

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF ELECTRONICS AND INSTRUMENTATION ENGINEERING

COURSE STRUCTURE AND SYLLABUS

For

B. TECH ELECTRONICS AND INSTRUMENTATION ENGINEERING

(Applicable for batches admitted from 2019-2020)



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA

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IV Year- I Semester

S.No.	Subjects	Category	L	T	P	Credits
1	Management and Organizational Behavior	HS	3	0	0	3
2	Biomedical Instrumentation	PC	3	0	0	3
3	Digital Image and video Processing	PC	3	0	0	3
4	Professional Elective (PE-III)	PE	3	0	0	3
5	Professional Elective (PE-IV)	PE	3	0	0	3
6	Instrumentation lab- II	LC	0	0	3	1.5
7	VLSI Lab	LC	0	0	3	1.5
8	Project - Part I	PR	0	0	6	3
	Total Credits					21

IV Year - II Semester

S.No.	Subjects	Category	L	T	P	Credits
1	Professional Elective (PE-V)	PE	3	0	0	3
2	Open Elective (OE2)	OE	3	0	0	3
3	Project - Part II	PR	0	0	18	9
	Total Credits					15

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IV Year- I Semester	L	T	P	C
	3	0	0	3
MANAGEMENT AND ORGANIZATIONAL BEHAVIOR				

OBJECTIVES:

The main objectives of this course are:

- To familiarize with the process of management and to provide basic insight into select contemporary management practices.
- To provide conceptual knowledge on functional management Human resource management, strategic management and Organizational Behaviour.

UNIT-I:

INTRODUCTION: Management and organizational concepts of management and organization- Nature and Importance of Management, Functions of Management, System approach to Management - Taylor's Scientific Management Theory, Fayol's Principles of Management, Leadership Styles, Social responsibilities of Management. Designing Organizational Structures: Basic concepts related to Organization - Departmentation and Decentralization, MBO, Process and concepts.

UNIT-II:

FUNCTIONAL MANAGEMENT: Human Resource Management (HRM) Concepts of HRM, Basic functions of HR Manager: Manpower planning, Recruitment, Selection, Training and Development, Wage and Salary Administration Performance Appraisal, Grievance Handling and Welfare Administration, Job Evaluation and Merit Rating. - Marketing Management: Concepts of Marketing, Marketing mix elements and marketing strategies.

UNIT-III:

STRATEGIC MANAGEMENT: Strategic Management and Contemporary Strategic Issues: Mission, Goals, Objectives, Policy, Strategy, Programmes, Elements of Corporate Planning Process, Environmental Scanning, Value Chain Analysis, SWOT Analysis, Steps in Strategy Formulation and implementation, Generic Strategy alternatives. Benchmarking and Balanced Score Card as Contemporary Business Strategies.

UNIT-IV:

INDIVIDUAL BEHAVIOUR: Perception-Perceptual process- Impression management- Personality development – Socialization – Attitude- Process- Formation- Positive attitude- Change – Learning – Learning organizations- Reinforcement Motivation – Process- Motives – Theories of Motivation: Maslow's Theory of Human Needs, Douglas McGregor's Theory X and Theory Y, Herzberg's Two-Factor Theory of Motivation.

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UNIT-V:

GROUP DYNAMICS: Types of Groups, Stages of Group Development, Group Behaviour and Group Performance Factors, Organizational conflicts: Reasons for Conflicts, Consequences of Conflicts in Organization, Types of Conflicts, Strategies for Managing Conflicts, Organizational Climate and Culture, Stress, Causes and effects, coping strategies of stress.

TEXTBOOKS:

1. Organizational Behavior by SubbaRao.P, Himalaya Publishing House. Mumbai.
2. Organizational Behaviour by Fred Luthans, TMH, New Delhi.
3. Fundamentals of Management, Robins, Stephen P, Pearson, India.

REFERENCES:

1. Marketing Management by Kotler Philip & Keller Kevin Lane, 12/e, PHI, 2007
2. Essentials of Management by Koontz & Weihrich, 6/e, TMH, 2007
3. Production and Operations Management by Kanishka Bedi, Oxford University Press, 2007.

OUTCOMES:

At the end of this course the student will be able to:

- After completion of the Course the student will acquire the knowledge on management functions, global leadership and organizational behaviour.
- Will familiarize with the concepts of functional management project management and strategic management.

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	3	0	0	3
BIOMEDICAL INSTRUMENTATION				

OBJECTIVES:

The main objectives of this course are:

- Understand bio systems and medical systems from an engineering perspective.
- Elucidate the methods to monitor the activity of the heart, brain, eyes and muscles.
- Introduce therapeutic equipment for intensive and critical care.
- Outline medical imaging techniques and equipment for certain diagnosis and therapies.

UNIT-I:

BIO POTENTIAL SIGNALS AND ELECTRODES: Bio-signals and their characteristics, Organization of cell, Nernst equation of membrane, Resting and Action potentials, Bio-amplifiers, characteristics of medical instruments, problems encountered with measurements from living systems, Bio-potential electrodes – Body surface recording electrodes, Internal electrodes, micro electrodes, Bio- chemical transducers – reference electrode, the pH electrodes, Blood gas electrodes.

UNIT-II:

CARDIOVASCULAR INSTRUMENTATION: Heart and cardiovascular system Heart electrical activity, blood pressure and heart sounds, cardiovascular measurements electro cardiograph-electrocardiogram, ECG Amplifier, Electrodes and leads, ECG recorder principles. Types of ECG recorders. Principles of blood pressure and blood flow measurement.

UNIT-III:

NEUROLOGICAL INSTRUMENTATION: Neuronal communication, electro encephalogram (EEG), EEG Measurements EEG electrode-placement system, interpretation of EEG, EEG system Block diagram, pre- amplifiers and amplifiers EMG block diagram and Stimulators.

UNIT-IV:

EQUIPMENT'S FOR CRITICAL CARE: Therapeutic equipment - Pacemaker, Defibrillator, Shortwave diathermy, Hemodialysis machine. Respiratory Instrumentation - Mechanism of respiration, Spirometry, Pneumotachograph, Ventilators.

UNIT-V:

PRINCIPLES OF MEDICAL IMAGING: Radiography, computed Radiography, Computed Tomography (CT), Magnetic Resonance Imaging (MRI), Nuclear Medicine, Single Photon Emission Computed Tomography (SPECT), Positron Emission Tomography (PET), Ultrasonography, Introduction to Telemedicine.

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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.

REFERENCES:

1. Biomedical Instrumentation and Measurements – by Leslie Cromwell, F.J. Weibell, E.A. Pfeiffer, PHI.
2. Principles of Applied Biomedical Instrumentation – by L.A. Geddes and L.E. Baker, John Wiley and Sons.
3. Introduction to Biomedical equipment technology-by Joseph Carr and Brown.

OUTCOMES:

At the end of this course the student will be able to:

- Identify significant biological variables at cellular level and ways to acquire different bio-signals.
- Identify the techniques to acquire record and primarily understand physiological activity of the human body through cell potential, ECG, EEG, BP and blood flow measurement and EMG.
- Describe the working of various medical instruments and critical care equipment.
- Compare various imaging techniques including CT, PET, SPECT and MRI used in diagnosis of various medical conditions.

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	3	0	0	3
DIGITAL IMAGE AND VIDEO PROCESSING				

OBJECTIVES:

The main objectives of this course are:

- To introduce fundamentals of digital image processing and study image transforms
- To demonstrate digital image processing techniques in spatial and frequency domains
- To study and compare various image compression algorithms
- To study advanced image analysis methods: image segmentation, morphological image processing, & image restoration

UNIT-I:

FUNDAMENTALS OF IMAGE PROCESSING: Digital Image Fundamentals, Basic steps of Image Processing System, Sampling and Quantization of an image, relationship between pixels, Imaging Geometry.

IMAGE TRANSFORMS: 2 D- Discrete Fourier Transform, Discrete Cosine Transform (DCT), Haar Transform, Hadamard Transform, Hotelling Transform and slant transform.

UNIT-II:

IMAGE ENHANCEMENT: Spatial domain methods: Histogram processing, Fundamentals of Spatial filtering, smoothing spatial filters, Sharpening spatial filters.

FREQUENCY DOMAIN METHODS: Basics of filtering in frequency domain, image smoothing, image sharpening, Selective filtering.

UNIT-III:

IMAGE SEGMENTATION: Segmentation concepts, Point, Line and Edge Detection, Edge Linking using Hough Transform, Thresholding, Region Based segmentation.

WAVELET BASED IMAGE PROCESSING: Introduction to wavelet Transform, Continuous wavelet Transform, Discrete wavelet Transform, Filter banks, Wavelet based image compression.

UNIT-IV:

IMAGE COMPRESSION: Image compression fundamentals - Coding Redundancy, Spatial and Temporal redundancy, Compression models: Lossy and Lossless, Huffman coding, Arithmetic coding, LZW coding, Runlength coding, Bit plane coding, Transform coding, Predictive coding, JPEG 2000 Standards.

UNIT-V:

IMAGE RESTORATION: Image Restoration Degradation model, Algebraic approach to restoration, Inverse Filtering, Least Mean square filters.

MORPHOLOGICAL IMAGE PROCESSING: Dilation and Erosion, Opening and closing, the hit or miss Transformation, Overview of Digital Image Watermarking Methods.

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TEXTBOOKS:

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

REFERENCES:

1. Digital Image Processing-William K.Pratt, 3rdEdition, John Willey,2004.
2. Digital Image Processing using MATLAB - Rafael C. Gonzalez, Richard E.Woods and Steven L.Edding 2nd, TMH.2010.
3. Digital Image Processing and Computer Vision-Somka,Hlavac,Boyl, CengageLearning,2008
4. Introduction to image Processing and Analysis – John C. Russ, J. Christian Russ,CRCPress, 2010.

OUTCOMES:

At the end of this course the student will be able to:

- Acquire, represent the digital image and transforms.
- Apply various intensity-based image processing techniques.
- Apply various pixel position-based image processing techniques

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	3	0	0	3
EMBEDDED SYSTEMS PROFESSIONAL ELECTIVE -III				

OBJECTIVES:

The main objectives of this course are:

- The basic concepts of an embedded system are introduced.
- The various elements of embedded hardware and their design principles are explained.
- Different steps involved in the design and development of firmware for embedded systems is elaborated.
- Internals of Real-Time operating system and the fundamentals of RTOS based embedded firmware design is discussed.
- Fundamental issues in hardware software co-design were presented and explained.
- Familiarize with the different IDEs for firmware development for different family of processors/controllers and embedded operating systems.
- Embedded system implementation and testing tools are introduced and discussed.

UNIT-I:

INTRODUCTION: Embedded system-Definition, history of embedded systems, classification of embedded systems, major application areas of embedded systems, purpose of embedded systems, the typical embedded system-core of the embedded system, Memory, Sensors and Actuators, Communication Interface, Embedded firmware, Characteristics of an embedded system, Quality attributes of embedded systems, Application-specific and Domain-Specific examples of an embedded system.

UNIT-II:

EMBEDDED HARDWARE DESIGN: Analog and digital electronic components, I/O types and examples, Serial communication devices, Parallel device ports, Wireless devices, Timer and counting devices, Watchdog timer, Real time clock.

UNIT-III:

EMBEDDED FIRMWARE DESIGN: Embedded Firmware design approaches, Embedded Firmware development languages, ISR concept, Interrupt sources, Interrupt servicing mechanism, Multiple interrupts, DMA, Device driver programming, Concepts of C versus Embedded C and Compiler versus Cross-compiler.

UNIT-IV:

REAL TIME OPERATING SYSTEM: Operating system basics, Types of operating systems, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling, Threads, Processes and Scheduling, Task communication, Task synchronization.

HARDWARE SOFTWARE CO-DESIGN: Fundamental Issues in Hardware Software Co-Design, Computational models in embedded design, Hardware software Trade-offs, Integration of Hardware and Firmware.

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UNIT-V:

EMBEDDED SYSTEM DEVELOPMENT, IMPLEMENTATION AND TESTING: The integrated development environment, Types of files generated on cross-compilation, Deassembler/Decompiler, Simulators, Emulators and Debugging, Target hardware debugging, Embedded Software development process and tools, Interpreters, Compilers and Linkers, Debugging tools, Quality assurance and testing of the design, Testing on host machine, Simulators, Laboratory Tools.

TEXTBOOKS:

1. Embedded Systems Architecture- By Tammy Noergaard, Elsevier Publications, 2013.
2. Embedded Systems-By Shibu. K.V-Tata McGraw Hill Education Private Limited, 2013.

REFERENCES:

1. Embedded System Design, Frank Vahid, Tony Givargis, John Wiley Publications, 2013.
2. Embedded Systems-Lyla B.Das-Pearson Publications, 2013.

OUTCOMES:

At the end of this course the student will be able to:

- Understand the basic concepts of an embedded system and able to know an embedded system design approach to perform a specific function.
- The hardware components required for an embedded system and the design approach of an embedded hardware.
- The various embedded firmware design approaches on embedded environment.
- Understand how to integrate hardware and firmware of an embedded system using real time operating system.

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		3	0	0	3
ANALYTICAL INSTRUMENTATION PROFESSIONAL ELECTIVE -III					

OBJECTIVES:

The main objectives of this course are:

- Acquire knowledge about equipment for measurement of PH, conductivity and gas analyzers.
- Learn and understand UV-Visible spectroscopy, nuclear magnetic resonance and mass spectrometers.
- Acquire knowledge about Gas and liquid chromatography.
- Compare various nuclear radiation detectors.

UNIT-I:

pH AND CONDUCTIVITY & DISSOLVED COMPONENT ANALYSER: Conductivity meters – pH meters – Dissolved oxygen, hydrogen analysers – Sodium analyser – Silica analyser and sampling systems.

UNIT-II:

GAS ANALYSERS: Thermal conductivity types – CO monitor – Oxygen Analysers - NOX analyser – H₂S analyser system and sampling – Industrial analyser circuits, Theory and problems on Beer – Lamberts Law.

UNIT-III:

SPECTROSCOPY: Beer – Lamberts Law, Sources and detectors, UV, VIS Spectrophotometers – Single beam and double beam spectroscopy. IR Spectrophotometer, Sources and detectors, FT IR Spectrometer. Flame spectroscopy - atomic absorption Spectrophotometer – Atomic emission Spectrophotometer.

UNIT-IV:

NMR, ESR AND MASS SPECTROMETERS: Principles and Instrumentation associated with NMR Spectrometers, ESR Spectrometers, and Mass Spectrometers and their applications

UNIT-V:

CHROMATOGRAPHY & NUCLEAR RADIATION DETECTORS: Classification of Gas and liquid chromatography, Principles and Instrumentation associated with Gas and liquid chromatography – sample injection systems, columns, isothermal operation, different detectors, Ionization chamber, Geiger Muller counter, Proportional Counter, Scintillation counter and Solid-state detectors.

TEXT BOOKS:

1. Instrumental Methods of Analysis – by Willard H.H., Merrit L.L., Dean J.A. and Seattle F.L., CBS Publishing and Distributors, 6/e, 1995.
2. Handbook of Analytical Instruments – by R S Khandpur. TMH



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REFERENCES:

1. Instrument Technology – by Jones B.E., Butterworth Scientific Publ., London, 1987.
2. Mechanical and Industrial Measurements – by Jain R.K., Khanna Publishing, New Delhi, 2/e, 1992.
3. Principles of Instrumental Analysis – by Skoog D.A. and West D.M., Holt Sounder Publication, Philadelphia, 1985.

OUTCOMES:

At the end of this course the student will be able to:

- Measure various parameters like PH, Conductivity, CO, NOX and oxygen using various analyzers
- Compare different Spectrophotometer like UV, VIS and IR
- Distinguish between various Spectrometers.
- Compare various chromatographic techniques.
- Students get knowledge on Ionization chamber, Geiger Muller counter, Proportional Counter, Scintillation counter and Solid-state detectors.

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	3	0	0	3
ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING PROFESSIONAL ELECTIVE -III				

OBJECTIVES:

The main objective of this course is:

- To familiarize students with basic concepts, theories and advancements in ML and AI and help them in understanding the mathematics behind algorithms and apply them in real world scenarios.

UNIT-I:

INTRODUCTION TO MACHINE LEARNING / ARTIFICIAL INTELLIGENCE- Artificial Intelligence Foundation, Big questions of Artificial Intelligence, history of Artificial Intelligence, latest advancements

UNIT-II:

MACHINE LEARNING: Linear Regression - Learn to implement linear regression and predict continuous data values, Naïve Bayes and Logistic regression - Understand how supervised learning is used for classification, Clustering - Learn how to create segments based on similarities using K-Means and Hierarchical clustering, Support vector machines - Learn to classify data points using support vectors, decision trees - Tree-based model that is simple and easy to use. Learn the fundamentals on how to implement them

NATURAL LANGUAGE PROCESSING: Basics of text processing, lexical processing - Learn to extract features from unstructured text and build machine learning models on text data, syntax and semantics - Conduct sentiment analysis, learn to parse English sentences and extract meaning from them

UNIT-III:

DEEP LEARNING & NEURAL NETWORKS: Information flow in neural networks - Understand the components and structure of artificial neural networks, Training a neural network - Learn the latest techniques used to train highly complex neural networks, Convolutional neural networks - Use CNN's to solve complex image classification problems, Recurrent neural networks - Study LSTMs and RNN's applications in text analytics, Creating and deploying networks using Tensor Flow and keras - Build and deploy your own deep neural networks on a website, learn to use Tensor Flow API and keras

UNIT-IV:

GRAPHICAL MODELS: Introduction to Bayesian methods, Graphical models - Study probabilistic way of modelling systems - Markov properties, Factor Graphs and Bayesian belief networks, Learning and Inference - Learn how graphics models are used for supervised and unsupervised learning.

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UNIT-V:

REINFORCEMENT LEARNING: Introduction to RL, understand how machines can be programmed to learn by themselves, Exact methods - Learn the math behind Exact Statistics - Dynamic Programming, Monte Carlo methods, Temporal Difference Learning, Approximate Methods - Learn policy gradient methods and their applications in learning

TEXTBOOKS:

1. Machine Learning, by Tom M Mitchell, Indian Edition, McGraw Hill
2. Deep Learning by Good fellow, Bengio, Courville. The MIT Press, 2016

REFERENCES:

1. Understanding Machine Learning: From Theory to Algorithms, by Shai Shalev-Shwartz and Shai Ben-David, 1st Edition, Cambridge University Press
2. Artificial Intelligence - A Modern Approach by Stuart Russell & Peter Norvig, Prentice Hall

OUTCOMES:

At the end of this course the student will be able to:

- Understand machine learning concepts and range of problems that can be handled by machine learning.
- Apply the machine learning concepts in real life problems.
- Understand artificial neural networks concept and apply techniques to train the neural networks.
- Understand how graphical models are used for supervised and unsupervised learning.
- Understand Reinforcement Learning concept and applications.
- Modify the algorithms based on need.

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		3	0	0	3
ANALOG IC DESIGN PROFESSIONAL ELECTIVE -III					

OBJECTIVES:

The main objectives of this course are:

- The student will be able to understand the behavior of MOS Devices and Small-Signal & Large-Signal Modeling of MOS Transistor and Analog Sub-Circuits.
- Learn and understand CMOS Amplifiers like Differential Amplifiers, Cascode Amplifiers, Output Amplifiers, and Operational Amplifiers.
- To motivate the graduate students to design and to develop the Analog CMOS Circuits for different Analog operations.
- Acquire knowledge about concepts of Open-Loop Comparators and Different Types of Oscillators like Ring Oscillator, LC Oscillator etc.

UNIT-I:

MOS Devices and Modelling: The MOS Transistor, Passive Components- Capacitor & Resistor, Integrated circuit Layout, CMOS Device Modelling - Simple MOS Large-Signal Model, Other Model Parameters, Small-Signal Model for the MOS Transistor, Computer Simulation Models, Sub-threshold MOS Model.

UNIT-II:

Analog CMOS Sub-Circuits: MOS Switch, MOS Diode, MOS Active Resistor, Current Sinks and Sources, Current Mirrors-Current mirror with Beta Helper, Degeneration, Cascode current Mirror and Wilson Current Mirror, Current and Voltage References, Band gap Reference.

UNIT-III:

CMOS Amplifiers: Inverters, Differential Amplifiers, Cascode Amplifiers, Current Amplifiers, Output Amplifiers, High Gain Amplifiers Architectures.

CMOS Operational Amplifiers: Design of CMOS Op Amps, Compensation of Op Amps, Design of Two-Stage Op Amps, Power- Supply Rejection Ratio of Two-Stage Op Amps, Cascode Op Amps, Measurement Techniques of OP Amp.

UNIT-IV:

Comparators: Characterization of Comparator, Two-Stage, Open-Loop Comparators, Other Open-Loop Comparators, Improving the Performance of Open-Loop Comparators, Discrete-Time Comparators.

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UNIT-V:

Oscillators & Phase-Locked Loops: General Considerations, Ring Oscillators, LC Oscillators, Voltage Controlled Oscillators, Simple PLL, Charge Pump PLLs, Non-Ideal Effects in PLLs, Delay Locked Loops, Applications.

TEXT BOOKS:

1. Design of Analog CMOS Integrated Circuits- Behzad Razavi, TMH Edition.
2. CMOS Analog Circuit Design - Philip E. Allen and Douglas R. Holberg, Oxford University Press, International Second Edition/Indian Edition, 2010.

REFERENCES:

1. Analysis and Design of Analog Integrated Circuits- Paul R. Gray, Paul J. Hurst, S. Lewis and R. G. Meyer, Wiley India, Fifth Edition, 2010.
2. Analog Integrated Circuit Design- David A. Johns, Ken Martin, Wiley Student Edn, 2013.

OUTCOMES:

At the end of this course the student will be able to:

- Understand the concepts of MOS Devices and Modeling.
- Design and analyze any Analog Circuits in real time applications.
- Apply the knowledge of Analog Circuit Design to develop Different Applications in Real Time.
- Compare different Open-Loop Comparators and Different Types of Oscillators.

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		3	0	0	3
ROBOTICS & AUTOMATION PROFESSIONAL ELECTIVE -IV					

OBJECTIVES:

The main objective of this course is:

- To impart knowledge about basic mathematics related to industrial robots for their control, design and application in robotics & automation Industries.

UNIT-I:

BASIC CONCEPTS: Automation and Robotics – An over view of Robotics – present and future applications – classification by coordinate system and control system, Dynamic stabilization of Robotics.

POWER SOURCES AND SENSORS: Hydraulic, Pneumatic and electric drivers – Determination HP of motor and gearing ratio, variable speed arrangements, Path Determination - Machinery Vision – Ranging – Laser – Acoustic, Magnetic Fiber Optic and Tactile Sensor

UNIT-II:

MANIPULATORS Construction of Manipulators, Manipulator Dynamic and Force Control, Electronic and Pneumatic manipulators.

ACTUATORS AND GRIPPERS: Pneumatic, Hydraulic Actuators, Stepper Motor Control Circuits, End Effector, Various types of Grippers, Design consideration.

UNIT-III:

Differential transformation and manipulators, Jacobians – problems. Dynamics: Lagrange – Euler and Newton – Euler formations – Problems.

KINEMATICS Forward and Inverse Kinematic Problems, Solutions of Inverse Kinematic problems, Multiple Solution, Jacobian Work Envelop – Hill Climbing Techniques.

UNIT-IV:

PATH PLANNING: Trajectory planning and avoidance of obstacles, path planning, skew motion, joint integrated motion – straight line motion – Robot programming, languages and software packages.

UNIT-V:

CASE STUDY: Multiple Robots – Machine Interface – Robots in Manufacturing and Non-Manufacturing applications – Robot Cell Design Selection of a Robot.

TEXT BOOKS:

1. Industrial Robotics by Groover M P, Pearson Edu.
2. Robotics by Fu K S, McGraw Hill.

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REFERENCES:

1. Robotics by CSP Rao and V.V. Reddy, Pearson Publications
2. Robotics and Control by Mittal R K & Nagrath I J, TMH.
3. An Introduction to Robot Technology by P. Coiffet and M. Chaironze Kogam Page Ltd. 1983 London.
4. Robotic Engineering by Richard D. Klafter, Prentice Hall
5. Introduction to Robotics by John J Craig, Pearson Edu.
6. Robot Dynamics and Control by Mark W. Spong and M. Vidyasagar, John Wiley & Sons.

OUTCOMES:

At the end of this course the student will be able to:

- Perform kinematic and dynamic analyses with simulation.
- Design control laws for a simple robot.
- Integrate mechanical and electrical hardware for a real prototype of robotic device.
- Select a robotic system for given industrial application.



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OPTOELECTRONICS & LASER INSTRUMENTATION (PROFESSIONAL ELECTIVE –IV)					

OBJECTIVES:

The main objective of this course is:

- To expose the students to the basic concepts of optical fibers and their properties.
- To provide adequate knowledge about the Industrial applications of optical fibers.
- To expose the students to the Laser fundamentals.
- To provide adequate knowledge about Industrial application of lasers.
- To provide adequate knowledge about holography and Medical applications of Lasers.

UNIT-I:

OPTICAL FIBERS AND THEIR PROPERTIES: Principles of light propagation through a fiber - Different types of fibers and their properties, fiber characteristics – Absorption losses – Scattering losses – Dispersion – Connectors and splicer's – Fiber termination – Optical sources – Optical detectors.

UNIT-II:

INDUSTRIAL APPLICATION OF OPTICAL FIBERS: Fiber optic sensors – Fiber optic instrumentation system – Different types of modulators – Interferometric method of measurement of length – Moiré fringes – Measurement of pressure, temperature, current, voltage, liquid level and strain.

UNIT-III:

LASER FUNDAMENTALS: Fundamental characteristics of lasers – three level and four level lasers – properties of laser – laser modes – resonator configuration – q-switching and mode locking – cavity damping – types of lasers – gas lasers, solid lasers, liquid lasers, semiconductor lasers.

UNIT-IV:

INDUSTRIAL APPLICATION OF LASERS: Laser for measurement of distance, length, velocity, acceleration, current, voltage and Atmospheric effect – Material processing – Laser heating, welding, melting and trimming of material – Removal and vaporization.

UNIT-V:

HOLOGRAM AND MEDICAL APPLICATIONS: Holography – Basic principle - Methods – Holographic interferometry and application, Holography for non-destructive testing – Holographic components – Medical applications of lasers, laser and tissue interactive – Laser instruments for surgery, removal of tumors of vocal cards, brain surgery, plastic surgery, gynecology and oncology.

TEXTBOOKS:

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

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REFERENCES:

1. 'Optical Fiber Communication', G. Keiser, McGraw Hill, 1995.
2. 'Optical Fiber Communication and Sensors', M. Arumugam, Anuradha Agencies, 2002.
3. 'Industrial Applications of Lasers', John F. Read, Academic Press, 1978.

OUTCOMES:

At the end of this course the student will be able to:

- Estimate the losses and analyze the propagation characteristics of an optical signal in different types of fibers.
- Apply Laser theory for the selection of lasers for a specify industrial and medical application.
- Apply the knowledge of lasers for industrial, hologram and medical applications.

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IV Year- I Semester	L	T	P	C
	3	0	0	3
INDUSTRIAL INTERNET OF THINGS (PROFESSIONAL ELECTIVE –IV)				

OBJECTIVES:

The main objectives of this course are:

- Learn and understand the Importance of IoT in industrial applications
- Know how IoT has become a game changer in the new economy where the customers are looking for integrated value.
- Apply the IoT concepts in building solutions to Industrial problems
- Learn and understand the tools and techniques that enable IoT solution and Security aspects.

UNIT-I:

INTRODUCTION: Introduction to IoT, IoT Vs. IIoT, History of IIoT, Components of IIoT - Sensors, Interface, Networks, People & Process, Hype cycle, IOT Market, Trends & future Real life examples, Key terms of IoT – IoT Platform, Interfaces, API, clouds, Data Management Analytics, Mining & Manipulation; Role of IIoT in Manufacturing Processes Use of IIoT in plant maintenance practices, Sustainability through Business excellence tools Challenges and Benefits in implementing IIoT.

UNIT-II:

ARCHITECTURES: Overview of IoT components: Various Architectures of IoT and IIoT, Advantages & disadvantages, Industrial Internet - Reference Architecture; IIoT System components: Sensors, Gateways, Routers, Modem, Cloud brokers, servers and its integration, WSN, WSN network design for IoT.

SENSORS AND INTERFACING: Introduction to sensors, Transducers, Classification, Roles of sensors in IIoT, Various types of sensors, Design of sensors, sensor architecture, special requirements for IIoT sensors, Role of actuators, types of actuators. Hardwire the sensors with different protocols such as HART, MODBUS-Serial & Parallel, Ethernet, BACnet, Current, M2M etc.

UNIT-III:

PROTOCOLS AND CLOUD: Need of protocols; Types of Protocols, Wi-Fi, Wi-Fi direct, Zigbee, Z wave, BACnet, BLE, Modbus, SPI, I2C, IIoT protocols –COAP, MQTT, 6LoWPAN, LWM2M, AMPQ IIoT cloud platforms: Overview of COTS cloud platforms, Predix, PTC Thing Worx, Microsoft Azure etc. Data analytics, cloud services, Business models: SaaS, PaaS, IaaS.

UNIT-IV:

SECURITY: Introduction to web security, Conventional web technology and relationship with IIoT, Vulnerabilities of IoT, Privacy, Security requirements, Threat analysis, Trust, IoT security tomography and layered attacker model, Identity establishment, Access control, Message integrity, Non-repudiation and availability, Security model for IoT, Network security techniques Management aspects of cyber security.

ANALYTICS: IoT Analytics: Role of Analytics in IoT, Data visualization Techniques.

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UNIT-V:

DIGITAL TWIN: Introduction to Digital Twin, need for Digital Twin, Elements of Digital Twin, Digital Twin process design and information requirements, Digital twin conceptual architecture - create, communicate, Aggregate, Analyze, Insight, Act, driving business value through digital twin.

DIGITAL TWIN FOR ASSET: Digitalizing asset behaviour using simulated mathematical modelling and building Digital Twin - Need, Benefits, Architecture, Models and Use cases - Predictive and Prescriptive maintenance.

TEXT BOOKS:

1. Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications, by Daniel Minoli, Bernd Scholz-Reiter, Florian, Willy Publication
2. Digital Twin Technologies and Smart Cities by Farsi, M., Daneshkhah, A., Hosseinian-Far, A., Jahankhani, H., Springer International Publishing, 2020.
3. Architecting the Internet of Things, by Michahelles, Springer, 2011

REFERENCES:

1. The Internet of Things Connecting Objects to the Web” by Hakima Chaouchi, Willy Publications
2. The Internet of Things: Key Applications and Protocols, Olivier Hersent, David Boswarthick, Omar Elloumi, 2nd Edition, Willy Publications
3. Inside the Internet of Things (IoT), Deloitte University Press
4. Internet of Things- From Research and Innovation to Market Deployment; By Ovidiu & Peter; River Publishers Series
5. Five thoughts from the Father of the Internet of Things; by Phil Wainewright - Kevin Ashton
6. How Protocol Conversion Addresses IIoT Challenges: White Paper By Red Lion.
7. <https://www.ge.com/digital/applications/digital-twin>
8. <https://www2.deloitte.com/us/en/insights/focus/industry-4-0/digital-twin-technology-smart-factory.html>

OUTCOMES:

At the end of this course the student will be able to:

- Understand the elements of IoT to build a total control plane in an Industrial application
- Apply M2M protocols for development of IoT Applications.
- Learn and understand the concept of digitalization and data acquisition.
- Build smart factory based on the concepts
- Build Industrial Digital Twins.

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IV Year- I Semester		L	T	P	C
		3	0	0	3
LOW POWER VLSI DESIGN (PROFESSIONAL ELECTIVE –IV)					

OBJECTIVES:

The main objectives of this course are:

- Known the low power low voltage VLSI design
- Understand the impact of power on system performances.
- Known about different Design approaches.
- Identify suitable techniques to reduce power dissipation in combinational and sequential circuits.

UNIT-I:

FUNDAMENTALS: Need for Low Power Circuit Design, Sources of Power Dissipation – Switching Power Dissipation, Short Circuit Power Dissipation, Leakage Power Dissipation, Glitching Power Dissipation, Short Channel Effects – Drain Induced Barrier Lowering and Punch Through, Surface Scattering, Velocity Saturation, Impact Ionization, Hot Electron Effect.

UNIT-II:

SUPPLY VOLTAGE SCALING FOR LOW POWER: Device Feature Size Scaling, Constant-Field Scaling, Constant-Voltage Scaling, Architectural-Level Approaches: Parallelism for Low Power, Pipelining for Low Power, Combining Parallelism with Pipelining, Voltage Scaling Using High-Level Transformations: Multilevel Voltage Scaling Challenges in MVS Voltage Scaling Interfaces, Static Timing Analysis Dynamic Voltage and Frequency Scaling

UNIT-III:

LOW-POWER DESIGN APPROACHES: Low-Power Design through Voltage Scaling – VTCMOS circuits, MTCMOS circuits, Architectural Level Approach – Pipelining and Parallel Processing Approaches. Power Gating, Clock Gating Versus Power Gating, Power-Gating Issues, Isolation Strategy, State Retention Strategy, Power-Gating Controller, Power Management, Combining DVFS and Power Management.

UNIT-IV:

LOW-VOLTAGE LOW-POWER ADDERS: Introduction, Standard Adder Cells, CMOS Adder's Architectures – Ripple Carry Adders, Carry Look-Ahead Adders, Carry Select Adders, Carry Save Adders, Low-Voltage Low-Power Design Techniques – Trends of Technology and Power Supply Voltage.

LOW-VOLTAGE LOW-POWER MULTIPLIERS: Introduction, Overview of Multiplication, Types of Multiplier Architectures, Braun Multiplier, Baugh- Wooley Multiplier,

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Introduction to Wallace Tree Multiplier.

UNIT-V:

LOW-VOLTAGE LOW-POWER MEMORIES: Basics of ROM, Low-Power ROM Technology, Future Trend and Development of ROMs, Basics of SRAM, Memory Cell, Pre-charge and Equalization Circuit, Low-Power SRAM Technologies, Basics of DRAM, Self-Refresh Circuit, Future Trend and Development of DRAM.

TEXTBOOKS:

1. CMOS Digital Integrated Circuits – Analysis and Design – Sung-Mo Kang, Yusuf Leblebici, TMH,2011.
2. Low-Voltage, Low-Power VLSI Subsystems – Kiat-Seng Yeo, Kaushik Roy, TMH Professional Engineering.

REFERENCES:

1. Introduction to VLSI Systems: A Logic, Circuit and System Perspective – Ming-BO Lin, CRC Press,2011
2. Low Power CMOS VLSI Circuit Design – Kaushik Roy, Sharat C. Prasad, John Wiley & Sons, 2000.
3. Practical Low Power Digital VLSI Design – Gary K. Yeap, Kluwer Academic Press, 2002.
4. Leakage in Nanometer CMOS Technologies – Siva G. Narendran, AnathaChandrakasan, Springer,2005.

OUTCOMES:

At the end of this course the student will be able to:

- Understand the need of Low power circuit design.
- Attain the knowledge of architectural approaches.
- Analyze and design Low-Voltage Low-Power combinational circuits.
- Known the design of Low-Voltage Low-Power Memories.

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	3	0	3	1.5
INSTRUMENTATION LAB – II				

Process control lab contains 10 experiments; the overall course objective is to provide knowledge on different sensors and their measurement.

(Minimum of ten experiments should be conducted.)

List of Experiments:

1. Design and simulation of Analog Circuits using CAD Package.
2. Design of PCBs using Packages and Fabrication of PCB.
3. Linearization of Thermistor using Microprocessor.
4. Study of Level monitoring Instruments using PLC.
pH measurements.
5. Measurement of Blood Pressure.
6. Calibration of P to I and I to P converters.
7. RPM indicator using Strobostrom/Gyroscope.
8. Measurement of Humidity.
9. Measurement of velocity of liquid using Ultrasonic (Doppler effect) method and also flow measurement.
10. Measurement of Level using Capacitance method/Transducer.
11. Displacement measurement using inductive pickup and capacitive pickup.
12. PID Controller setup (Flow/Temp. Level).

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IV Year- I Semester		L	T	P	C
		3	0	3	1.5
VLSI LAB					

List of Experiments

PART (A): FPGA Level Implementation (Any Seven Experiments)

Note 1: The students need to develop VHDL/Verilog Source code, perform simulation using Relevant simulator and analyze the obtained simulation results using necessary Synthesizer.

Note 2: All the experiments need to be implemented on the latest FPGA/CPLD Hardware in the Laboratory.

1. Realization of Logic gates.
Design and Implementation of
2. 4-bit ripple carry and carry look ahead adder using behavioural, dataflow and structural modelling
3. a) 16:1 mux through 4:1 mux
b) 3:8 decoder realization through 2:4 decoder
4. 8:3 encoder
5. 8-bit parity generator and checker
6. Flip-Flops
7. 8-bit synchronous up-down counter
8. 4-bit sequence detector through Mealy and Moore state machines.

EDA Tools/Hardware Required:

1. EDA Tool that supports FPGA programming including Xilinx Vivado/Altera (Intel)/Cypress/Equivalent Industry standard tool along with corresponding FPGA hardware.
2. Desktop computer with appropriate Operating System that supports the EDA tools.

PART (B): Back-end Level Design and Implementation (Any Five Experiments)

Note: The students need to design the following experiments at schematic level using CMOS logic and verify the functionality. Further students need to draw the corresponding layout and verify the functionality including parasites. Available state of the art technology libraries can be used while simulating the designs using Industry standard EDA Tools.

Design and Implementation of the following

1. Universal Gates
2. An Inverter
3. Full Adder
4. Full Subtractor
5. Decoder
6. D-Flip-flop

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EDA Tools/Hardware Required:

1. Mentor Graphics Software / Cadence/Synopsys/Tanner or Equivalent Industry Standard/CAD Tool.
2. Desktop computer with appropriate Operating System that supports the EDA tools.

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IV Year- I Semester		L	T	P	C
		0	0	6	1.5
PROJECT –PART I					