JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B.TECH. ELECTRONICS AND INSTRUMENTATION ENGINEERING
IV YEAR COURSE STRUCTURE AND SYLLABUS (R16)

Applicable From 2016-17 Admitted Batch

IV YEAR I SEMESTER

S. No	Course Code	Course Title	L	T	P	Credits
1	EI701PC	Embedded System Design	4	0	0	4
2	EI702PC	Industrial Automation	4	0	0	4
3		Professional Elective – II	3	0	0	3
4		Professional Elective - III	3	0	0	3
5		Professional Elective - IV	3	0	0	3
6	EI703PC	Embedded Systems Lab	0	0	3	2
7	EI704PC	Industrial Automation Lab	0	0	3	2
8	EI705PC	Industry Oriented Mini Project	0	0	3	2
9	EI706PC	Seminar	0	0	2	1
		Total Credits	**17**	**0**	**11**	**24**

IV YEAR II SEMESTER

S. No	Course Code	Course Title	L	T	P	Credits
1		Open Elective - III	3	0	0	3
2		Professional Elective - V	3	0	0	3
3		Professional Elective - VI	3	0	0	3
4	EI801PC	Major Project	0	0	30	15
		Total Credits	**9**	**0**	**30**	**24**

Professional Elective – I

EI611PE	Principles of Communications
EI612PE	Virtual Instrumentation
EI613PE	Object Oriented Programming through JAVA
EI614PE	Hydraulic and Pneumatic Control Systems

Professional Elective – II

EI721PE	Optoelectronics & Laser Instrumentation
ET722PE	Digital Image Processing
EI723PE	Telemetry and Telecontrol
EI724PE	Adaptive Control Systems

Professional Elective – III

EI731PE	Biomedical Instrumentation
EI732PE	Power plant Instrumentation
EE731PE	Digital Control Systems
EI734PE	Medical Imaging Techniques

Professional Elective – IV

EI741PE	VLSI Design
EI742PE	Robotics and Automation
EI743PE	Instrumentation Practices in Industries
EI744PE	Embedded Real Time Operating Systems

Professional Elective – V

EI851PE	Neural Networks and Fuzzy Logic
EI852PE	MEMS and Applications
EI853PE	Computer Networks
EI854PE	Industrial Data Communications

Professional Elective – VI

EI861PE	Internet of Things
EI862PE	Reliability Engineering
EI863PE	DSP Processors and Architectures
EI864PE	Machine Learning

***Open Elective** subjects' syllabus is provided in a separate document.

***Open Elective –** Students should take Open Electives from the List of Open Electives Offered by Other Departments/Branches Only.

Ex: - A Student of Mechanical Engineering can take Open Electives from all other departments/branches except Open Electives offered by Mechanical Engineering Dept.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
LIST OF OPEN ELECTIVES OFFERED BY VARIOUS DEPARTMENTS FOR B.TECH. III AND IV YEARS

S. No.	Name of the Department Offering Open Electives	Open Elective – I (Semester – V)	Open Elective – II (Semester – VI)
1	Aeronautical Engg.	AE511OE: Introduction to Space Technology	AE621OE: Introduction to Aerospace Engineering
2	Automobile Engg.	CE511OE: Disaster Management MT512OE: Intellectual Property Rights	MT621OE: Data Structures MT622OE: Artificial Neural Networks
3	Biomedical Engg.	BM511OE: Reliability Engineering	BM621OE: Medical Electronics
4	Civil Engg.	CE511OE: Disaster Management.	CE621OE: Remote Sensing and GIS CE622OE: Geo-Informatics CE623OE: Intellectual Property Rights
5	Civil and Environmental Engg.	CE511OE: Disaster Management	CN621OE: Environmental Impact Assessment CE623OE: Intellectual Property Rights
6	Computer Science and Engg. / Information Technology	CS511OE: Operating Systems CS512OE: Database Management Systems	CS621OE: Java Programming CS622OE: Software Testing Methodologies CS623OE: Cyber Security
7	Electronics and Communication Engg. / Electronics and Telematics Engg.	EC511OE: Principles of Electronic Communications	EC621OE: Principles of Computer Communications and Networks
8	Electronics and Computer Engg.	EM511OE: Scripting Languages	EM621OE: Soft Computing Techniques
9	Electrical and Electronics Engg.	EE511OE: Non-Conventional Power Generation EE512OE: Electrical Engineering Materials EE513OE: Nanotechnology	EE621OE: Design Estimation and Costing of Electrical Systems EE622OE: Energy Storage Systems EE623OE: Introduction to Mechatronics
10	Electronics and Instrumentation Engg.	EI511OE: Electronic Measurements and Instrumentation	EI621OE: Industrial Electronics
11	Mechanical Engg.	ME511OE: Optimization Techniques ME512OE: Computer Graphics ME513OE: Introduction	ME621OE: World Class Manufacturing ME622OE: Fundamentals of Robotics ME623OE: Fabrication

		to Mechatronics ME514OE: Fundamentals of Mechanical Engineering	Processes
12	Mechanical Engg. (Material Science and Nanotechnology)	NT511OE: Fabrication Processes NT512OE: Non destructive Testing Methods NT513OE: Fundamentals of Engineering Materials	NT621OE: Introduction to Material Handling NT622OE: Non-Conventional Energy Sources NT623OE: Robotics
13	Mechanical Engg. (mechatronics)	MT511OE: Analog and Digital I.C. Applications MT512OE: Intellectual Property Rights MT513OE: Computer Organization	MT621OE: Data Structures MT622OE: Artificial Neural Networks MT623OE: Industrial Management
14	Metallurgical and Materials Engg.	MM511OE: Materials Characterization Techniques	MM621OE: Science and Technology of Nano Materials MM622OE: Metallurgy of Non Metallurgists
15	Mining Engg.	MN511OE: Introduction to Mining Technology	MN621OE: Coal Gasification, Coal Bed Methane and Shale Gas
16	Petroleum Engg.	PE511OE: Materials Science and Engineering PE512OE: Renewable Energy Sources PE513OE: Environmental Engineering	PE621OE: Energy Management and Conservation PE622OE: Optimization Techniques PE623OE: Entrepreneurship and Small Business Enterprises

S. No.	Name of the Department Offering Open Electives	Open Elective –III (Semester – VIII)
1	Aeronautical Engg.	AE831OE: Air Transportation Systems AE832OE: Rockets and Missiles
2	Automobile Engg.	AM831OE: Introduction to Mechatronics AM832OE: Microprocessors and Microcontrollers
3	Biomedical Engg.	BM831OE: Telemetry and Telecontrol BM832OE: Electromagnetic Interference and Compatibility
4	Civil Engg.	CE831OE: Environmental Impact Assessment CE832OE: Optimization Techniques in Engineering CE833OE: Entrepreneurship and Small Business Enterprises
5	Civil and Environmental Engg.	CN831OE: Remote Sensing and GIS CE833OE: Entrepreneurship and Small Business

		Enterprises
6	Computer Science and Engg. / Information Technology	CS831OE: Linux Programming CS832OE: R Programming CS833OE: PHP Programming
7	Electronics and Communication Engg. / Electronics and Telematics Engg.	EC831OE: Electronic Measuring Instruments
8	Electronics and Computer Engg.	EM831OE: Data Analytics
9	Electrical and Electronics Engg.	EE831OE: Entrepreneur Resource Planning EE832OE: Management Information Systems EE833OE: Organizational Behaviour
10	Electronics and Instrumentation Engg.	EI831OE: Sensors and Transducers, EI832OE: PC Based Instrumentation
11	Mechanical Engg.	ME831OE: Total Quality Management ME832OE: Industrial Safety, Health, and Environmental Engineering ME833OE: Basics of Thermodynamics ME834OE: Reliability Engineering
12	Mechanical Engg. (Material Science and Nanotechnology)	NT831OE: Concepts of Nano Science And Technology NT832OE: Synthesis of Nanomaterials NT833OE: Characterization of Nanomaterials
13	Mechanical Engg. (mechatronics)	MT831OE: Renewable Energy Sources MT832OE: Production Planning and Control CE833OE: Entrepreneurship and Small Business Enterprises
14	Metallurgical and Materials Engg.	MM831OE: Design and Selection of Engineering Materials
15	Mining Engg.	MN831OE: Solid Fuel Technology MN832OE: Health & Safety in Mines
16	Petroleum Engg.	PE831OE: Disaster Management PE832OE: Fundamentals of Liquefied Natural Gas PE833OE: Health, Safety and Environment in Petroleum Industry

***Open Elective –** Students should take Open Electives from List of Open Electives Offered by Other Departments/Branches Only.

Ex: - A Student of Mechanical Engineering can take Open Electives from all other departments/branches except Open Electives offered by Mechanical Engineering Dept.

EMBEDDED SYSTEM DESIGN

B.Tech. IV Year I Sem.	**L**	**T**	**P**	**C**
Course Code: EI701PC/EC734PE/ET742PE	**4**	**0**	**0**	**4**

Course Objectives:

- To provide an overview of Design Principles of Embedded System.
- To provide clear understanding about the role of firmware, operating systems in correlation with hardware systems.

Course Outcomes:

- Expected to understand the selection procedure of Processors in the embedded domain.
- Design Procedure for Embedded Firmware.
- Expected to visualize the role of Real time Operating Systems in Embedded Systems.
- Expected to evaluate the Correlation between task synchronization and latency issues

UNIT - I

Introduction to Embedded Systems: Definition of Embedded System, Embedded Systems Vs General Computing Systems, History of Embedded Systems, Classification, Major Application Areas, Purpose of Embedded Systems, Characteristics and Quality Attributes of Embedded Systems.

UNIT - II

Typical Embedded System: Core of the Embedded System: General Purpose and Domain Specific Processors, ASICs, PLDs, Commercial Off-The-Shelf Components (COTS). **Memory:** ROM, RAM, Memory according to the type of Interface, Memory Shadowing, Memory selection for Embedded Systems, Sensors and Actuators, Communication Interface: Onboard and External Communication Interfaces.

UNIT - III

Embedded Firmware: Reset Circuit, Brown-out Protection Circuit, Oscillator Unit, Real Time Clock, Watchdog Timer, Embedded Firmware Design Approaches and Development Languages.

UNIT - IV

RTOS Based Embedded System Design: Operating System Basics, Types of Operating Systems, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling.

UNIT - V

Task Communication: Shared Memory, Message Passing, Remote Procedure Call and Sockets, Task Synchronization: Task Communication/Synchronization Issues, Task Synchronization Techniques, Device Drivers, How to Choose an RTOS.

TEXT BOOKS:

1. Introduction to Embedded Systems - Shibu K.V, Mc Graw Hill.

REFERENCE BOOKS:

1. Embedded Systems - Raj Kamal, MC GRAW HILL EDUCATION.
2. Embedded System Design - Frank Vahid, Tony Givargis, John Wiley.
3. Embedded Systems – Lyla, Pearson, 2013
4. An Embedded Software Primer - David E. Simon, Pearson Education.

INDUSTRIAL AUTOMATION

	L	T	P	C
B.Tech. IV Year I Sem.				
Course Code: EI702PC	**4**	**0**	**0**	**4**

Pre-requisites: Nil

UNIT - I

Programmable Logic Controllers (PLCs): Evolutions of PLCs– Sequential and Programmable Controllers, Architecture, Communication Networks for PLC, Comparative study of Industrial PLCs.

UNIT - II

PLC Programming: PLC Programming- Ladder logic, Functional block, Sequential Function Chart, Structured Text, and Instruction list.

UNIT - III

SCADA: Hardware and software, Remote terminal units, Master station, Communication architectures and open SCADA protocols.

UNIT - IV

Distributed Control System (DCS): Various Architectures– Comparison, Local control unit, Operator Interface, Displays, Engineering interface, Study of any one DCS available in market, Factors to be considered in selecting DCS.

UNIT - V

Advanced Topics in Automation: Study of Distributed Control Systems available in market, Factors to be considered in selecting DCS, OLE for Process Automation (OPC), Internet of Things, Cloud based Automation.

TEXT BOOKS:

1. F.D. Petruzella- Programmable Logic Controllers, Tata Mc-Graw Hill, Third Edition, 2010.
2. Michael P. Lukas- Distributed Control Systems: Their Evaluation and Design, Van Nostrand Reinhold Co., 1986.
3. Clarke. G, Reynders. D, and Wright. E, Practical Modern SCADA Protocols: DNP3, 60870.5 and Related Systems, Newnes, 1st Edition, 2004.

REFERENCE BOOKS:

1. Hughes, T. - Programmable Logic Controllers, ISA Press, 2000.
2. Mc-Millan, G.K. - Process/Industrial Instrument and Controls Handbook, McGraw-Hill, New York, 1999.

OPTOELECTRONICS & LASER INSTRUMENTATION
(Professional Elective – II)

	L	T	P	C
B.Tech. IV Year I Sem.				
Course Code: EI721PE	**3**	**0**	**0**	**3**

Pre-requisites: Nil.

Course Objective: To make the students understand the application of Optoelectronics and Lasers in the quantifying.

Course Outcome: Upon completion of this course the student shall be able to apply his instrumentation knowledge and understand how light and LASER can be used for measurements.

UNIT – I

Optical Fibers and Their Properties: Introduction to optical fiber - fiber characteristics - principles of light propagation through a fiber - Different types of fibers and their properties - Losses in the optical fiber - Dispersion - advantages and disadvantages of optical fibers

UNIT – II

Laser Fundamentals: Introduction to lasers - Laser characteristics – Laser configuration – Three level and four level lasers – Q-switching – Mode locking – Types of lasers: Gas lasers, Solid lasers, Liquid lasers and Semiconductor lasers

UNIT – III

Optoelectronic Components: Optical sources: LED, LD - Optical detectors: PIN, APD - Electro-optic, Magneto optic and Acousto-optic Modulators.

UNIT – IV

Industrial Applications of Optical Fibers: Interferometer method of measurement of length – Moire fringes – Measurement of pressure, Temperature, Current, Voltage, Liquid level and strain - fiber optic Gyroscope – Polarization maintaining fibers – Applications.

UNIT – V

Laser instrumentation: Industrial applications of lasers – Lasers for measurement of distance, length, velocity, acceleration, current, voltage and atmospheric effect - Bio-medical applications - Holography: Principle, Methods, Holographic Interferometers and applications.

TEXT BOOKS:

1. Optical Fiber Communication – Principles and Practice, J.M. Senior, Prentice Hall of India, 1985.
2. 'Introduction to Optoelectronics, J. Wilson and J.F.B. Hawkes, Prentice Hall of India, 2001.

REFERENCE BOOKS:

1. Understanding Fiber Optics, 4th or 5th edition; Jeff Hecht; Prentice Hall publishers
2. Optical Fibre Communication and Sensors, M. Arumugam, Anuradha Agencies, 2002.
3. Optical Fibre Communication, G. Keiser, McGraw Hill, 1995.
4. Lasers: Theory and Applications – by Thyagarajan K. and Ghatak A.K., Plenum Press
5. Monte Ross, Laser Applications, McGraw Hill, 1968.

DIGITAL IMAGE PROCESSING
(Professional Elective – II)

B.Tech. IV Year I Sem.	**L**	**T**	**P**	**C**
Course Code: ET722PE/EM732PE	**3**	**0**	**0**	**3**

Prerequisite: Nil

Course Objectives:

- To comprehend the relation between human visual system and machine perception and processing of digital images.
- To provide a detailed approach towards image processing applications like enhancement, segmentation, and compression.

Course Outcomes:

- Exploration of the limitations of the computational methods on digital images.
- Expected to implement the spatial and frequency domain image transforms on enhancement and restoration of images.
- Elaborate understanding on image enhancement techniques.
- Expected to define the need for compression and evaluate the basic compression algorithms.

UNIT - I

Digital Image Fundamentals & Image Transforms: Digital Image Fundamentals, Sampling, and Quantization, Relationship between Pixels.

Image Transforms: 2-D FFT, Properties, Walsh Transform, Hadamard Transform, Discrete Cosine Transform, Haar Transform, Slant Transform, Hotelling Transform.

UNIT - II

Image Enhancement (Spatial Domain): Introduction, Image Enhancement in Spatial Domain, Enhancement through Point Processing, Types of Point Processing, Histogram Manipulation, Linear and Non – Linear Gray Level Transformation, Local or Neighborhood criterion, Median Filter, Spatial Domain High-Pass Filtering.

Image Enhancement (Frequency Domain): Filtering in Frequency Domain, Low Pass (Smoothing) and High Pass (Sharpening) Filters in Frequency Domain.

UNIT - III

Image Restoration: Degradation Model, Algebraic Approach to Restoration, Inverse Filtering, Least Mean Square Filters, Constrained Least Squares Restoration, Interactive Restoration.

UNIT - IV

Image Segmentation: Detection of Discontinuities, Edge Linking, and Boundary Detection, thresholding, Region Oriented Segmentation.

Morphological Image Processing: Dilation and Erosion: Dilation, Structuring Element Decomposition, Erosion, Combining Dilation and Erosion, Opening and Closing, Hit or Miss Transformation.

UNIT - V

Image Compression: Redundancies and their Removal Methods, Fidelity Criteria, Image Compression Models, Huffman and Arithmetic Coding, Error Free Compression, Lossy Compression, Lossy and Lossless Predictive Coding, Transform Based Compression, JPEG 2000 Standards.

TEXT BOOKS:

1. Digital Image Processing - Rafael C. Gonzalez, Richard E. Woods, 3rd Edition, Pearson, 2008
2. Digital Image Processing- S Jayaraman, S Esakkirajan, T Veera kumar- TMH, 2010.

REFERENCE BOOKS:

1. Digital Image Processing and Analysis-Human and Computer Vision Application with using CVIP Tools - Scotte Umbaugh, 2nd Ed, CRC Press, 2011
2. Digital Image Processing using MATLAB – Rafael C. Gonzalez, Richard E Woods and Steven L. Eddings, 2nd Edition, MC GRAW HILL EDUCATION, 2010.
3. Digital Image Processing and Computer Vision – Somka, Hlavac, Boyle- Cengage Learning (Indian edition) 2008.
4. Introductory Computer Vision Imaging Techniques and Solutions- Adrian low, 2008, 2nd Edition

TELEMETRY AND TELECONTROL
(Professional Elective – II)

	L	T	P	C
B.Tech. IV Year I Sem.				
Course Code: EI723PE	**3**	**0**	**0**	**3**

Pre-requisites: Nil.

Course Objective: To make students understand the application of telemetry techniques to Instrumentation.

Course Outcome: Upon completion of this course students will appreciate t he application of different telemetry systems and control to any process.

UNIT – I

Telemetry Principles: Introduction, Functional blocks of Telemetry system, Methods of Telemetry – Non-Electrical, Electrical, Pneumatic, Frequency.

Symbols and Codes: Bits and Symbols, Time function pulses, Line and Channel Coding, Modulation Codes. Inter symbol Interference.

UNIT – II

Frequency & Time Division Multiplexed Systems: FDM, IRIG Standard, FM and PM Circuits, Receiving end, PLL.

TDM - PAM, PAM /PM and TDM – PCM Systems. PCM reception. Differential PCM Introduction, QAM, Protocols.

UNIT – III

Satellite Telemetry: General considerations, TT & C Service, Digital Transmission systems, TT&C Subsystems, Telemetry, and Communications.

Modern Telemetry: Zigbee, Ethernet.

UNIT – IV

Optical Telemetry: Optical fibers Cable – Sources and detectors – Transmitter and Receiving Circuits, Coherent Optical Fiber Communication System.

UNIT – V

Telecontrol Methods: Analog and Digital techniques in Telecontrol, Telecontrol apparatus – Remote adjustment, Guidance and regulation – Telecontrol using information theory – Example of a Telecontrol System.

TEXT BOOKS:

1. Telemetry Principles – D. Patranabis, TMH
2. Telecontrol Methods and Applications of Telemetry and Remote Control – by Swoboda G., Reinhold Publishing Corp., London, 1991

REFERENCE BOOKS:

1. Handbook of Telemetry and Remote Control – by Gruenberg L., McGraw Hill, New York, 1987.
2. Telemetry Engineering – by Young R.E., Little Books Ltd., London, 1988.
3. Data Communication and Teleprocessing System – by Housley T., PH Intl., Englewood Cliffs, New Jersey, 1987.

ADAPTIVE CONTROL SYSTEMS
(Professional Elective – II)

	L	T	P	C
B.Tech. IV Year I Sem.				
Course Code: EI724PE	**3**	**0**	**0**	**3**

UNIT – I

Introduction: Use of Adaptive control - definitions - essential aspects – classification - Model Reference Adaptive Systems - different configurations - classification - mathematical description - Equivalent representation as a nonlinear time varying system - direct and indirect MRAC.

UNIT - II

Continuous time MRAC systems: Model Reference Adaptive System Design based on Gradient method, Design of stable adaptive controllers based on Kalman - Meyer - Yakubovich Lemma, Lyapunov theory, Hyper stability theory - Narendra's error model approach. Discrete time MRAC systems - Hyper stability approach - Narendra's error model approach - Introduction - stability theorem - Relation to other algorithms - hybrid adaptive control.

UNIT - III

Self Tuning Regulators (STR): Different approaches to self tuning - Recursive parameter estimation - implicit STR - Explicit STR. hybrid STR, hybrid predictor design and algorithms. STR design based on pole - placement technique and LQG theory - Gain scheduling. - Stability of adaptive control algorithms.

UNIT - IV

Adaptive control of nonlinear systems: Adaptive predictive control - Robustness of adaptive control systems - Instability phenomena in adaptive systems. Concept of learning control systems. Different types of learning control schemes. LTI learning control via parameter estimation schemes. Convergence of learning control. Fuzzy logic adaptive control, stochastic adaptive control –multi decision problems-dual control.

UNIT - V

Case Studies: Robotic manipulators, Aerodynamic curve identification, Electric drives, Satellite altitude control, regulators, power system, and electrical generator.

TEXT BOOKS:

1. K. J. Astrom and Bjorn Witten mark, Adaptive control, Pearson Edu., 2nd Edn.
2. Sankar Sastry, Adaptive control

.

REFERENCE BOOKS

1. V. V. Chalam, Adaptive Control System - Techniques & Applications, Marcel Dekker Inc.

2. Miskhin and Braun, Adaptive control systems, MC Graw Hill
3. Karl Johan Åström, Graham Clifford Goodwin, P. R. Kumar, Adaptive Control, Filtering and Signal Processing.
4. G.C. Goodwin, Adaptive control.
5. Narendra and Anna Swamy, Stable Adaptive Systems.

BIOMEDICAL INSTRUMENTATION
(Professional Elective – III)

	L	T	P	C
B.Tech. IV Year I Sem.				
Course Code: EI731PE	**3**	**0**	**0**	**3**

Course Objective: Introduction to various Concepts of Medical Instrumentation.
Course Outcome: The student is expected to know the working and design of instruments used in Heath care

UNIT – I
Components of Medical Instrumentation System: Bioamplifier. Static and dynamic characteristics of medical instruments. Biosignals and characteristics. Problems encountered with measurements from human beings.

UNIT – II
Organization of cell: Nernst equation for membrane Resting Potential Generation and Propagation of Action Potential, Conduction through nerve to neuromuscular junction.
Bio Electrodes: Biopotential Electrodes-External electrodes, Internal Electrodes. Biochemical Electrodes.

UNIT – III
Mechanical function: Electrical Conduction system of the heart. Cardiac cycle. Relation between electrical and mechanical activities of the heart.
Cardiac Instrumentation: Blood pressure and Blood flow measurement. Specification of ECG machine. Einthoven triangle, Standard 12-lead configurations, Interpretation of ECG waveform with respect to electro mechanical activity of the heart**.**

UNIT – IV
Neuro-Muscular Instrumentation: Specification of EEG and EMG machines. Electrode placement for EEG and EMG recording. Interpretation of EEG and EMG.

UNIT – V
Therapeutic equipment: Pacemaker, Defibrillator, Shortwave diathermy. Haemodialysis machine**. Respiratory Instrumentation:** Mechanism of respiration, Spirometry, Pnemuotachograph Ventilators.

TEXT BOOKS:
1. Hand-book of Biomedical Instrumentation – by R. S. Khandpur, McGraw-Hill, 2003.
2. Medical Instrumentation, Application and Design – by John G. Webster, John Wiley.

REFERENCE BOOKS:
1. Principles of Applied Biomedical Instrumentation – by L.A. Geoddes and L.E. Baker, John Wiley and Sons.
2. Biomedical Equipment Technology – Carr & Brown, Pearson.

POWER PLANT INSTRUMENTATION
(Professional Elective – III)

	L	T	P	C
B.Tech. IV Year I Sem.				
Course Code: EI732PE	**3**	**0**	**0**	**3**

Course Objectives: Able to introduce various methods of power generation and specially provide the knowledge of instrumentation and control in thermal power plants.

Course Outcomes: Upon completion of this course the student shall be able to apply his knowledge and understand how instrumentation system is designed for a power plant.

UNIT - I

Overview of Power Generation: Introduction, Various sources of Electrical energy, Non-conventional energy sources, Conventional energy sources, Importance of Instrumentation and control in power generation, piping and instrumentation diagram, Cogeneration of power, Control Rooms.

UNIT - II

Instrumentation and Control in Water Circuit: Water circuit, Boiler Feed Water circulation, Measurements in Water circuit, Controls in water circuit, Impurities in Water and Steam.

UNIT - III

Instrumentation and Control in Air- Fuel Circuit: Air- Fuel Circuit, Measurement in Air-Fuel Circuit, Controls in Air- Fuel Circuit, Analytical Measurement.

UNIT - IV

Power Plant Management: Introduction, Master Control, Combustion Process, Boiler Efficiency, Maintenance of Measuring Instruments, Intrinsic and Electrical Safety, Interlocks for Boiler Operation, Computer based Control and Data Logging Systems, Distributed Control Systems.

UNIT - V

Turbine – Monitoring and Control: Introduction, Turbine System Inlet System, turbine Measurements, Turbine Control Systems, Lubrication for Turbo-alternator, Turbo-alternator Cooling System.

TEXT BOOKS:

1. Power Plant Instrumentation by K. Krishnaswamy, M. Ponni Bala, PHI Learning Pvt. Ltd., 2011.

REFERENCES:

1. Power-Plant Control and Instrumentation: The Control of Boilers and HRSG Systems, David Lindsey IET, 2000.
2. Power Plant Engineering, Nag, Tata McGraw-Hill Education, 07-Aug-2008.
3. The Control of boilers - Sam .G.Duke low - ISA press,1991

DIGITAL CONTROL SYSTEMS
(Professional Elective – III)

	L	T	P	C
B.Tech. IV Year I Sem.				
Course Code: EE731PE	**3**	**0**	**0**	**3**

Prerequisite: Control Systems

Course Objectives:

- To understand the fundamentals of digital control systems, z-transforms
- To understand state space representation of the control systems, concepts of controllability and observability
- To study the estimation of stability in different domains
- To understand the design of discrete time control systems, compensators, state feedback controllers, state observers through various transformations

Course Outcomes: After completion of this course, the student will be able to

- Carry map S-plane and Z-plane, do state-space analysis
- Carry stability analysis in S-domain and Z-domains
- Carry stability analysis through bilinear transformation and R-H criteria,
- design of discrete-time control systems, design of lag, lead, lead-lag compensators, design of PID controllers and design of state feedback controllers and observers,
- Apply the above concepts to real-world electrical and electronics problems and applications.

UNIT - I

Introduction To Digital Control Systems And Z-Transforms: Introduction - Merits and Demerits of Digital Control Systems - Practical aspects of the choice of sampling rate and Multirate sampling - Basic discrete time signals - Quantization – Sampling Theorem - Data Conversions and Quantization - Sampling process - Mathematical Modeling - Data Reconstruction and Filtering of sampled signals - Zero - Order Hold (ZOH).

z- Transform and Inverse z-Transform, Relationship between s - plane and z - plane - Difference equation - Solution by recursion and z-Transform - Pulse Transfer Functions of the ZOH and relationship between G(s) and G(z) - Bilinear Transformation.

UNIT- II

Input/output Analysis of Digital Control Systems: Pulse transfer function - z transform analysis of open loop, closed loop systems - Modified z Transform - transfer function - Stability of linear digital control systems - Stability tests – Jury Stability test.

Root loci - Frequency domain analysis - Bode plots - Gain margin and phase margin.

UNIT – III

Design of Controllers For I/O Model Digital Control Systems: Cascade and Feedback Compensation by continuous data controllers - Digital controllers - Design using Bilinear

Transformation - Realization of Digital PID controllers, Design of Digital Control Systems based on Root Locus Technique.

UNIT – IV

State Space Analysis and State Feedback Control Design of Digital Control Systems: State Equations of discrete data systems, solution of discrete state equations, State Transition Matrix: Computation methods for State Transition Matrix: z - transform method - Relation between State Equations and Pulse Transfer Functions.

Concepts on Controllability and Observability - Pole placement design by state feedback.

UNIT - V

Digital State Observer and Stability Analysis: Design of the full order and reduced order state observer, Design of Dead beat Controller - some case studies - Stability analysis of discrete time systems based on Lyapunov approach.

TEXT BOOKS:

1. K. Ogata, Discrete Time Control Systems, PHI/Addison - Wesley Longman Pte. Ltd., India, Delhi, 1995.
2. B. C Kuo, Digital Control Systems, 2nd Edition, Oxford University Press, Inc., 1992.

REFERENCE BOOKS:

1. F. Franklin, J.D. Powell, and M.L. Workman, Digital control of Dynamic Systems, Addison - Wesley Longman, Inc., Menlo Park, CA , 1998.
2. M. Gopal, Digital Control and State Variable Methods, Tata McGraw Hill, India, 1997.
3. C. H. Houpis and G.B. Lamont, Digital Control Systems, McGraw Hill, 1985.
4. John S. Baey, Fundamentals of Linear State Space Systems, McGraw Hill, 1st edition 1999
5. Bernard Fried Land, Control System Design, McGraw Hill, 1st edition 1986.
6. Dorsay, Continuous and Discrete Control Systems, McGraw Hill, 2001.

MEDICAL IMAGING TECHNIQUES
(Professional Elective – III)

	L	T	P	C
B.Tech. IV Year I Sem.				
Course Code: EI734PE	**3**	**0**	**0**	**3**

UNIT - I

Fundamentals of X-Ray: Electromagnetic Radiation, Interactions between X-rays and Matter, Intensity of an X-ray Beam, Attenuation.

Generation and Detection of X-rays: X-ray Generation, Fillers, Beam Restrictors and Grids, Intensifying Screens, Fluorescent Screens, X-ray detectors.

X-Ray Image Characteristics: Spatial Resolution, Image Noise, Image Contrast, Receiver Operating Curve (ROC), Image Subtraction, Digital Radiography. X-ray diagnostic methods, Biological effects of Ionizing radiation.

UNIT - II

Conventional Tomography, Longitudinal Section Tomography, Computed Tomography, Reconstruction Techniques: Algebraic, Iterative reconstruction Techniques, Radon Transform and its applications. Back Projection, Filter Back Projection Algorithms. Radio Nuclide Imaging: Fundamentals of Radioactivity, Radioactive materials, Generation and Detection of Nuclear Emission, Diagnostic Methods using Radiation Detectors.

Radio Nuclide Imaging Systems: SPECT, PET, Attenuation compensation. Characteristics of Radio nuclide Images, Internal Radiation, Dosimetry and Biological effects,

UNIT - III

Fundamentals Of Acoustic Propagation: Reflection, Refraction, Attenuation, Absorption, Scattering, Non linearity Parameter and Doppler Effect.

Image Characteristics: Ultrasonic Texture, Speckle reduction, Compensation of Phase Aberration, Tissue Characterization. Transducer Beam Characteristics, Axial and Lateral Resolution, Focusing arrays.

UNIT - IV

Ultrasonic Diagnostic Methods: Pulse-Echo Systems, Transmission Methods, Doppler Methods, Duplex Methods, Duplex Imaging. Biological effects due to Ultrasound.

UNIT - V

Magnetic Resonance Imaging: Fundamentals of Nuclear Magnetic Resonance, Fourier Spectrum of the NMR Signal, Spin Density, Relaxation Times, Pulse Sequences.

Generation and Detection of NMR signal: Magnetic field Gradients, The NMR Coil/ Probe, The Transmitter, and The Receiver. Characteristics of Magnetic Resonance Imaging: Spatial Resolution, Image contrast.

Imaging Methods: Data Acquisition, Spin - Echo Imaging, Gradient Echo Imaging, Blood Flow Imaging, NMR Spectroscopy, Sensitivity and Resolution, Imaging Safety. Biological Effects of Magnetic Fields.

TEXT BOOKS:

1. K. KirkShung, Michael B. Smith, Benjamin Tsui. Principles of Medical Imaging., Pub : Academic Press, 1992
2. Rangaraj M. Rangayyan, Biomedical Image Analysis", CRC Press, Boca Raton, FL, 2005.

REFERENCE BOOKS:

1. Avinash C. Kak, Principles of Computerised Tomographic Imaging. IEEE PRESS

VLSI DESIGN
(Professional Elective – IV)

	L	T	P	C
B.Tech. IV Year I Sem.				
Course Code: EC702PC/ET721PE/EI741PE	**3**	**0**	**0**	**3**

Course Objectives: The objectives of the course are to:

- Give exposure to different steps involved in the fabrication of ICs using MOS transistor, CMOS/BICMOS transistors, and passive components.
- Explain electrical properties of MOS and BiCMOS devices to analyze the behavior of inverters designed with various loads.
- Give exposure to the design rules to be followed to draw the layout of any logic circuit.
- Provide concept to design different types of logic gates using CMOS inverter and analyze their transfer characteristics.
- Provide design concepts to design building blocks of data path of any system using gates.
- Understand basic programmable logic devices and testing of CMOS circuits.

Course Outcomes: Upon successfully completing the course, the student should be able to:

- Acquire qualitative knowledge about the fabrication process of integrated circuit using MOS transistors.
- Choose an appropriate inverter depending on specifications required for a circuit
- Draw the layout of any logic circuit which helps to understand and estimate parasitic of any logic circuit
- Design different types of logic gates using CMOS inverter and analyze their transfer characteristics
- Provide design concepts required to design building blocks of data path using gates.
- Design simple memories using MOS transistors and can understand design of large memories.
- Design simple logic circuit using PLA, PAL, FPGA and CPLD.
- Understand different types of faults that can occur in a system and learn the concept of testing and adding extra hardware to improve testability of system

UNIT – I

Introduction: Introduction to IC Technology – MOS, PMOS, NMOS, CMOS & BiCMOS

Basic Electrical Properties: Basic Electrical Properties of MOS and BiCMOS Circuits: I_{ds}-V_{ds} relationships, MOS transistor threshold Voltage, g_m, g_{ds}, Figure of merit ωo; Pass transistor, NMOS Inverter, Various pull ups, CMOS Inverter analysis and design, Bi-CMOS Inverters.

UNIT - II

VLSI Circuit Design Processes: VLSI Design Flow, MOS Layers, Stick Diagrams, Design Rules and Layout, 2 μm CMOS Design rules for wires, Contacts and Transistors Layout Diagrams for NMOS and CMOS Inverters and Gates, Scaling of MOS circuits.

UNIT – III

Gate Level Design: Logic Gates and Other complex gates, Switch logic, Alternate gate circuits, Time delays, Driving large capacitive loads, Wiring capacitance, Fan – in, Fan – out, Choice of layers.

UNIT - IV

Data Path Subsystems: Subsystem Design, Shifters, Adders, ALUs, Multipliers, Parity generators, Comparators, Zero/One Detectors, Counters.

Array Subsystems: SRAM, DRAM, ROM, Serial Access Memories.

UNIT - V

Programmable Logic Devices: PLAs, FPGAs, CPLDs, Standard Cells, Programmable Array Logic, Design Approach, Parameters influencing low power design.

CMOS Testing: CMOS Testing, Need for testing, Test Principles, Design Strategies for test, Chip level Test Techniques.

TEXT BOOKS:

1. Essentials of VLSI circuits and systems – Kamran Eshraghian, Eshraghian Dougles and A. Pucknell, PHI, 2005 Edition
2. CMOS VLSI Design – A Circuits and Systems Perspective, Neil H. E Weste, David Harris, Ayan Banerjee, 3rd Ed, Pearson, 2009.

REFERENCE BOOKS:

1. CMOS logic circuit Design - John .P. Uyemura, Springer, 2007.
2. Modern VLSI Design - Wayne Wolf, Pearson Education, 3rd Edition, 1997.

ROBOTICS AND AUTOMATION
(Professional Elective – IV)

B.Tech. IV Year I Sem.	L	T	P	C
Course Code: EI742PE	3	0	0	3

Course Objectives:

- To study the various parts of robots and fields of robotics.
- To study the various kinematics and inverse kinematics of robots.
- To study the Euler, Lagrangian formulation of Robot dynamics.
- To study the trajectory planning for robot.
- To study the control of robots for some specific applications.

UNIT - I

Basic Concepts: Definition and origin of robotics – different types of robotics – various generations of robots – degrees of freedom – Asimov's laws of robotics – dynamic stabilization of robots.

UNIT - II

Power Sources and Sensors: Hydraulic, pneumatic and electric drives – determination of HP of motor and gearing ratio – variable speed arrangements – path determination – micro machines in robotics – machine vision – ranging – laser – acoustic – magnetic, fiber optic and tactile sensors.

UNIT - III

Manipulators, Actuators and Grippers: Construction of manipulators – manipulator dynamics and force control – electronic and pneumatic manipulator control circuits – end effectors – U various types of grippers –design considerations.

UNIT - IV

Kinematics and Path Planning: Solution of inverse kinematics problem – multiple solution jacobian work envelop – hill climbing techniques – robot programming languages.

UNIT - V

Case Studies: Multiple robots – machine interface – robots in manufacturing and non-manufacturing applications – robot cell design – selection of robot.

TEXT BOOKS:

1. Mikell P. Weiss G.M., Nagel R.N., Odraj N.G., Industrial Robotics, McGraw-Hill Singapore, 1996.
2. Ghosh, Control in Robotics and Automation: Sensor Based Integration, Allied Publishers, Chennai, 1998.

REFERENCE BOOKS:

1. Deb.S.R., Robotics technology and flexible Automation, John Wiley, USA 1992.
2. Asfahl C.R., Robots and manufacturing Automation, John Wiley, USA 1992.
3. Klafter R.D., Chimielewski T.A., Negin M., Robotic Engineering – An integrated approach, Prentice Hall of India, New Delhi, 1994.
4. Mc Kerrow P.J. Introduction to Robotics, Addison Wesley, USA, 1991.
5. Issac Asimov I Robot, Ballantine Books, New York, 1986.

INSTRUMENTATION PRACTICES IN INDUSTRIES
(Professional Elective – IV)

	L	T	P	C
B.Tech. IV Year I Sem.				
Course Code: EI743PE	**3**	**0**	**0**	**3**

Pre-requisites: Nil.

Course Objective: To provide the knowledge of basic and contemporary instrumentation and control practices in the Industries like Paper and Pulp, Petrochemical, Aerospace etc.

Course Outcomes: Upon completion of this course the student shall be able to apply his instrumentation knowledge which he acquired during the course of study.

UNIT - I

Pulp and Paper Industries:

Manufacture of pulp: Raw Materials, Pulping Processes, Craft Pulping, Soda Pulping, Sulfite Pulping, Semi Chemical Pulping, Mechanical, and Thermo mechanical Pulping.

Manufacture of paper: Wet Processing, Fourdrinier Machine, Coated Papers, Specialty Papers.

UNIT - II

Cement Industries: Portland Cements, Other Cements, Lime, Gypsum, Miscellaneous Calcium Components, Magnesium Components

Nuclear Industries: Nuclear Reactions, Uranium and Thorium Fission, Uranium as an Energy Source, Nuclear Fuels, Nuclear Reactors, Fusion Reactions, Fusion, Processing Nuclear Materials, Isotopes and Isotope Separation, Protection from Radioactivity, Waste Disposal.

UNIT - III

Petrochemical Industries: Unit Operations: Drying-Separation-Heat Transfer-Distillation-Thermal Cracking- Catalytic Cracking-Catalytic Reforming- Hydro Cracking – Hydro Treating -Chemical Oxidation-Chemical Reduction-Polymerization- Alkylation-Isomerization-Production of Ethylene, Acetylene- And Propylene from Petroleum

Measurements in refineries petrochemical industries: Differential Pressure Transmitter, Thermocouples Infrared Pyrometer, Mass Flow Meters, Potentiometric Level Transmitter, Vacuum Measurement,

UNIT - IV

Flight Instrumentation - I:

Primary Flight Instruments (Principle of operation)**:** Pitot Static System For The Measurement Of Aircraft Speed, Aneroid Barometer And Altimeter, Gyroscope And Its Properties, Methods Of Operating Gyroscopic Flight Instruments, Gyro Horizon, Vacuum Driven Gyro Horizon, Electric Gyro Horizon.

Heading Indicating Instruments (Principle of operation): Direct Reading Magnetic Compass, Liquid Damping Direct Reading Compass and Liquid Expansion Compensating Direct Reading Compass, Remote Indicating Compass System.

UNIT - V

Flight Instrumentation - II:

Measurement of Engine Speed, Engine Temperature, Aircraft Pressure(Principle Of Operation)**:** Mechanical Tachometers, Electrical Tachometers, Air Temperature Sensors To Measure RAT And SAT, Radiation Pyrometer System, Methods Of Measuring Pressure, U-Tube Manometer, Direct Reading Pressure Gauges, Remote Indicating Pressure Gauges.

Measurement of Fuel quantity and Fuel flow (Principle of Operation)**:** Float Type Fuel Quantity Indicating System, Capacitance Type Fuel Gauge System, Fuel Flow Measurement, Independent, and Integrated Flow Meter System.

TEXT BOOKS:

1. Austin G.T. Shreeves, Chemical Process Industries, McGraw-Hill International Student Edition, Singapore, 1985
2. Pallet, E.H.J. Aircrafts Instruments and Integrated Systems. Longman Scientific & Technical, McGraw-Hill, 1992.

REFERENCE BOOKS:

1. Principles of Industrial Instrumentation, D. Patranabis, Mc Graw Hill.
2. John R Lavigne, An Introduction To Paper Industry Instrumentation, Miller Freeman Publications, California, 1985 Series.
3. Liptak B.G. Instrumentation in Process Industries, Chilton Book Company, 1994.
4. Liptak B.G., Process Measurement and Analysis, Third Edition, Chilton Book Company, 1996.

EMBEDDED REAL TIME OPERATING SYSTEMS
(Professional Elective – IV)

B.Tech. IV Year I Sem.	**L**	**T**	**P**	**C**
Course Code: EI744PE	**3**	**0**	**0**	**3**

Pre-requisites: Computer Organization and Operating Systems.

Course Objectives:

- To provide broad understanding of the requirements of Real Time Operating Systems.
- To make the student understand, applications of these Real Time features using case studies.

Course Outcomes:

- To acquire knowledge on Real Time features of UNIX and LINUX.
- To understand the basic building blocks of Real Time Operating Systems in terms of scheduling, context switching and ISR.
- Elaborative understanding on Real Time applications using Real Time Linux, ucos2, VX works, Embedded Linux, etc.

UNIT – I

Introduction to UNIX/LINUX, Overview of Commands, File I/O, (open, create, close, lseek, read, write), Process Control (fork, vfork, exit, wait, waitpid, exec).

UNIT - II

Real Time Operating Systems: Brief History of OS, Defining RTOS, The Scheduler, Objects, Services, Characteristics of RTOS, Defining a Task, asks States and Scheduling, Task Operations, Structure, Synchronization, Communication and Concurrency. Defining Semaphores, Operations and Use, Defining Message Queue, States, Content, Storage, Operations and Use

UNIT - III

Objects, Services and I/O Pipes, Event Registers, Signals, Other Building Blocks, Component Configuration, Basic I/O Concepts, I/O Subsystem

UNIT - IV

Exceptions, Interrupts and Timers: Exceptions, Interrupts, Applications, Processing of Exceptions and Spurious Interrupts, Real Time Clocks, Programmable Timers, Timer Interrupt Service Routines (ISR), Soft Timers, Operations.

UNIT - V

Case Studies of RTOS: RT Linux, MicroC/OS-II, Vx Works, Embedded Linux, and Tiny OS.

TEXT BOOKS:

1. Real Time Concepts for Embedded Systems – Qing Li, Elsevier, 2011

REFERENCE BOOKS:

1. Embedded Systems - Architecture, Programming and Design by Rajkamal, 2007, TMH.
2. Advanced UNIX Programming, Richard Stevens
3. Embedded Linux: Hardware, Software and Interfacing – Dr. Craig Hollabaugh

EMBEDDED SYSTEMS LAB

B.Tech. IV Year I Sem.	**L**	**T**	**P**	**C**
Course Code: EI703PC	**0**	**0**	**3**	**2**

This lab is to provide skills needed to develop software for ARM based Embedded System. The aim is to teach the basics of device drivers, programming for Linux Kernel. The lab programs will be taught on ARM board with simple devices like GPIOs, LEDs, seven segment displays, keypads, Temperature sensors, and E^2PROM devices, and also to provide interface to real world through ADCs and DACs.

The goal is to focus on learning the kernel interface, while still programming real hardware.

Required Skill-set:

1. Keil IDE or Equivalent IDE
2. Embedded C
3. ARM architecture
4. LINUX OS
5. Circuit simulation software like Proteus, Multisim (MCU).

INDUSTRIAL AUTOMATION LAB

B.Tech. IV Year I Sem.	**L**	**T**	**P**	**C**
Course Code: EI704PC	**0**	**0**	**3**	**2**

Course Objectives:

- To study about different PLC units and other interfacing devices
- To acquire knowledge about SCADA programming.
- To study about different industrial applications using PLC.

Course Outcomes: The student will be able to:

- Familiarity with common PLC components, their use, symbols, and mathematical models
- Ability to formulate and analyze simple mathematical models of PLC circuits
- Ability to design, analyze and implement simple control systems Industrial Applications using PLC circuits

List of Experiments

1. Control of bottle filling plant using PLC
2. Control of Elevator using PLC.
3. Development of Human Machine Interface using any SCADA package.
4. Level and flow control using PLC.
5. Pressure and flow control using DCS.
6. Creating an Analog – open loop & Digital loop using DCS
7. Feed forward with feedback control for temperature control process.
8. Configuring DCS- System for given application.
9. Creating interlock logic in DCS.

NEURAL NETWORKS AND FUZZY LOGIC
(Professional Elective – V)

B.Tech. IV Year II Sem.	**L**	**T**	**P**	**C**
Course Code: EI851PE	**3**	**0**	**0**	**3**

Pre-requisites: Nil.

Course Objectives: This course introduces the basics of Neural Networks and essentials of Artificial Neural Networks with Single Layer and Multilayer Feed Forward Networks. Also deals with Associate Memories and introduces Fuzzy sets and Fuzzy Logic system components. The Neural Network and Fuzzy Network system application to Electrical Engineering is also presented. This subject is very important and useful for doing Project Work.

Course Outcomes: After going through this course the student gets a thorough knowledge on, biological neurons and artificial neurons, comparative analysis between human and computer, artificial neural network models, characteristics of ANN's, different types of activation functions, learning strategies, learning rules, perceptron models, single and multi layer feed-forward and feed-back neural networks, back-propagation algorithm, Kolmogorov Theorem, different types of associative memories and basics of fuzzy logic, concept of classical and fuzzy sets, fuzzy logic system components fuzzification and defuzzification, with which he/she can able to apply the above conceptual things to real-world electrical and electronics problems and applications.

UNIT – I

Introduction &Essentials to Neural Networks: Introduction, Humans and Computers, Organization of the Brain, Biological Neuron, Biological and Artificial Neuron Models, Hodgkin-Huxley Neuron Model, Integrate-and-Fire Neuron Model, Spiking Neuron Model, Characteristics of ANN, McCulloch-Pitts Model, Historical Developments, Potential Applications of ANN. Artificial Neuron Model, Operations of Artificial Neuron, Types of Neuron Activation Function, ANN Architectures, Classification Taxonomy of ANN – Connectivity, Neural Dynamics (Activation and Synaptic), Learning Strategy (Supervised, Unsupervised, Reinforcement), Learning Rules, Types of Application

UNIT – II

Single & Multi Layer Feed Forward Neural Networks: Introduction, Perceptron Models: Discrete, Continuous and Multi-Category, Training Algorithms: Discrete and Continuous Perceptron Networks, Perceptron Convergence theorem, Limitations of the Perceptron Model, Applications. Credit Assignment Problem, Generalized Delta Rule, and Derivation of Back-propagation (BP) Training, Summary of Back-propagation Algorithm, Kolmogorov Theorem, Learning Difficulties, and Improvements.

UNIT - III

Associative Memories – I: Paradigms of Associative Memory, Pattern Mathematics, Hebbian Learning, General Concepts of Associative Memory (Associative Matrix, Association Rules, Hamming Distance, The Linear Associator, Matrix Memories, Content Addressable Memory).

UNIT - IV

Associative Memories-II: Bidirectional Associative Memory (BAM) Architecture, BAM Training Algorithms: Storage and Recall Algorithm, BAM Energy Function, Proof of BAM Stability Theorem. Architecture of Hopfield Network: Discrete and Continuous versions, Storage and Recall Algorithm, Stability Analysis, Capacity of the Hopfield Network Summary and Discussion of Instance/Memory Based Learning Algorithms, Applications.

UNIT – V

Fuzzy Logic Classical & Fuzzy Sets: Introduction to classical sets - properties, Operations and relations; Fuzzy sets, Membership, Uncertainty, Operations, properties, fuzzy relations, cardinalities, membership functions.

Fuzzy Logic System Components: Fuzzification, Membership value assignment, development of rule base and decision making system, De-fuzzification to crisp sets, De-fuzzification methods.

TEXT BOOKS:

1. Neural Networks, Fuzzy logic, Genetic algorithms: synthesis and applications, Rajasekharan and Pai, PHI.
2. Neural Networks and Fuzzy Logic, C. Naga Bhaskar, G. Vijay Kumar, BS Publications.

REFERENCE BOOKS:

1. Artificial Neural Networks, B. Yegnanarayana, PHI.
2. Artificial Neural Networks, Zaruda, PHI.
3. Neural Networks and Fuzzy Logic System, Bart Kosko, PHI.
4. Neural Networks, James A Freeman and Davis Skapura, Pearson Education.
5. Neural Networks, Simon Hakins, Pearson Education.

MEMS AND APPLICATIONS
(Professional Elective – V)

	L	T	P	C
B.Tech. IV Year II Sem.				
Course Code: EI852PE	**3**	**0**	**0**	**3**

Pre-requisites: Nil.

Course Objective: To provide knowledge of fabrication process and applications.

Course Outcomes: Upon completion of this course the student shall be able to apply his instrumentation knowledge and understand MEMS fabrication and its use in the industries.

UNIT - I

Introduction to MEMS: MEMS; Use of MEMS. Fabrication process

The Substrate and adding material to it: Introduction, The silicon substrate, Additive technique: Oxidation, Additive technique: Physical vapour deposition, other additive techniques.

UNIT - II

MEMS Fabrication: Creating and transferring patterns - Photolithography:

Introduction, keeping it clean, Photoresist, Working with resist, masks, Resolution, Permanent resists.

Creating structures-Micromachining: Introduction, Bulk Micromachining processes, Surface Micromachining, Process Integration.

UNIT - III

MEMS Transducers - I:

Thinking about modelling: What is modeling? Units, The input-output concept, Physical variables and notation, preface to the modeling chapters.

MEMS Transducers-An overview of how they work: What is a transducer? Distinguishing between sensors and actuators, Response characteristics of transducers, MEMS Sensors: Principles of operation, MEMS Actuators: Principles of operation, Signal conditioning, RF applications and Optical applications.

Piezoresistive transducers: Introduction, Modeling Piezoresistive transducers, Piezoresistive pressure sensor.

UNIT - IV

MEMS Transducers- II:

Capacitive transducers: Introduction, Capacitor fundamentals, Modeling a capacitor sensor, Capacitive accelerometer.

UNIT - V

MEMS Transducers- III:

Piezoelectric transducers: Introduction, Modeling piezoelectric materials, Mechanical modelling of beams and plates, Cantilever piezoelectric actuator.

Thermal transducers: Introduction, Basic heat transfer, Hot-arm actuator.

TEXT BOOKS:

1. Introductory MEMS- Fabrication and Applications - Adams, Thomas M., Layton, Richard A., Spinger, 2010.

REFERENCE BOOKS:

1. MEMS and Microsystems: Design and manufacture, Tai-Ran Hsu ,McGraw-Hill, 2002
2. MEMS: Applications Mohamed Gad-el-Hak, CRC Press, 29-Nov-2005

COMPUTER NETWORKS
(Professional Elective – V)

	L	T	P	C
B.Tech. IV Year II Sem.				
Course Code: EI853PE	**3**	**0**	**0**	**3**

Pre-requisites: Nil

Course Objectives:

- To introduce the fundamental various types of computer networks.
- To demonstrate the TCP/IP and OSI models with merits and demerits.
- To explore the various layers of OSI Model.
- To introduce UDP and TCP Models.
- To have the concept of different routing techniques for data communications.

Course Outcomes:

- Students should understand and explore the basics of Computer Networks and Various Protocols. He/She will be in a position to understand the World Wide Web concepts.
- Students will be in a position to administrate a network and flow of information further he/she can understand easily the concepts of network security, Mobile and ad hoc networks.

UNIT - I

Introduction to Networks: Internet, Protocols and Standards, The OSI Model, Layers in OSI Model, TCP/IP Suite, Addressing.

Physical Layer: Multiplexing, Transmission Media, Circuit Switched Networks, Datagram Networks, and Virtual Circuit Networks.

UNIT - II

Data Link Layer: Introduction, Checksum, Framing, Flow and Error Control, Noiseless Channels, Noisy Channels, Random Access Controlled Access, Channelization, IEEE Standards, Ethernet, Giga-Bit Ethernet, Wireless LANs, SONET-SDH, Frame Relay and ATM.

UNIT - III

Network Layer: Logical Addressing, Internetworking, Tunneling, Address Mapping, ICMP, IGMP, Forwarding, Routing-Flooding, Bellman& Ford, Disjkstra's routing protocols, RIP, OSPF, BGP,- and Multicast Routing Protocols. Connecting Devices-Passive Hubs, Repeaters, Active Hubs, Bridges, Routers.

UNIT - IV

Transport Layer: Process to Process Delivery, UDP, TCP and SCTP Protocols, Congestion, Congestion Control, Quality of Service.

Application Layer: Domain Name Space, DNS in Internet, Electronic Mail, File Transfer Protocol, WWW, HTTP, SNMP, Multi-Media.

UNIT - V

Network Security: Security services, mechanisms and attacks, IPSec, SSL, VPN, Firewall. Bluetooth, Zigbee, IPv4, IPv6.

TEXT BOOKS:

1. Data Communications and Networking – Behrouz A. Forouzan, 4th Edition Mc Graw Hill Education, 2006.
2. Computer Networks -- Andrew S Tanenbaum, 4th Edition, Pearson Education.
3. Computer Networking: A Top-Down Approach Featuring the Internet, James F. Kurose, K. W. Ross, 3rd Edition, Pearson Education.

REFERENCES:

1. Data communications and Networks by william stallings
2. Data communication and Networks - Bhusan Trivedi, Oxford university press 2016.
3. An Engineering Approach to Computer Networks-S.Keshav, 2nd Edition, Pearson Education.
4. Understanding Communications and Networks, 3rd Edition, W.A.Shay, Cengage Learning.

INDUSTRIAL DATA COMMUNICATIONS
(Professional Elective – V)

B.Tech. IV Year II Sem.	L	T	P	C
Course Code: EI854PE	3	0	0	3

Pre-requisites: Nil

UNIT - I

RS-232 and RS-485: ISO-OSI model, EIA 232 interface standard, EIA 485 interface standard, EIA 422 interface standard, 20 mA current loop, Serial interface converters.

UNIT - II

Modbus, Data Highway (Plus) and Hart Protocols: MODBUS protocol structure, Function codes, Troubleshooting, Data highway (Plus) protocol, Review of HART Protocol.

UNIT - III

AS-Interface (AS-I) and Device Net: AS interface- Introduction, Physical layer, Data link layer and Operating characteristics. Device net- Introduction, Physical layer, Data link layer and Application layer.

UNIT - IV

Profibus PA/DP/FMS and Foundation Field bus: Profibus- Introduction, Profibus protocol stack, Profibus communication model, Communication objects, System operation and Troubleshooting, Foundation fieldbus versus Profibus.

UNIT - V

Industrial Ethernet and Wireless Communication: Industrial Ethernet- Introduction, 10 Mbps Ethernet and 100 Mbps Ethernet, Radio and wireless communication- Introduction, Components of radio link, The radio spectrum and frequency allocation and Radio modems, Comparison between various industrial networks.

TEXT BOOKS:

1. Mackay, S., Wrijut, E., Reynders, D. and Park, J. - Practical Industrial Data Networks Design, Installation and Troubleshooting, Newnes Publication, Elsevier, 1st Edition, 2004.
2. Buchanan, W. - Computer Busses, CRC Press, 2000.
3. Stallings, W. - Wireless Communication and Network, 2nd Edition, Prentice Hall of India, 2005.

INTERNET OF THINGS
(Professional Elective – VI)

	L	T	P	C
B.Tech. IV Year II Sem.				
Course Code: BM854PE/EI861PE	**3**	**0**	**0**	**3**

Course Objectives:

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

UNIT - I

Introduction to Internet of Things –Definition and Characteristics of IoT, Physical Design of IoT – IoT Protocols, IoT communication models, Iot Communication APIs, IoT enabled Technologies – Wireless Sensor Networks, Cloud Computing, Big data analytics, Communication protocols, Embedded Systems, IoT Levels and Templates, Domain Specific IoTs – Home, City, Environment, Energy, Retail, Logistics, Agriculture, Industry, health and Lifestyle.

UNIT - II

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

UNIT - III

Introduction to Python - Language features of Python, Data types, data structures, Control of flow, functions, modules, packaging, file handling, data/time operations, classes, Exception handling. Python packages - JSON, XML, HTTP Lib, URL Lib, SMTP Lib.

UNIT - IV

IoT Physical Devices and Endpoints - Introduction to Raspberry PI - Interfaces (serial, SPI, I2C). Programming – Python program with Raspberry PI with focus of interfacing external gadgets, controlling output, reading input from pins.

UNIT - V

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

TEXT BOOKS:

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

RELIABILITY ENGINEERING
(Professional Elective – VI)

	L	T	P	C
B.Tech. IV Year II Sem.				
Course Code: AM852PE/EI862PE/ME834OE	**3**	**0**	**0**	**3**

Prerequisite: Mathematics III

Course Objectives:

- To introduce the basic concepts of reliability, various models of reliability
- To analyze reliability of various systems
- To introduce techniques of frequency and duration for reliability evaluation of repairable systems.

Course Outcomes: After completion of this course, the student will be able to

- model various systems applying reliability networks
- evaluate the reliability of simple and complex systems
- estimate the limiting state probabilities of repairable systems
- apply various mathematical models for evaluating reliability of irrepairable systems

UNIT – I

Basic Probability Theory: Elements of probability, probability distributions, Random variables, Density and Distribution functions- Binomial distribution- Expected value and standard deviation - Binomial distribution, Poisson distribution, normal distribution, exponential distribution, Weibull distribution.

Definition of Reliability: Definition of terms used in reliability, Component reliability, Hazard rate, derivation of the reliability function in terms of the hazard rate. Hazard models - Bath tub curve, Effect of preventive maintenance. Measures of reliability: Mean Time to Failure and Mean Time Between Failures.

UNIT – II

Network Modeling and Evaluation Of Simple Systems: Basic concepts- Evaluation of network Reliability / Unreliability - Series systems, Parallel systems- Series-Parallel systems- Partially redundant systems- Examples.

Network Modeling and Evaluation of Complex systems: Conditional probability method- tie set, Cutset approach- Event tree and reduced event tree methods- Relationships between tie and cutsets- Examples.

UNIT – III

Time Dependent Probability: Basic concepts- Reliability function f(t). F(t), R(t) and h(t) - Relationship between these functions.

Network Reliability Evaluation Using Probability Distributions: Reliability Evaluation of Series systems, Parallel systems – Partially redundant systems- determination of reliability measure- MTTF for series and parallel systems – Examples.

UNIT – IV

Discrete Markov Chains: Basic concepts- Stochastic transitional probability matrix- time dependent probability evaluation- Limiting State Probability evaluation- Absorbing states – Examples

Continuous Markov Processes: Modeling concepts- State space diagrams- Unreliability evaluation of single and two component repairable systems

UNIT – V

Frequency and Duration Techniques: Frequency and duration concepts, application to multi state problems, Frequency balance approach.

Approximate System Reliability Evaluation: Series systems – Parallel systems- Network reduction techniques- Cut set approach- Common mode failures modeling and evaluation techniques- Examples.

TEXT BOOKS:

1. Roy Billinton and Ronald N Allan, Reliability Evaluation of Engineering Systems, Plenum Press, 1983.
2. E. Balagurusamy, Reliability Engineering by Tata McGraw-Hill Publishing Company Limited, 2002.

REFERENCE BOOK:

1. K. K. Agarwal, Reliability Engineering-Kluwer Academic Publishers, 1993**.**

DSP PROCESSORS AND ARCHITECTURES
(Professional Elective – VI)

B.Tech. IV Year II Sem.	**L**	**T**	**P**	**C**
Course Code: EI863PE	**3**	**0**	**0**	**3**

Pre-requisites: Digital Signal Processing.

Course Objectives: The objectives of the course are:

- To recall digital transform techniques.
- To introduce architectural features of programmable DSP Processors of TI and Analog Devices.
- To give practical examples of DSP Processor architectures for better understanding.
- To develop the programming knowledge using Instruction set of DSP Processors.
- To understand interfacing techniques to memory and I/O devices.

Course Outcomes: Upon completion of the course, the student

- Be able to distinguish between the architectural features of General purpose processors and DSP processors.
- Understand the architectures of TMS320C54xx and ADSP 2100 DSP devices.
- Be able to write simple assembly language programs using instruction set of TMS320C54xx.
- Can interface various devices to DSP Processors.

UNIT – I

Introduction to Digital Signal Processing: Introduction, 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.

Computational Accuracy in DSP Implementations: Number formats for signals and coefficients in DSP systems, Dynamic Range and Precision, Sources of error in DSP implementations, A/D Conversion errors, DSP Computational errors, D/A Conversion Errors, Compensating filter.

UNIT – II

Architectures for Programmable DSP Devices: Basic Architectural features, DSP Computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Address Generation Unit, Programmability and Program Execution, Speed Issues, Features for External interfacing.

UNIT - III

Programmable Digital Signal Processors: Commercial Digital signal-processing Devices, Data Addressing modes of TMS320C54XX DSPs, Data Addressing modes of

TMS320C54XX Processors, Memory space of TMS320C54XX Processors, Program Control, TMS320C54XX instructions and Programming, On-Chip Peripherals, Interrupts of TMS320C54XX processors, Pipeline Operation of TMS320C54XX Processors.

UNIT – IV

Analog Devices Family of DSP Devices: Analog Devices Family of DSP Devices – ALU and MAC block diagram, Shifter Instruction, Base Architecture of ADSP 2100, ADSP-2181 high performance Processor.

Introduction to Blackfin Processor - The Blackfin Processor, Introduction to Micro Signal Architecture, Overview of Hardware Processing Units and Register files, Address Arithmetic Unit, Control Unit, Bus Architecture and Memory, Basic Peripherals.

UNIT – V

Interfacing Memory and I/O Peripherals to Programmable DSP Devices:

Memory space organization, External bus interfacing signals, Memory interface, Parallel I/O interface, Programmed I/O, Interrupts and I/O, Direct memory access (DMA).

TEXT BOOKS:

1. Digital Signal Processing – Avtar Singh and S. Srinivasan, Thomson Publications, 2004.
2. A Practical Approach to Digital Signal Processing - K Padmanabhan, R. Vijayarajeswaran, Ananthi. S, New Age International, 2006/2009
3. Embedded Signal Processing with the Micro Signal Architecture Publisher: Woon-Seng Gan, Sen M. Kuo, Wiley-IEEE Press, 2007

REFERENCE BOOKS:

1. Digital Signal Processors, Architecture, Programming and Applications – B. Venkataramani and M. Bhaskar, 2002, TMH.
2. Digital Signal Processing – Jonatham Stein, 2005, John Wiley.
3. DSP Processor Fundamentals, Architectures & Features – Lapsley et al. 2000, S. Chand & Co.
4. Digital Signal Processing Applications Using the ADSP-2100 Family by The Applications Engineering Staff of Analog Devices, DSP Division, Edited by Amy Mar, PHI
5. The Scientist and Engineer's Guide to Digital Signal Processing by Steven W. Smith, Ph.D., California Technical Publishing, ISBN 0-9660176-3-3, 1997
6. Embedded Media Processing by David J. Katz and Rick Gentile of Analog Devices, Newnes.

MACHINE LEARNING
(Professional Elective – VI)

	L	T	P	C
B.Tech. IV Year II Sem.				
Course Code: EC854PE/EI864PE	**3**	**0**	**0**	**3**

Prerequisites:

- Data Structures
- Knowledge on statistical methods

Course Objectives:

- This course explains machine learning techniques such as decision tree learning, Bayesian learning etc.
- To understand computational learning theory.
- To study the pattern comparison techniques.

Course Outcomes:

- Understand the concepts of computational intelligence like machine learning
- Ability to get the skill to apply machine learning techniques to address the real time problems in different areas
- Understand the Neural Networks and its usage in machine learning application.

UNIT - I

Introduction - Well-posed learning problems, designing a learning system, Perspectives and issues in machine learning

Concept learning and the general to specific ordering – introduction, a concept learning task, concept learning as search, find-S: finding a maximally specific hypothesis, version spaces and the candidate elimination algorithm, remarks on version spaces and candidate elimination, inductive bias**.**

Decision Tree Learning – Introduction, decision tree representation, appropriate problems for decision tree learning, the basic decision tree learning algorithm, hypothesis space search in decision tree learning, inductive bias in decision tree learning, issues in decision tree learning.

UNIT - II

Artificial Neural Networks-1– Introduction, neural network representation, appropriate problems for neural network learning, perceptions, multilayer networks and the back-propagation algorithm.

Artificial Neural Networks-2- Remarks on the Back-Propagation algorithm, An illustrative example: face recognition, advanced topics in artificial neural networks.

Evaluation Hypotheses – Motivation, estimation hypothesis accuracy, basics of sampling theory, a general approach for deriving confidence intervals, difference in error of two hypotheses, comparing learning algorithms.

UNIT - III

Bayesian learning – Introduction, Bayes theorem, Bayes theorem and concept learning, Maximum Likelihood and least squared error hypotheses, maximum likelihood hypotheses for predicting probabilities, minimum description length principle, Bayes optimal classifier, Gibs algorithm, Naïve Bayes classifier, an example: learning to classify text, Bayesian belief networks, the EM algorithm.

Computational learning theory – Introduction, probably learning an approximately correct hypothesis, sample complexity for finite hypothesis space, sample complexity for infinite hypothesis spaces, the mistake bound model of learning.

Instance-Based Learning- Introduction, *k*-nearest neighbour algorithm, locally weighted regression, radial basis functions, case-based reasoning, remarks on lazy and eager learning.

UNIT - IV

Genetic Algorithms – Motivation, Genetic algorithms, an illustrative example, hypothesis space search, genetic programming, models of evolution and learning, parallelizing genetic algorithms.

Learning Sets of Rules – Introduction, sequential covering algorithms, learning rule sets: summary, learning First-Order rules, learning sets of First-Order rules: FOIL, Induction as inverted deduction, inverting resolution.

Reinforcement Learning – Introduction, the learning task, Q–learning, non-deterministic, rewards and actions, temporal difference learning, generalizing from examples, relationship to dynamic programming.

UNIT - V

Analytical Learning-1- Introduction, learning with perfect domain theories: PROLOG-EBG, remarks on explanation-based learning, explanation-based learning of search control knowledge.

Analytical Learning-2-Using prior knowledge to alter the search objective, using prior knowledge to augment search operators.

Combining Inductive and Analytical Learning – Motivation, inductive-analytical approaches to learning, using prior knowledge to initialize the hypothesis.

TEXT BOOK:

1. Machine Learning – Tom M. Mitchell, - MGH

REFERENCE:

1. Machine Learning: An Algorithmic Perspective, Stephen Marshland, Taylor & Francis