image segmentation and understanding, hidden Markov models.

4. 3-D Vision, Geometry and Radiometry: 3D vision tasks, geometry for 3D vision, radiometry and 3D vision.

10 Hours

MODULE 3

5. Use of 3D Vision: Shape for X, full 3D objects, 3-D model based vision, 2D view based representation of a 3-D scene.

6. Mathematical Morphology: Basic morphological concepts, four morphological principles, binary dilation and erosion, gray scale dilation and erosion, skeletons and object marking, granulometry, morphological segmentation and watersheds.

10 Hours

MODULE 4

7. Texture: Statistical texture description, syntactic texture description methods, hybrid texture description methods, texture recognition method applications.

8. Motion Analysis: Differential motion analysis methods, optical flow, analysis based on correspondence of interest points, Kalman filters.

10 Hours

Textbooks:

1. **Image Processing, Analysis and Machine Vision**, Milan Sonka, Vaclav, H lavac, Vikas
2. **Pattern Recognition and Image Analysis**, Earl Gose, Richard Johnsonbaugh, Steve Jost , PHI

Reference Book:

Introduction to Artificial Neural Networks, S.N. Sivanandam, M. Paul Raj, Vikas

Course Title:	**SPEECH SIGNAL PROCESSING**	**L**	**T**	**P**	**C**
Course Code:	**20EI762**	**3**	**0**	**0**	**3**
Hours / week: 3	**CIE: 50 Marks SEE: 50 MarksExam hours: 3 Total hours: 40**				

MODULE 1

1 Digital Models for Speech Signals: Process of Speech Production, Lossless tube models, Digital models for Speech signals.

2 Time Domain Models For Speech Processing: Time dependent processing of speech, Short time Energy and average magnitude, Short time average zero crossing rate, Speech Vs silence discrimination using energy and zero crossing.

10 Hours

MODULE 2

3 Pitch period estimation, Short time autocorrelation function, Short time average magnitude difference function, Pitch period estimation using autocorrelation function.

4 Short Time Fourier analysis: Linear filtering interpretation, Filter bank summation method, Design of digital filter banks, Implementation using FFT, Spectrographic displays.

10 Hours

MODULE 3

5 Digital Representations of the Speech Waveform: Sampling speech signals, Review of the statistical model for speech, Instantaneous quantization, Adaptive Quantization, General theory of differential quantization, Delta modulation.

6 Linear Predictive Coding of Speech: Basic principles of linear predictive analysis, Solution of LPC equations, Prediction error signal, Frequency domain interpretation, Relation between the various speech parameters, Applications of LPC parameters**.**

10 Hours

MODULE 4

7 **Speech Synthesis:** Principles of Speech synthesis, Synthesis based on waveform coding, analysis synthesis method, speech production mechanism, Synthesis by rule, Text to speech conversion.

8 **Speech Recognition:** Principles of Speech recognition, Speech period detection, Spectral distance measures, Structure of word recognition systems, Dynamic time warping (DTW), Word recognition using phoneme units.

10 Hours

Text Books:

1. **Digital Processing of Speech Signals-** L R Rabiner and R W Schafer, Pearson Education 2004.
2. **Digital Speech Processing-** Synthesis and Recognition, SadoakiFurui, 2nd Edition, Mercel Dekker 2002.

Reference Books:

1. **Introduction to Data Compression**- Khalid Sayood, 3rd Edition, Elsevier Publications.
2. **Digital Speech**-A M Kondoz, 2nd Edition, Wiley Publications.

Course Title:	ADVANCED BIOMEDICAL INSTRUMENTATION	L	T	P	C
Course Code:	20EI763	3	0	0	3
Hours / week: 3	CIE: 50 Marks SEE: 50 MarksExam hours: 3 Total hours: 40				

MODULE 1

1. **X-Ray and Digital Radiography:** Basics of diagnostics radiology, nature and production of X-Rays, X-Ray machine, Digital radiography, X-Ray computed tomography, system components
2. **Nuclear medical imaging system:** Radio isotopes in medical diagnosis, physics of radioactivity, radiation detectors, radio isotope rectilinear scanner, gamma camera, emission computed tomography, SPCET,PET scanner.

10 Hours

MODULE 2

3. **Laser applications and lithotriptors in biomedical field:** principal operation, pulsed ruby, ND-YAG, helium – neon, argon, co_2, excimer, and semiconductor lasers, laser safety, lithotriptorer machine modern lithotriptor system: extra-corporeal shock wave therapy.
4. **Hemodialysis machines:** function of kidneys, artificial kidney, dialyzers, performance analysis of dialyzers, hemodialysis machine, and portable kidney machines.

10 Hours

MODULE 3

5. **Physiotherapy and electrotherapy:** short wave diathermy, microwave diathermy, ultrasonic therapy unit, electro diagnosis, electrotherapy, type of apparatus, functional block diagram, inferential current therapy, pain relief through electrical stimulation.
6. **Thermal imaging systems:** physics of thermography, infrared detectors, thermograhic equipment, quantitative medical thermography, pyro electric vidicon camera.

10 Hours

MODULE 4

7. **Ventilators:** mechanics of respiration, artificial ventilation**,**ventilatorsterms,classification, pressure-volume-flow diagrams, modern ventilators, high frequency ventilators.
8. **Drug delivery systems:** infusion pumps, components of drugs infusion systems implantable infusion systems, closed loop control in infusion systems, examples of typical infusion pumps.

10 Hours

Text Book:

1. **Hand book of biomedical instrumentation:** R S Khandpur (2nd edition) pub TMH Company.

Reference Books:

1. **Introduction to biomedical equipment technology:** Joseph.J.Corr and Jhon.M.Brown, Pearson education, 4th edition, 2001
2. **Principals of applied biomedical instruments:** Leslie Cromwell and John M Brown, Pearson education, 4th edition, 2004

Course Title:	DSP ARCHITECTURE	L	T	P	C
Course Code:	20EI764	3	0	0	3
Hours / week: 3	CIE: 50 Marks SEE: 50 Exam hours: 3Total hours: 40				

Prerequisites: Digital Signal Processing, Microprocessor

Course Outcomes: Upon completion of this course, students should be able to:

CO1: Explain the fundamentals, architecture and featuresofDSPprocessor.
CO2: Illustrate functional elements of TMS320c54XX Processor.
CO4: Develop programs to implement basic DSP algorithms.
CO5: Design memory and I/O devices interface to DSP processor.

MODULE-1

1. **Introduction to Digital Signal Processing:** A Digital Signal Processing System, the Sampling Process, discrete time sequences, Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT), linear time invariant systems, Digital filters, Decimation and Interpolation.
2. **Computational Accuracy in DSP Implementation:** Introduction, Number formats for signals and coefficients in DSP systems, Dynamic range and precision, Sources of error in DSP implementations, A/D conversion error, DSP computational error and D/A Conversion error.

10 Hours

MODULE-2

3. **Digital Signal Processing Devices:** Introduction, Basic architectural features, DSP computational building blocks, Bus architecture and memory, Data addressing capabilities, Address generation unit, Programmability and Program execution, Speed issues.
4. **Programmable Digital Signal Processors:** Introduction, Architecture of TMS320C54xx digital signal processors: Bus structure, Central processing unit, internal memory and memory mapped registers, Data addressing modes of TMS320C54xx processors, Memory space of TMS320C54xx processors.

10 Hours

MODULE-3

5. **TMS 320c54xx Instructions and Programming,** On-chip peripherals, Interrupts of TMS320C54xx processors, Pipeline operation of TMS320C54xx processors.
6. **Implementation of Basic DSP Algorithms:** Introduction, The Q-notation, FIR Filters, IIR Filters, Interpolation Filters, Decimation Filters, Adaptive Filters, butterfly computation, FFT implementation on the TMS320C54xx

10 Hours

MODULE-4

7. **Interfacing Memory and Parallel I/O Peripherals to Programmable DSP Devices:** Introduction, Memory space organization, External bus interfacing signals, Memory interface, Parallel I/O interface, Programmed I/O, Interrupts and I/O, Direct memory access (DMA). Interfacing Serial Converters to a Programmable DSP device: Introduction, Synchronous Serial Interface (SSI), A multi-channel buffered serial port (McBSP), CODEC-DSP interface circuit.

10 Hours

Text Books:

1. **Digital Signal Processing**, Avtar Singh and S. Srinivasan, Thomson Publishing, 2004, Singapore.

Reference Book:

1. **Digital Signal Processors**, B.Venkataramani and M Bhaskar, Tata-McGraw Hill, New Delhi, 2002.

CO-PO, PSO Mapping

EI 701	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1.	3													
CO2.	3				2									
CO3.					2									
CO4.			2										2	3
CO5.			3		1									

Course Title:	PATTERN RECOGNITION	L	T	P	C
Course Code:	20EI765	3	0	0	3
Hours / week: 3	CIE: 50 Marks SEE: 50 Exam hours: 3Total hours: 40				

Upon completion of the course, student will be able to:

CO1: Illustrate the fundamental concepts of pattern Recognition

CO2: Apply statistical approaches to obtain an optimal classifier using Supervised and unsupervised Learning

CO3: Analyze different parameter estimation methods, non-parametric procedures and error minimizing techniques in Pattern Recognition.

CO4: Develop algorithms for applications and current trends in Pattern Recognition.

MODULE 1

1 **Introduction:** Machine perception, an example, Pattern recognition systems, the design cycle, Learning and adaptation.
Bayesian Decision Theory: Introduction, Bayesian decision theory, Continuous features, Minimum error rate classification, Classifiers, Discriminant functions and decision theory.

10 Hours

MODULE 2

2 **Bayesian Decision Theory (Cont..):** The normal density. Discriminant functions for the normal density, Bayesian decision theory – discrete features.
Maximum likelihood and Bayesian Parameter Estimation: Introduction, Maximum likelihood estimation, general principle, The Gaussian case, Bayesian estimation, the class conditional densities.

10 Hours

MODULE 3

3 **Linear Discriminant Functions:** Introduction, linear discriminant functions and decision surfaces, generalized discriminant functions, the two category linearly separable case, minimizing the perception criterion function, relaxation procedures, nonseparable behavior, and minimum squared error procedures.
Unsupervised Learning: Introduction, mixture densities and identifiability, maximum likelihood estimates, application to normal mixtures, unsupervised Bayesian learning, Data description and clustering, Similarity measures.

10 Hours

MODULE 4

4 **Clustering and Applications of Pattern recognition**: Criterion functions for clustering, Scatter criteria, Iterative optimization, Hierarchical clustering, Applications: Optical character recognition.
Applications: Introduction to Biometric techniques, Fingerprint verification, Face recognition, Iris recognition, Retina identification.

10 Hours

Text Books:

1. **Pattern classification** , Duda , Hart and Stork, Second edition, John Wiley
2. **Biometrics Personal identification in a networked society**, L.C. Jain and S. Ponkanti, First edition, Elsevier Publications.

Reference Book:

1. **Pattern recognition and image analysis**- Earl Gose, R.Johnsonbough and Steve Jost, PH India, 1999.

Course Title:	MEDICAL IMAGING	L	T	P	C
Course Code:	20EI766	3	0	0	3
Hours / week: 3	CIE: 50 Marks SEE: 50 Exam hours: 3Total hours: 40				

MODULE 1

1 **X-raysI:** Interaction between X-Rays and matter, Intensity of an X-Ray, Attenuation, X-Ray Generation and Generators, Beam Restrictors and Grids, Intensifying screens, fluorescent screens and Image intensifiers.
X-rays II: X-Ray detectors, Conventional X-Ray radiography, Fluoroscopy, Angiography, Digital radiography, Dynamic spatial re-constructor, X-Ray image characteristics and Biological effects of ionizing radiation.

10 Hours

MODULE 2

2 **Computed Tomography:** Conventional tomography, Computed tomography principle, Projection function Generations of CT machines, Electron beam CT, Reconstruction algorithms, Helical CT.
Ultrasound Imaging: Acoustic propagation, Attenuation, Absorption and Scattering, Ultrasonic transducers, Arrays, A mode, B mode, M mode scanners, Tissue characterization, Color Doppler flow imaging.

10 Hours

MODULE 3

3 **Magnetic Resonance Imaging:** Angular momentum, Magnetic dipole moment, Magnetization, Larmor frequency, Rotating frame of reference, free induction decay, Relaxation times, Pulse sequences. Introduction to functional MRI.
Block of a Magnetic Resonance Imager: Slice selection, Frequency encoding, Phase encoding, Spin-Echo imaging, Gradient-Echo imaging, Imaging safety.

10 Hours

MODULE 4

4 **Radionuclide Imaging:** Interaction of nuclear particles and matter, nuclear sources, Radionuclide generators, nuclear radiation detectors, rectilinear scanner, scintillation camera, SPECT, PET.
Thermal Imaging: Medical thermography, Infrared detectors, Thermographic equipment, Pyro electric vidicon camera.

10 Hours

Text Books:

1. **Principles of Medical Imaging**- Kirk shung, Academic Press.
2. **Handbook of Biomedical Instrumentation**- Khandpur, Tata McGraw-Hill Publishing Company Ltd., 2nd Edition.

Reference Books:

1. **Medical Imaging Signals and Systems**- Jerry L Prince and Jonathan M Links, Prentice Hall of India/Pearson.
2. **Fundamentals of medical Imaging**- ZhongHicho and Manbirsingh, John Wiley.

E Books:

1. http://people.ucalgary.ca/~ranga/enel697
2. http://www.fields.utoronto.ca/
3. http://link.springer.com/chapter/10.1007%2F978-3-540-68993-5_10
4. http://ebooks.cambridge.org/ebook.jsf?bid=CBO9780511596803

MOOCs:
1. scpd.stanford.edu
2. ocw.mit.edu
3. https://www.edx.org/course/introduction-biomedical-imaging-uqx-bioimg101x-2
4. https://www.mooc-list.com/bioimg101x-introduction-biomedical-imaging-edx

Course Title:	**DIGITAL TWIN TECHNOLOGY**	**L**	**T**	**P**	**C**
Course Code:	**20EI767**	**3**	**0**	**0**	**3**
Hours / week: 3	**CIE: 50 Marks SEE: 50 Exam hours: 3Total hours: 40**				

Module 1

1. Background and Concept of Digital Twin:

History of digital twin, concept of digital twin, cores of digital twin: models, data, connections, and services, digital twin and physical/virtual space, digital twin and virtual prototype, digital twin and PLM, digital twin and digital asset/enterprise/industry, digital twin and digital thread, digital twin and digital shadow, value of digital twin.**Digital Twin Modelling:**Traditional three-dimension digital twin, new requirements on digital twin, extended five-dimension digital twin, application-oriented three-level digital twins, key technologies for digital twin modelling, and rules for digital twin modelling.

10 Hours

Module 2

2. Digital Twin Shop-Floor:

Evolution path of shop-floor, concept of digital twin shop-floor, implementation of digital twin shop-floor, characteristics of digital twin shop-floor, key technologies for digital twin shop-floor, challenges for digital twin shop-floor.**Equipment Energy Consumption Management In Digital Twin Shop-Floor:**

Introduction, framework of EECM in digital twin shop-floor, implementation of EECM in digital twin shop-floor, potential advantages of EECM in digital twin shop-floor.

10 Hours

Module 3

3. Cyber Physical Fusion In Digital Twin Shop-Floor:

Introduction, reference architecture for digital twin, Shop-floor, physical elements fusion, models fusion, data fusion, services fusion.**Digital Twin-Driven Prognostics and Health Management:**

Introduction, digital twin for complex equipment, digital twin-driven PHM method, complete case study.

10 Hours

Module 4

4. Digital Twin and Services:

Services in manufacturing, services in digital twin, digital twin service generation, digital twin service management, digital twin service application.**Digital Twin and Virtual Reality & Augmented Reality:**

Introduction, VR in design, manufacturing, and service, AR in design, manufacturing, and service, digital twin and VR & AR, digital twin-driven assembly combining VR & AR.

10 Hours

Text book:

Digital twin driven smart manufacturing, Fei Tao, Meng Zhang, and A.Y.C. Nee, Academic Press, Elsevier, 2019

Reference books:

1. Digital twinstools and concepts for smart bio-manufacturing, editors: Herwig, Christoph, Portner, Ralf, Moller, Johannes (eds.), springer, 2020
2. The convergence of digital twin, iot, and machine learning: transforming data into action, Ved P. Mishra, university press, 2020

Course Title:	INDUSTRIAL PROCESS CONTROL	L	T	P	C
Course Code:	20OEEI71	3	0	0	3
Hours / week: 4	CIE: 50 Marks SEE: 50 Marks Exam hours: 3 Total hours: 40				

Course Outcomes: Upon completion of this course, student should be able to:

CO1: Explain the elements of a process control loop, different standards and symbols used in process control industry.

CO2: Distinguish different process control principles and valve selection procedures for a given application.

CO3: Design various controllers using analog and digital devices

CO4: Illustrate various types of controllers for process compensation

CO5: Evaluate stability and process loop tuning

Module-1

Introduction to Process Control: Process controls block diagram, control system evaluation, units, standards and definitions (Except1.6.4 of C D Johnson). Converters: Frequency based converters, Data Acquisition Systems: DAS Hardware, DAS software. **Final control:** Introduction to final control operation, signal conversions, actuators, valve actuators, valve positioner..

10 Hours

Module-2

Control Valves: Capacity of control valve, valve sizing, determining pressure drop across valve, cavitation and flashing, valve range ability, selection factors, sequencing control valves, viscosity corrections. **Controller principles:** Introduction, process characteristics, control system parameters, discontinuous control modes, continuous control modes, and composite control modes.

10 Hours

Module-3

Analog controllers: Introduction, general features, electronic controllers, pneumatic controllers, designs considerations. **Digital controllers**: Digital electronic methods, computers in process control, process control networks, characteristics of digital data.

10 Hours

Module-4

Combination control systems: Ratio controller, Cascade controller, saturation in cascade loops, feed forward control, advantages, technique. **Control-loop characteristics**: Introduction, control system configuration, control system quality, stability, and process loop tuning.

10 Hours

Text Books:

1. **Process Control Instrumentation Technology**, C D Johnson PHI,8th Edition, 2004
2. **Instrumentation for Process Measurement and control**, Norman.A.Anderson, CRC Press, Third Edition

Reference Books:

1. **Instrument Engineers Handbook** (Vol 1 & 2),B G Liptak ,Chilton Book Company, 3rdEdition
2. **Process Control**, K Krishnaswamy, New age International India, 1st Edition, 2006.
3. **Computer based Industrial Control**, Krishna Kant, PHI.

E Books:

1. http://www.learnerstv.com/Free-engineering-Video-lectures-ltv689-Page1.htm
2. http://nptel.ac.in/courses/103105064/

MOOCs:

1. https://www.mooc-list.com/tags/process-management
2. http://freevideolectures.com/Course/2345/Industrial-Automation-and-Control/3

CO-PO, PSO Mapping

EI 603	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
	3	2								1				
		2												
			3										1	3
			3	3	1	1								

Course Title:	MICRO AND SMART SYSTEMS TECHNOLOGY	L	T	P	C
Course Code:	20OEEI72	3	0	0	3
Hours / week: 3	CIE: 50 Marks SEE: 50 MarksExam hours: 3 Total hours: 40				

Prerequisites: Transducer and Instrumentation, Control Systems

Course Outcomes: Upon completion of this course, students should be able to:

CO1. Explain micro systems and their role in automobile and biomedical fields
CO2. Explain the various fabrication technologies and micro machining technologies of micro systems.
CO3. Illustrate the working of micro sensors and micro actuators.
CO4. Develop suitable signal conditioning circuits for micro sensors.
CO5. Explain various packaging technologies of micro devices

MODULE 1

1. **Introduction to MEMS and Micro systems:** MEMS and Micro systems. Comparison of Micro systems and Microelectronics. Evolution of micro-manufacturing. Multi-disciplinary aspects. Micro systems and Miniaturization, Applications areas.
   Micromachining Technologies-I: Silicon as a material for micro machining, Lithography, Ion Implantation, Diffusion, Oxidation, Thin-film deposition and Etching.

10 Hours

MODULE 2

2. **Micromachining Technologies – II:** Bulk micromachining, Silicon micromachining, wafer bonding and LIGA Process.

Micro Sensors, Actuators, Smart Materials and Systems-1: Silicon capacitive accelerometer, Piezo-resistive pressure sensor, Conductometric gas sensor, Portable blood analyzer. Electrostatic comb-drive.

10 Hours

MODULE 3

3. **Micro Sensors, Actuators, Smart Materials and Systems-2:** Principle means for micro actuation, micro grippers, Piezo-electric based inkjet print-head, Magnetic micro relay, Silicon micro-mirror arrays. Smart Materials and systems.
   Electronics Circuits and Control for Micro and Smart Systems-1: Semiconductor Devices: Operational amplifiers. Basic Op-Amp circuits. Difference amplifier, Instrumentation amplifier as a differential voltage amplifier, Wheat stone bridge for measurement of change in resistance.

10 Hours

MODULE 4

4. **Electronics Circuits and Control for Micro and Smart Systems-2:** Phase locked loop, ADC, Differential charge measurement, Circuits for measuring frequency shift, Introduction to control theory: Mathematical Description, Representation, State Space Modeling, and Implementation of Controllers**.**
   Integration and Packaging of Micro Electro- Mechanical Systems: Integration of microelectronics, Special issues in Microsystems packaging, Types of Microsystems Packaging: Packaging technologies: Wire Bonding, Flip-Chip Assembly, ball-Grid Array, Embedded Overlay, Wafer-Level Packaging.

10 Hours

Text Books:

1. **Micro and Smart Systems,** G K Ananthasuresh et al., John-Wiley India, First Edition, 2010
2. **MEMS & Microsystems: Design and Manufacture-** Tai-Ran Tsu, Tata Mc-Graw-Hill.

E-Books:

1. https://www.crcpress.com/Bio-MEMS-Technologies-and-Applications/Wang-Soper/p/book/9780849335327
2. https://www.amazon.in/Bio-MEMS-Technologies-Applications-Wanjun-Wang-ebook/dp/B009AI34IS

MOOCs :

1. https://www.extension.harvard.edu/academics/courses/introduction-mems-biomems/14876
2. https://onlinecourses.nptel.ac.in/noc15_me01/preview

Course Title:	**Foundations Innovations**	**L**	**T**	**P**	**C**
Course Code:	**20OEEI73**	**3**	**0**	**0**	**3**
Hours / week: 3	**CIE: 50 Marks SEE: 50 Marks Exam hours: 3**	**Total hours: 40**			

Module 1

Introduction: Understanding the Concept of Innovation and its Importance, Types of Innovation, Innovation in Organization,Lay the Foundation and Create a Challenge Book: Step one: Lay the Foundation, Create a Challenge Book, Let's Discuss Step One and Two, The Innovation Activity.

10Hours

Module 2

Build Participation and Experiment with Low-cost at High –speed: Choosing the Right "Role Model", Ways to Motivate Innovation Activity in Organization, Role of Catalyst in Building Participation in Innovation Process, How to Overcome Velocity Problem?, Failure Fallacy, Encouraging Experimentation, Prototyping. Go Fast from Prototyping to Incubation and Iterate on The Business Model: Being a Champion, Iterating on Business Model, Design of a Pitch, Business Model Metaphors

10Hours

Module 3

Build an Innovation Sandbox and Create a Margin of Safety: Ways to Enhance the Batting Average Problem, Sand box, Platform and Open Source Approach, Intellectual Property Protection, Risk Management, Big Bets Risks, Where Do We Stand?Innovative Leadership in Growing Companies. The Path to Entrepreneurship: Seven Rules for Business Success, Plan to Succeed

10Hours

Module 4

The Evolution of an Innovative Business Unit, Disruptive Innovation, Mission Driven Innovation, Extraordinary Measures, Leveraging Collaboration for Innovation, Building Innovative Partnerships to Heal the World.

10Hours

Text Books:

1. **8 STEPS TO INNOVATION Going from Jugaad to Excellence** Vinay DabholkarRishikesha T. Krishnan, HarperCollins Publishers, First Edition, 2013.
2. **Entrepreneurship and Innovation**, James C. Barood, Rothman Institute of Entrepreneurship, 2010.

Reference Books:

1. Lateral Thinking, De Bano , Penguin UK, 2016
2. Innovation and Entrepreneurship, Peter F. Drucker, Butterworth-Heinemann, 2012

MOOCs:

1. https://swayam.gov.in/nd2_imb19_mg05

Mode of evaluation for 10 marks component of continuous internal evaluation:

1. Student has to present a Seminar on Cutting edge developments in selected domain - 5 marks
2. Student batch has to do case study and submit a report on selected topics -5 marks

VIII Semester Syllabus

Course Title:	**SEMINAR ON ADVANCED TOPICS**	**L**	**T**	**P**	**C**
Course Code:	**20EI801**	**0**	**2**	**0**	**2**
Hours / week: 2	**CIE: 100 Marks SEE: N/A Exam hours: N/A Total hours: 26**				

Course Outcomes: Upon completion of this course, students should be able to:

CO1: Identify seminar topic by literature survey

CO2: Summarize the chosen topicforits technical and societal relevance.

CO3: Demonstrate communication skillsand professional ethics through presentation.
CO4: Illustrate the required attributes as an individual presenter

Topics must be selected by the student in consultation with relevant course faculty/advisor and the topic must reflect recent advances in Engineering & technology and it should be of current trends and relevance. The topics must be approved by the departmental committee consisting of HOD or his nominee, seminar coordinator and seminar advisor. The topics must be selected from recent IEEE transactions / conference proceedings papers or journals of high impact factor.
The distribution of evaluation marks is as follows:
Report: 30 marks.
Presentation Slides: 20 marks.
Oral presentation: 30 marks.
Quality of the selected paper and Viva: 20 marks.
Total: 100 marks.

CO-PO, PSO Mapping

EI 801	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1.		3												
CO2.				3										
CO3.										3		3	2	2
CO4.								2						
CO5.									3					

Course Title:	**PROJECT WORK**	**L**	**T**	**P**	**C**
Course Code:	**20EI802**	**0**	**0**	**18**	**9**
Hours / week: 18	**CIE: 50 Marks SEE: 50**	**Exam hours: 3**			

Course outcomes: Upon the completion of this course student will be able to:
CO1: Identify the need based problem
CO2: Develop engineering model considering needs of society, environment and ethics as a team
CO3: Summarize thework, document and present.
CO4: Demonstrate the management principles.
CO5: Develop solution by considering sustainable design
CO6: Identify necessity of lifelong learning from technological perspective

The project work is to be carried out in **three phases**

- **Project Phase – I:** Duration of two weeks between VII and VIII semesters. Candidates in consultation with the guides shall carry out literature survey / visit premier institutions/ laboratory/ industry to finalize the topic of the project. Evaluation of the project and its feasibility is evaluated in the concerned department in the beginning of the VIII semester. **(05 Marks)**
- **Project Phase – II:** Eight weeks duration, during the VIII semester students are expected to finalize the project work and indicate intermediate results, design carried out/ algorithms developed must be validated. **(15 Marks)**
- **Project Phase – III:** Project evaluation shall be taken up during this phase. At the end of the semester project work evaluation and Viva – Voce examination shall be conducted. **(25 Marks)**
- **Publications in Refereed Journals/IEEE Conferences. (05 Marks)**
- The working condition of the project work carried out must be shown to the committee
- The continuous evaluation of the project phase – I, II, and III shall be carried out by the committee consisting of head of the department, senior faculty and guide.

- ❖ In general the project work of good standard is to be carried out.
- ➢ Relevance of the topic for the project in the present context
- ➢ Problem formulation / methodology / limitation / existing methods / proposed method / comparisons / selection criteria
- ➢ A comprehensive literature survey is to be conducted based on the topic
- ➢ Experimental observation / theoretical modeling / Hard ware design / algorithms developed for implementation
- ➢ Results — Presentation & Discussion
- ➢ If description of the work is explained with a snap shot, give figure number and indicate the internal details. For tables and graphs, give relevant explanation and highlight the findings.
- ➢ **Give conclusions, scope for future work, limitation of the project work , merits and demerits**

Guidelines for the preparation of B.E. project reports:

- **Project reports should be typed neatly on both sides of the paper with 1 .5 or double line spacing** on an A4 size bond paper (210 x 297 mm). The margins should be: Left - 1.25", Right - 1, Top and Bottom - 0.75".
- The total **number of reports** to be prepared are:
  - One copy to the department
  - One copy to the concerned guide(s)
  - Two copies to the sponsoring agency
  - One copy to the candidate.

3. Before taking the final printout**,** the approval of the concerned guide(s) is mandatory and suggestedcorrections, if any, must be incorporated in the thesis.

4. For making copies, **dry tone Xerox** is suggested.

5. Every copy of the report must contain:
- Inner Title page (White)
- Outer Title page with a plastic cover
- Certificate in the format enclosed both from the college and the organization where the project is carried out.
- An abstract / synopsis not exceeding 100 words, indicating salient features of the work carried out must be included
- Four copies of the abstract are to be submitted to the Department on the date of submission separately

6. The **organization of the report** should be as follows
- ➢ Inner title page
- ➢ Abstract or Synopsis
- ➢ Acknowledgments
- ➢ Table of Contents
- ➢ List of table & figures (optional)
- ➢ Usually numbered in roman
- ➢ **Chapters** (to be numbered in Arabic) containing **Introduction**-, which usually specifies the scope of work and its importance and relation to previous work and the present developments, **Main body** of the report divided appropriately into chapters, sections and subsections.
- ➢ The **chapters, sections** and **subsections** may be numbered in the decimal form for e.g. Chapter 2, sections as **2.1, 2.2** etc., and subsections as **2.2.3, 2.5.1** etc.
- ➢ The chapter must be left or right justified (**font size 16**). Followed by the title of **chapter centered (font size 18)**, section/subsection numbers along with their headings must be left justified with section number and its **heading in font size 16** and subsection and its heading in font size 14. The body or the **text of the report should have font size 12.**

- The **figures** and **tables** must be numbered chapter wise for e.g.: **Fig. 2.1** Block diagram of the proposed model, **Table 3.1** Normal ECG, range, age group etc.
- The **last chapter** should contain the summary of the work carried, contributions if any, their utility along with the scope for further work.
- **Reference OR Bibliography:** The references should be numbered serially in the order of their occurrence in the text and their numbers should be indicated within square brackets for e.g. **[3].** The section on references should list them in serial order in the following format.

• **For textbooks** - Simon Haykin, Neural Networks- A Comprehensive Foundation, Prentice-Hall India, Second Edition, 2005.

• **For papers** – G.E. Chirstensen, S.C. Joshi and M.I. Miller, " Volumetric transformation of brain anatomy", IEEE Transaction of Medical Imaging, Vol 2, pp.864-877, 1997.

Only SI units are to be used in the report. Important Equations must be numbered in decimal form for e.g. **V=IZ** …….**(3.2)**

All equation numbers should be right justified.

- The **project report** should be brief and include descriptions of work carried out by others only to the minimum extent necessary. **Reproduction of material available elsewhere should be strictly avoided.** Downloaded material should not be used. In case used, it should be properly acknowledged.
- Where short excerpts from published work are desired to be included, they should be within quotation marks appropriately referenced.
- Proper **attention** is **to be paid not only to the technical contents but also to the organization of the report and clarity of the expression.** Due care should be taken to avoid spelling and typing errors. The student should note that report-write-up forms the important component in the overall evaluation of the project.
- **Hardware projects** must include: the component layout, complete circuit with the component list containing the name of the component, numbers used, etc. and the main component data sheets as Appendix. At the time of report submissions, the students must hand over a copy of these details to the project coordinator and see that they are entered in proper registers maintained in the department.
- Software projects must include a virus free disc, containing the software developed by them along with the read me file. Read me file should contain the details of the variables used, salient features of the software and procedure of using them: compiling procedure, details of the computer hardware/software requirements to run the same, etc. **If the developed software uses any public domain software downloaded from some site,** then the address of the site along with the module name etc. must be included on a separate sheet. It must be properly acknowledged in the acknowledgments.
- Sponsored Projects must also satisfy the above requirements along with statement of accounts & bills for the same dully attested by the concerned guides to process further. They must also produce NOC from the concerned guide before taking the internal viva examination.
- The reports submitted to the department/guide(s) must be hard bounded, with a plastic covering.
- Separator sheets, used if any, between chapters, should be of thin paper.

Format of Certificate

(*On a separate sheet*)

MALNAD COLLEGE OF ENGINEERING,

HASSAN- 573202

Department of Electronics and Instrumentation Engineering

CERTIFICATE

This is to Certify that the project work

……Title

is a bonafide work carried out by

Mr./Ms ……...,USN ……..

Mr./Ms ……...,USN ……..

Mr./Ms ……...,USN ……..

Mr./Ms ……...,USN ……..

in partial requirement for the award of ***Bachelor of Engineering*** in Electronics and Instrumentation Engineering of the Malnad College of Engineering, Hassan, an autonomous institution affiliated to **Visvesvaraya Technological University, Belagavi** during the year…… It is certified that all corrections/suggestions indicated for Internal Assessment have been incorporated in the Report. The project report has been approved as it satisfies the academic requirements in respect of Project work prescribed for the said Degree.

Signature of the Guide Signature of the HOD Signature of the Principal

External Viva

Name of the examiners Signature with date

1.

2.

PROJECT EVALUATION: CIE - 50 Marks, SEE - 50 Marks

The Project report should have the following contents

Sl. No.	**Particulars**
1.	Relevance of the subject in the present context / motivation
2.	Objective of the Project
3.	Literature Survey
4.	Methodology / limitation
5.	Organization of the report
6.	System design
7.	Algorithms / flow chats

8.	Experimental observation / theoretical modeling
9.	Results & Discussion
10.	Conclusions and scope for future work
11.	References
12.	Appendices

CO-PO, PSO Mapping

EI 802	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1.	1	3	2	1										
CO2.			3			2	2		3					
CO3.										3				
CO4.											3		3	3
CO5.								3						
CO6.					2							2		

Course Title:	ENTREPRENEURSHIP AND MANAGEMENT	L	T	P	C
Course Code:	20EI803	4	0	0	4
Hours / week: 4	CIE: 50 Marks SEE: 50 Exam hours: 3Total hours: 52				

Course Outcomes: Upon completion of this course, students should be able to:
CO1: Explain entrepreneurship and its intricacies.
CO2: Examine the feasibility of a venture.
CO3: Develop plan for a new business idea.
CO4: Identify the ways and means of organizing and launching an enterprise.
CO5: Inspect various factors affecting human resource management.

Module 1

Entrepreneurs & Entrepreneurship: Introduction, What is Entrepreneurship? Who are Entrepreneurs and what do they do? **The Context of Entrepreneurship:** Issues affecting entrepreneurship in action, identifying environmental opportunities, Understanding competitive advantage.

13 Hours.

Module 2

Researching the Venture's Feasibility: Generating and evaluating business ideas, Researching competitors, Researching finance options.**Planning the Venture:** Developing organizational vision and mission, Organizational culture issues, Developing and writing the business plan.

13 Hours.

Module 3

Organizing the Venture: Legal forms of business organization, other legal issues, Organizational design issues.
Launching the Venture: Establishing the organizational goals and strategies, designing the venture's production & operations management function, establishing the Venture's marketing function, designing the venture's information systems and establishing the venture's financial and accounting systems.

12 Hours.

Module4

Managing Processes: Making decisions, Measuring and evaluating organizational performance, Stimulating and making changes – Being a change agent and Contemporary issues in managing the venture.**Managing People:** Human resource management issues, Motivating employees, Employee work teams and leadership and other people issues.

14 Hours.

Text Books:

1. **Entrepreneurship in Action**, Mary Coulter, PHI 2nd Edition.

References:

1. **Entrepreneurship Development,** E. Gordon & K. Natarajan, Himalaya publishers, 2008.
2. **Entrepreneurship Development**, S S Khanka, S Chand & Co., New Delhi.
3. **Entrepreneurship Development and Management,** A. K. Singh, JBA publishers, New Delhi.
4. **Principles of Management** – P.C.Tripathi, P.N.Reddy – Tata McGraw Hill,

List of Student Activities for Self Learning:

Following is the list of proposed activities by students:

1. Prepare project proposal to develop a product from household waste.
2. Download product development and innovative films from internet.
3. Prepare a collage for "Traits of successful entrepreneurs."
4. Interview at least four entrepreneurs or businessman and identify charms of entrepreneurship and characteristics of successful entrepreneurs.
5. Identify your hobbies and interests and convert them into business idea.
6. Mock Business Model- Choose a product and design a unique selling preposition, brand name, logo, advertisement (print, radio, and television), jingle, packing, packaging, label for it.
7. Develop your own website. Share your strengths and weakness on it. Declare your time bound goals and monitor them on the website.
8. Choose any product/ advertisement and analyze its good and bad points/ cost sheet/ supply chain etc.
9. Study schemes for entrepreneurship promotion of any bank.
10. Visit industrial exhibitions, trade fairs, GIM and observe nitty-gritty of business.
11. Conduct a market survey for a project. Collect data on machinery specifications, price, output/hr, power consumption, manpower requirement, wages, raw material requirement, specification, price, competitor's product price, features, dealer commissions, marketing mix etc.
12. Select a social cause, set objectives, plan and work for its accomplishment. Find details about at least one NGO.

Some motivational films to be watched on Sundays/holidays by students on their own.

1. AmbaniThe Investor (Kannada Short Movie)
2. Corporate
3. Do Duni Char
4. Guru
5. Oh My God
6. Pirates of Silicon Valley
7. Pursuit of Happiness
8. Rocket Singh
9. Start-up.com
10. The Social Network
11. Wall Street
12. English Vinglish

Visit these Websites and Write a Brief Summary about the Info Available

1. https://www.e-elgar.co.uk/PDFs/WebCats/EntrepreneurshipUK.pdf
2. Dabbawalas Case- http://www.youtube.com/watch?v=N25inoCea24
3. Barefoot College http://www.ted.com/talks/bunker_roy.html
4. Entrepreneurship Class XI, XII- CBSE, New Delhi
5. The Art of the Executive Summary by Bill Reichert www.garage.com/resources/writingexecsum.shtml

6. Write a Business Plan – Essential Elements of a Good Business Plan
   www.sba.gov/smallbusinessplanner/plan/writeabusinessplan/SERV_ESSENTIAL.html
7. http://www.entrepreneur.com

CO-PO, PSO Mapping

EI 803	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1.						2		2						
CO2.											3	2		
CO3.									2		3			
CO4.							2	2			3			
CO5.							3				3			
CO6.										2	3			

Course Title:	INTELLECTUAL PROPERTY RIGHTS	L	T	P	C
Course Code:	20EI851	3	0	0	3
Hours / week: 3	CIE: 50 Marks SEE: 50 Exam hours: 3Total hours: 40				

Course Outcomes: Upon completion of this course, student should be able to:
CO1: Explain basics of IP and Patent laws of UK, USA and India
CO2: Explain patenting procedure of UK, USA and India
CO3: Assesspatent specification drafting in India
CO4: Illustrate various aspects of copyright lawandtrademark law
CO5: Explain basic principles of design rights and typical case studies involving various forms of IP

MODULE 1

1. **Basics of Intellectual Property and Principles of Patent Law:** Concept of property, evolution of patent system, basics for protection, invention, criteria for patentability, non patentable inventions, rights of a patent owner
   Patent Procedures in India: Main steps for prosecution application, preliminary scrutiny of document, publication of patent application, consequences of publication. Consequences of examination, pre grant opposition, grant and sealing of patent, post grant opposition.

10 Hours

MODULE 2

2. **Drafting of Patent Specification:** Patent specification, kinds of patent specification, parts of patent specification, claims.
   Drafting of Patent Specification (continued): patentable aspects of invention in specification, restrictions on patentability imposed by act.

10 Hours

MODULE 3

3. **Understanding Copyright Law:,** justification of copyright law, subject matter of copy right, terms of protection, concepts, acquisition in India, rights of a copyright owner, transfer of copyright.
   Basic Principles of Trademark: Justification, trademark, rights of trademark owner, transfer of trademarks, infringement of trademarks, passing off.

10 Hours

MODULE 4

4. **Basic Principles of Design Rights:** Justification, subject matter, definition of design, excluded subject matter, rights of design owner, assignments of design rights, infringement of designs
   Case Studies: Typical case studies involving patents, copyrights, trade mark, design rights.

10 Hours

Text Books:

1. **Basic principles of acquisition of IPR** (3rd edition 2007)-Dr. T. Ramakrishna Pub: CIPRA, NLSIU, Bangalore.
2. **Ownership of enforcement of IPRs** (3rd edition 2007)-Dr. T. Ramakrishna Pub: CIPRA, NLSIU.

Reference Book:

1. **Law relating to IP:** Dr. B L Wadhera, 4th edition, Universal law Publishing Company.

Course Title:	R PROGRAMMING FOR DATA SCIENCE	L	T	P	C
Course Code:	20EI852	3	0	0	3
Hours / week: 3	CIE: 50 Marks SEE: 50 MarksExam hours: 3 Total hours: 40				

Module 1

Introduction: Basic Features of R programming, Entering Input, Evaluation, R Objects, Numbers, Attributes, Creating Vectors, Mixing Objects, Explicit Coercion, Matrices, Lists, Factors, Missing Values, Data Frames, Reading and Writing Data, Reading Data Files with and Reading in Larger Datasets and Using Textual and Binary Formats for Storing Data.

Interfaces to the Outside World: File Connections, Reading Lines of a Text File, Reading from a URL Connection, Sub-setting of Vectors, Matrices, Lists and Nested elements of a list. Extracting multiple elements of a list.

10 Hours

Module 2

Managing Data Frames, Control Structures, Functions and Lazy Evaluation in functions.

Scoping Rules of R: Scoping Rules, Lexical Scoping, Lexical vs. Dynamic Scoping, Application: Optimization, Plotting the Likelihood.

10 Hours

Module 3

Coding Standards for R Loop functions: Looping on the Command Line, Splitting a Data Frame, Column/Row Sums and Means and Vectorizing a Function.

6. Debugging and Profiling R Code: Figuring Out What's Wrong, Debugging Tools in R, Timing Longer Expressions and The R Profiler.

10 Hours

Module 4

7. Simulation: Generating Random Numbers, Setting the random number seed, Simulating a Linear Model and random Sampling.

8. Data Analysis Case Study: Changes in Fine Particle Air Pollution- Synopsis, Loading and Processing the Raw Data and Analysis of Results.

10 Hours

Text Book:

1. R Programming for Data Science, Roger D. Peng, Leanpub, 2015

Reference Books:

1. An Introduction to R, Notes on R: A Programming Environment for Data Analysis and Graphics. W. N. Venables, D.M. Smith and the R Development Core Team. Version 3.0.1 (2013 -05 -16). URL: https://cran.r-project.org/doc/manuals/r-release/R-intro.pdf
2. R for everyone: Advanced analytics and graphics, Jared P Lander, Pearson Education, 2013

Ebooks:

1. https://www.cs.upc.edu/~robert/teaching/estadistica/rprogramming.pdf
2. http://heather.cs.ucdavis.edu/~matloff/132/NSPpart.pdf
3. http://www.tutorialspoint.com/r/r_tutorial.pdf

MOOCs:

1. https://www.coursera.org/learn/r-programming
2. https://www.mooc-list.com/tags/r-programming
3. https://www.edx.org/course/introduction-r-data-science-microsoft-dat204x-5

Course Title:	**LASERS AND OPTICAL INSTRUMENTATION**			**L**	**T**	**P**	**C**
Course Code:	**20EI853**			**3**	**0**	**0**	**3**
Hours / week: 3	**CIE: 50 Marks**	**SEE: 50**	**Exam hours: 3**			**Total hours: 40**	

Course Outcomes: Upon completion of this course, student should be able to:

CO1: Explain the principle of generation of laser radiation and classes of lasers.
CO2: Illustrate the various techniques of laser generation.
CO3: Explain the different applications of laser.
CO4: Illustrate the basics of optical fiber communications.
CO5: Explain the various optical laws, fabrication methodsandworking of optical amplifiers.

MODULE 1

1. **Lasers -I:** Introduction, Emission and absorption of radiation, Einstein relation, population inversion, threshold conditions, Line shape function, population inversion and pumping threshold conditions.
2. **Lasers -II:** LASER modes: Axial & Transverse modes; Classes of LASER: Doped insulator LASERs, semiconductor LASERs, Gas LASERs, Liquid dye LASERs.

10 Hours

MODULE 2

3. **Generation of Lasers:** Single mode operation, frequency stabilization. Q-switching, mode locking, lasing threshold.

6 Hours

4. **Applications of Laser:** Measurement of distance: Interferometric methods, Beam modulation telemetry, Pulse echo techniques; Holography & its applications.

10 Hours

MODULE 3

5. **Overview of optical fiber communications:** Motivations for light wave communications, optical spectral bands, Decibel units, Network information rates, WDM concepts, Key elements of optical fiber systems, standards for optical fiber communications.

6. **Structures, Wave guiding, and Fabrication I:** The nature of light, basic optical laws and definitions, optical fiber modes and configurations, Mode theory for circular waveguides, Single mode fibers.

10 Hours

MODULE 4

7. **Structures, Wave guiding, and Fabrication II:** Graded index fiber structure, Fiber materials, Photonic crystal fibers, Fiber fabrication, Mechanical properties of fibers, Fiber optic cables.
8. **Optical Amplifiers:** Types of optical amplifiers and its applications, Semiconductor optical amplifiers, Erbium-doped fiber amplifiers, Amplifier noise, Optical SNR, System Applications, Raman amplifiers, wideband optical amplifiers.

10 Hours

Textbooks:

1. **Optoelectronics- an Introduction-**Wilson & Hawkes, Prentice Hall of India.
2. **Optical fiber communications-**GeirdKeser, McGraw Hill education (India) private limited, Fifth edition.

Reference Book:

1. **LASER Fundamentals-** William T. Silfvast, Cambridge University Press.

Course Title:	**JAVA PROGRAMMING**	**L**	**T**	**P**	**C**
Course Code:	**20EI854**	**3**	**0**	**0**	**3**
Hours / week: 3	**CIE: 50 Marks SEE: 50 Exam hours: 3Total hours: 40**				

Prerequisites: C & C++ Programming

Course Outcomes: Upon completion of this course, student should be able to:

CO1: Explain the fundamentals of Java programming
CO2: Design software systems with object oriented java programming.
CO3: Illustrate decision structures.
CO4: Apply loops and files in java programming
CO5: Develop Java programs using methods and classes
CO6: Explain inheritance, polymorphism and exceptions handling.

MODULE 1

Introduction to Java: A History of Java, Java Applications and Applets, What Is a Program Made of? Java fundamentals: The Parts of a Java Program, The print and println Methods, and the Java API, Variables and Literals.**Java fundamentals (Continued)**: Primitive Data Types, Arithmetic Operators, Combined Assignment Operators, Conversion between Primitive Data Types and Creating Named Constants with final, The String Class.

10 Hours

MODULE 2

Decision Structures: The if Statement, The if-else Statement, Nested if Statements, The if-else-if Statement, Logical Operators, Comparing String Objects, More about Variable Declaration and Scope, The Conditional Operator (Optional), The switch Statement.**Loops and Files**: The Increment and Decrement Operators, The while Loop, Using the while Loop for Input Validation, The do-while Loop, the for Loop, Nested Loops, The break and continue Statements.

10 Hours

MODULE 3

Methods: Introduction to Methods, Passing Arguments to a Method, More about Local Variables, Returning a Value from a Method, Problem Solving with Methods. **A First Look at Classes**: Objects and Classes, Writing a Simple Class, Step by Step, Instance Fields and Methods, Constructors, Passing Objects as Arguments, Overloading Methods and Constructors.

10 Hours

MODULE 4

Inheritance: What Is Inheritance?, Calling the Super class Constructor, Overriding Super class Methods, Protected Members, Chains of Inheritance and Polymorphism.**Exceptions and Advanced File I/O:** Handling Exceptions and Throwing Exceptions

5 Hours

Text Book:

1. Tony Gaddis, "Starting out with JAVA", 6th Edition, Pearson, 2016.

Reference Book:

1. Y. Daniel Liang, "Introduction to JAVA Programming", 6th Edition, Pearson Education, 2007.

Course Title:	MACHINE LEARNING	L	T	P	C
Course Code:	20EI855	3	0	0	3
Hours / week: 3	CIE: 50 Marks SEE: 50 Exam hours: 3Total hours: 40				

Module 1

Introduction: Machine learning, Machine LearningandPython, Learning NumPy, SciPy, first machine learning application, Pre-processing and cleaning the data, Choosing the right model and learning algorithm.

Learning How to Classify with Real-world Examples: The Iris dataset, Building more complex classifiers, A more complex dataset and a more complex classifier, Binary and multiclass classification.

10 Hours

Module 2

Clustering: Preprocessing – similarity measured as similar number of common words, Clustering, Solving the initial challenge**,** Tweaking the parameters.**TopicModeling:**Comparing similarity in topic space, choosing the number of topics.

10 Hours

Module 3

Classification – Detecting Poor Answers: Learning to classify classy answers, fetching the data, creating our first classifier, deciding how to improve, Using logistic regression, looking behind accuracy – precision and recall, slimming the classifier.

Classification II – Sentiment Analysis: Fetching the Twitter data, introducing the Naive Bayes classifier, creating our first classifier and tuning it, cleaning tweets, taking the word types into account.

Regression: Penalized regression, P greater than N scenarios, Recommendations Improved, Basket analysis.

10 Hours

Module 4

Classification III – Music Genre Classification: Fetching the music data, looking at music, Using FFT to build our first classifier, improving classification performance with Mel Frequency Cepstral Coefficients.

Pattern Recognition: Introducing Image Processing, Loading and displaying images, classifying a harder dataset, Local feature representations.

10 Hours

Text Books:
Building Machine Learning Systems with Python,Willi Richert and Luis Pedro Coelho, Shroff Publishers, 2013

Reference Books:
1. EthemAlpaydin, "Introduction to Machine Learning", 2nd Ed., PHI Learning Pvt. Ltd., 2013.
2. T. Hastie, R. Tibshirani, J. H. Friedman, "The Elements of Statistical Learning", Springer,1st edition, 2001.

EBooks:
1. http://alex.smola.org/drafts/thebook.pdf
2.http://www.cs.huji.ac.il/~shais/UnderstandingMachineLearning/understanding-machine-learning-theory-algorithms.pdf
3. http://ciml.info/dl/v0_8/ciml-v0_8-all.pdf
4. http://cs.du.edu/~mitchell/mario_books/Introduction_to_Machine_Learning_2e_Ethem_Alpaydin.pdf

MOOCs:
1. https://www.udacity.com/course/intro-to-machine-learning--ud120
2. https://work.caltech.edu/telecourse.html
3. https://www.coursera.org/learn/machine-learning
4. https://www.reddit.com/r/MachineLearning/comments/2rqv7x/which_moocs/

Course Title:	AUGMENTED AND VIRTUAL REALITY	L	T	P	C
Course Code:	20EI856	3	0	0	3
Hours / week: 3	CIE: 50 Marks SEE: 50 MarksExam hours: 3 Total hours: 40				

MODULE 1

1. Introduction of Virtual Reality: Fundamental Concept and Components of Virtual Reality. Primary Features and Present Development on Virtual Reality.

2. Multiple Models of Input and Output Interface in Virtual Reality: Input - Tracker, Sensor, Digital Glove, Movement Capture, Video-based Input, 3D Menus & 3DScanner etc. Output - Visual /Auditory / Haptic Devices.

MODULE 2

3. Visual Computation in Virtual Reality: Fundamentals of Computer Graphics. Software and Hardware Technology on Stereoscopic Display. Advanced Techniques in CG: Management of Large Scale Environments & Real Time Rendering.

4. Interactive Techniques in Virtual Reality: Body Track, Hand Gesture, 3D Menus, Object Grasp.

MODULE 3

5. Development Tools and Frameworks in Virtual Reality: Frameworks of Software Development Tools in VR. X3D Standard; Vega, MultiGen, Virtools.

6. Application of VR in Digital Entertainment: VR Technology in Film & TV Production. VR Technology in Physical Exercises and Games. Demonstration of Digital Entertainment by VR.

MODULE 4

7. Augmented and Mixed Reality, Taxonomy, technology and features of augmented reality, difference between AR and VR, Challenges with AR, AR systems and functionality.

8. Augmented reality methods, visualization techniques for augmented reality, wireless displays in educational augmented reality applications, mobile projection interfaces, marker-less tracking for augmented reality, enhancing interactivity in AR environments, evaluating AR systems.

Text Books:

1. Alan B. Craig, Understanding Augmented Reality, Concepts and Applications, Morgan Kaufmann, 2013.
2. Burdea, G. C. and P. Coffet. Virtual Reality Technology, Second Edition. Wiley-IEEE Press, 2003/2006.

Reference Books:

1. Alan Craig, William Sherman and Jeffrey Will, Developing Virtual Reality Applications, Foundations of Effective Design, Morgan Kaufmann, 2009.

Course Title:	**Industry 4.0 and IIoT**	**L**	**T**	**P**	**C**
Course Code:	**20EI857**	**3**	**0**	**0**	**3**
Hours / week: 3	**CIE: 50 Marks SEE: 50 Marks Exam hours: 3 Total hours: 40**				

Module 1

Unit 1: Introduction to Industry 4.0 – Need for Industry 4.0, Challenges in integrated development vs Distributed development, Cyber physical systems, Role of data analytics and communication.
Text book 2 Chapter 1

Unit 2:
Traditional process planning
Text book 2 Chapter 2
Industry 4.0: Smart sensors, Miniaturizations, Cyber physical systems, Role of communication, Cloud, Fog computing, Role of data science and analytics, Augmented Reality and Virtual Reality, Artificial Intelligence, Big Data and Advanced Analysis, Cybersecurity in Industry 4.0
Text book 1 Chapter 3

Module 2

Unit 3: Secure manufacturing infrastructure, Cyber physical system architecture, Security enforcement. Need for forensics in SCADA, Forensics challenges
Textbook 3 Chapter 2
Unit 4: Industrial IoT: Business Model and RefereceArchiterture: IIoT-Business Models-Part I, Part II, IIoT Reference Architecture-Part I, Part II. Industrial IoT- Layers: IIoT Sensing-Part I, Part II, IIoT Processing-Part I, Part II, IIoT Communication-Part I.
Textbook 3 Chapter 3

Module 3

Unit 5: Industrial IoT- Layers: IIoT Communication-Part II, Part III, IIoT Networking-Part I, Part II, Part III. Big Data Analytics and Software Defined Networks: IIoT Analytics - Introduction, Machine Learning and Data Science - Part I, Part II

Unit 6: Industrial IoT: Big Data Analytics and Software Defined Networks: SDN in IIoT-Part I, Part II, Data Center Networks, Industrial IoT: Security and Fog Computing: Cloud Computing in IIoT- Part I, Part II.

Textbook 1 Chapter 5

Module 4

Unit 7: Industrial IoT: Security and Fog Computing - Fog Computing in IIoT, Security in IIoT-Part I, Part II, IndustrialIoT- Application Domains: Factories and Assembly Line, Food Industry.

Unit 8: Industrial IoT- Application Domains: Healthcare, Power Plants, Inventory Management & Quality Control, Plant Safety and Security (Including AR and VR safety applications), Facility Management.

Textbook 1 Chapter 7, 8

Text Book:

1. "Industry 4.0: The Industrial Internet of Things", by Alasdair Gilchrist (Apress)
2. Industry 4.0 – Development towards the fourth Industrial revolution Kaushik Kumar, Divya Zindani ,J. Paulo Davim
3. Cyber-security for Industry 4.0 - Andre Wegner, James Graham, Eli Ribble

Reference Book:

"Industrial Internet of Things: Cyber manufacturing Systems" by Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat (Springer)

Course Title:	**DIGITAL IMAGE PROCESSING**			**L**	**T**	**P**	**C**
Course Code:	**20EI858**			**3**	**0**	**0**	**3**
Hours / week: 3	**CIE: 50 Marks**	**SEE: 50**	**Exam hours: 3**				**Total hours: 40**

Module-1

Fundamentals: Introduction, Fundamental steps in digital image processing (DIP), components of DIP system, Structure of Human eye, Image formation in the eye, Brightness Adaption & Discrimination, A simple image formation model, Image sampling and quantization, Basic relationship between pixels.

10 Hours

Module-2

Image Enhancement in Spatial Domain-1: Background, Point processing – Image negatives, Log transformations, Power law transformations, Contrast stretching, Gray level slicing, Bit plane slicing, Histogram processing – Histogram equalization, Histogram matching (specification) and Local enhancement.

Image Enhancement in Spatial Domain-2: Arithmetic/Logic operations – Image subtraction, Image averaging, Basics of spatial filtering, Smoothing spatial filters – Smoothing linear filters, ordered statistics filters, Sharpening spatial filters – Foundation, Laplacian and gradient.

10 Hours

Module-3

Image Enhancement in Frequency Domain: Background, Basic properties of the frequency domain, Basic filtering in the frequency domain, Basic filters and their properties, Smoothing frequency domain filters – Ideal low-pass filters, Butterworth low-pass filters, Gaussian low-pass filters, Sharpening frequency domain filters – Ideal high-pass filters, Butterworth high-pass filters, Gaussian high-pass filters, Homomorphic filtering.

Noise filtering by frequency domain filtering – band reject filter, band pass filter, notch filter, inverse filtering, minimum mean square error (Wiener) filtering.

10 Hours

Module-4

Image Restoration: A model of Image degradation and restoration process, Some important Noise Probability functions, restoration in the presence of noise only - spatial filtering, Periodic noise reduction by Frequency domain filtering, Linear Position Invariant Degradation, Estimating the degradation function.

Detection of discontinuities- Point line edge detection, Gradient operators, Laplacian, edge linking and boundary detection- local processing. Global processing through Hough transform, Thresholding- Foundation, Illumination role, Basic global thresholding, Region based separation- Region growing, Region splitting and merging.

10 Hours

Text Books:

1. **Digital Image Processing**, Rafael C. Gonzalez & Richard E. Woods,. Pearson Education Inc.,2nd Edition, 2004 (units 1,3,4,5 and 6)
2. **Digital Image Processing and Analysis**, B.Chanda, D.DuttaMajumder, PHI, 6th reprint, 2005

Reference Books:

1. **Fundamentals of Digital Image Processing**, A.K.Jain, PHI, 2nd Edition, 2007
2. **Image Processing, analysis and Machine Vision**, Milan Sonka, Vaclar H lavac and Roger boyle, Thomson, 2nd Edition ,2003

E Book:

1. https://www.cs.nmt.edu/~ip/lectures.html

MOOC:

1. http://nptel.ac.in/courses/117105079/