



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**  
**DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING**

### IV Year – I Semester

S. No.	Course	Category	L	T	P	Credits
1	Microwave and Optical Communication Engineering	PC	3	0	0	3
2	Data Communications & Computer networks	PC	3	0	0	3
3	Digital Image and Video Processing	PC	3	0	0	3
4	Professional Elective (PE3)	PE	3	0	0	3
5	Professional Elective (PE4)	PE	3	0	0	3
6	Internet of Things Lab	LC	0	0	3	1.5
7	Microwave and Optical Communication Engineering LAB	LC	0	0	3	1.5
8	Project - Part I	PR	0	0	6	3
			Sub-Total			<b>21</b>

### IV Year – II Semester

S. No.	Course	Category	L	T	P	Credits
1	Professional Elective (PE5)	PE	3	0	0	3
2	Open Elective (OE2)	OE	3	0	0	3
3	Project - Part II	PR	0	0	18	9
			Sub-Total			<b>15</b>
			<b>Total</b>			<b>160</b>



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**  
**DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING**

**PROFESSIONAL ELECTIVES 1:**

1. Information Theory & Coding
2. Digital System Design using HDL
3. Data structures and Algorithms
4. Soft computing techniques and Python programming
5. Simulation & Mathematical Modeling

**PROFESSIONAL ELECTIVES 2:**

1. Cellular & Mobile Communication
2. Digital IC Design
3. Business Intelligence & Analytics
4. Pattern Recognition
5. Robotics and Automation

**PROFESSIONAL ELECTIVES 3:**

1. Communication Standards and Protocols
2. Analog IC Design
3. Smart Sensors
4. Advanced Digital Signal Processing
5. Augmented Reality

**PROFESSIONAL ELECTIVES 4:**

1. Software Radio
2. Low power VLSI Design
3. Embedded Systems
4. DSP processors and Architectures
5. Multi Media Communication

**PROFESSIONAL ELECTIVES 5:**

1. Wireless Communication
2. VLSI Testing & Testability
3. Machine Learning & Artificial Intelligence
4. Speech Processing
5. Industrial Internet of Things



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**  
**DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING**

**OPEN ELECTIVES FOR ECE:**

**Open Elective 1:**

1. DataMining
2. PowerElectronics
3. MEMS and itsapplications
4. Artificial NeuralNetworks

**Open Elective 2:**

1. 3D Printing
2. Block chainTechnology
3. Cyber Security &Cryptography

**OPEN ELECTIVES OFFERED BY ECE:**

- OE 1 Principles of communication  
OE 2 Embedded Systems



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**  
**DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING**

<b>IV Year - I Semester</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**MICROWAVE and OPTICAL COMMUNICATION ENGINEERING**

**Course Objectives:**

The student will be able to

- Understand fundamental characteristics of waveguides and Micro strip lines through electromagnetic field analysis.
- Understand the basic properties of waveguide components and Ferrite materials composition
- Understand the function, design, and integration of the major microwave components oscillators, power amplifier.
- Understand a Microwave test bench setup for measurements.

**UNIT I**

**MICROWAVE TUBES (Qualitative treatment only):** Cavities, Re-entrant Cavities, Two Cavity Klystrons-Structure, Velocity Modulation and Bunching process, Reflex Klystrons-Structure, principle of working.

**HELIX TWTS:** Significance, Types and Characteristics of Slow Wave Structures; Structure of TWT.

**M-TYPE TUBES**

Introduction, Cross-field effects, Magnetrons – 8-Cavity Cylindrical Travelling Wave Magnetron.

**MICROWAVE SOLID STATE DEVICES:** Introduction, Classification, Applications. TEDs – Introduction, Gunn Diode – Principle, RWH Theory, Characteristics, LSA Mode of operation

**UNIT II**

**WAVEGUIDE COMPONENTS AND APPLICATIONS- I (Qualitative treatment only):**

Waveguide Attenuators – Resistive Card, Rotary Vane types, Scattering matrix parameters: Definition, Properties, Salient Features -S- parameters of two port, three port, four port networks. 2 Hole, Bethe Hole types.

**UNIT III** Over view of optical fiber communication, Total Internal Reflection, Numerical Aperture, Graded index fibers, Cut off wavelength.

**OPTICAL FIBER CONNECTORS-** Connector types, Single mode fiber connectors, Connector return loss, Fiber Splicing- Splicing techniques, Splicing single mode fibers, Multimode fiber joints, single mode fiber joints.



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**  
**DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING**

**UNIT I V**

**OPTICAL SOURCES and Detectors:** Qualitative treatment, Structures, Materials, Quantum efficiency, Physical principles and comparison of: Optical sources and detectors, Related problems.

Optical system design- Point to point links – Component Choice and considerations, Link power budget, Line coding in Optical links, WDM, Necessity, Principles, Eye pattern.

**UNIT –V: MEASUREMENTS:**

**a. MICROWAVE MEASUREMENTS:** Description Of Microwave Bench- Different Blocks, Microwave Power Measurement- Bolometer Method. Measurement of Attenuation by Reflection Method, VSWR, Impedance Measurement

**b. OPTICAL MEASUREMENTS:** OTDR, Attenuation, Detector Characteristics

**TEXT BOOKS :**

1. Microwave Devices and Circuits – Samuel Y. Liao, PHI, 3rd Edition, 1994.
2. Foundations for Microwave Engineering – R.E. Collin, IEEE Press, John Wiley, 2nd Edition, 2002.
3. Optical Fiber Communications – Gerd Keiser, Mc Graw-Hill International edition, 3rd Edition, 2000.

**REFERENCES :**

1. Microwave Engineering- Annapurna Das and Sisir K.Das, Mc Graw Hill Education, 3<sup>rd</sup> Edition, 2014.
2. Microwave Engineering – G S N Raju , I K International Publishing House Pvt. Limited, 2008.
3. Fiber Optic Communication Systems – Govind P. Agarwal , John Wiley, 3rd Edition, 2004.

**Course Outcomes:** After going through this course the student will be able to

- Design different modes in waveguide structures
- Calculate S-matrix for various waveguide components and splitting the microwave energy in a desired direction
- Distinguish between Microwave tubes and Solid State Devices, calculation of efficiency devices.
- Measure various microwave parameters using a Microwave testbench



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**  
**DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING**

<b>IV Year - I Semester</b>		<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>DATA COMMUNICATIONS &amp; COMPUTER NETWORKS</b>					

**Course Objectives:**

- To introduce the Fundamentals of data communication networks
- To demonstrate the Functions of various protocols of Data link layer.
- To demonstrate Functioning of various Routing protocols.
- To introduce the Functions of various Transport layer protocols.
- To understand the significance of application layer protocols

**UNIT I:**

**Introduction to Data Communications:** Components, Data Representation, Data Flow, Networks-Distributed Processing, Network Criteria, Physical Structures, Network Models, Categories of Networks Interconnection of Networks, The Internet - A Brief History, The Internet Today, Protocol and Standards - Protocols, Standards, Standards Organizations, Internet Standards. Network Models, Layered Tasks, OSI model, Layers in OSI model, TCP/IP Protocol Suite, Addressing Introduction, Wireless Links and Network Characteristics, WiFi: 802.11 Wireless LANs -The 802.11 Architecture,

**UNIT II:**

**Data Link Layer:** Links, Access Networks, and LANs- Introduction to the Link Layer, The Services Provided by the Link Layer, Types of errors, Redundancy, Detection vs Correction, Forward error correction Versus Retransmission Error-Detection and Correction Techniques, Parity Checks, Check summing Methods, Cyclic Redundancy Check (CRC) , Framing, Flow Control and Error Control protocols , Noisy less Channels and Noisy Channels, HDLC, Multiple Access Protocols, Random Access ,ALOHA, Controlled access, Channelization Protocols. 802.11 MAC Protocol, IEEE 802.11 Frame.

**UNIT III:**

**The Network Layer:** Introduction, Forwarding and Routing, Network Service Models, Virtual Circuit and Datagram Networks-Virtual-Circuit Networks, Datagram Networks, Origins of VC and Datagram Networks, Inside a Router-Input Processing, Switching, Output Processing, Queuing, The Routing Control Plane, The Internet Protocol(IP):Forwarding and Addressing in the Internet-Datagram format, Ipv4 Addressing, Internet Control Message Protocol(ICMP), IPv6



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**  
**DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING**

**UNIT IV:**

**Transport Layer:** Introduction and Transport Layer Services : Relationship Between Transport and Network Layers, Overview of the Transport Layer in the Internet, Multiplexing and Demultiplexing, Connectionless Transport: UDP -UDP Segment Structure, UDP Checksum, Principles of Reliable Data Transfer-Building a Reliable Data Transfer Protocol, Pipelined Reliable Data Transfer Protocols, Go-Back-N(GBN), Selective Repeat(SR), Connection Oriented Transport: TCP - The TCP Connection, TCP Segment Structure, Round-Trip Time Estimation and Timeout, Reliable Data Transfer, Flow Control, TCP Connection Management, Principles of Congestion Control - The Cause and the Costs of Congestion, Approaches to CongestionControl

**UNIT V:**

**Application Layer:** Principles of Networking Applications – Network Application Architectures, Processes Communicating, Transport Services Available to Applications, Transport Services Provided by the File Transfer: FTP,- FTP Commands and Replies, Electronic Mail in the Internet-STMP, Comparison with HTTP, DNS-The Internet’s Directory Service – Service Provided by DNS, Overview of How DNS Works, DNS Records andmessages.

**TEXT BOOKS:**

1. Computer Networking A Top-Down Approach – Kurose James F, Keith W, 6thEdition , Pearson,2017.
2. Data Communications and Networking Behrouz A.Forouzan4th Edition McGraw Hill Education,2017.

**REFERENCES:**

1. Data communication and Networks - Bhusan Trivedi, Oxford university press,2016
2. Computer Networks -- Andrew S Tanenbaum, 4th Edition, PearsonEducation,2003.
3. Understanding Communications and Networks,3rdEdition,W.A.Shay,CengageLearning,2003.

**Course Outcomes:**

Upon completing this course, the student will be able to

- Know the Categories and functions of various Data communication Networks
- Design and analyze various error detectiontechniques.
- Demonstrate the mechanism of routing the data in networklayer
- Know the significance of various Flow control and Congestion controlMechanisms
- Know the Functioning of various Application layerProtocols.



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**  
**DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING**

<b>IV Year - I Semester</b>		<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>DIGITAL IMAGE and VIDEO PROCESSING</b>					

**Course Objectives:**

- To study the image fundamentals and mathematical transforms necessary for image Processing.
- To study the image enhancement techniques
- To study image restoration procedures.
- To study the image compression procedures.
- To study the basics of Video processing and 2-D Motion estimation

**UNIT I:****Fundamentals of Image Processing and Image Transforms:**

Introduction, Image sampling, Quantization, Resolution, Image file formats, Elements of image processing system, Applications of Digital image processing. Introduction, Need for transform, image transforms, Fourier transform, 2 D Discrete Fourier transform and its transforms, Importance of phase, Walsh transform, Hadamard transform, Haar transform, slant transform Discrete cosine transform, KL transform, singular value decomposition, comparison of different image transforms.

**UNIT II:****Image Enhancement:**

Spatial domain methods: point processing techniques, 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.

**Image Restoration:**

Introduction to Image restoration, Image degradation, Types of image blur, Classification of image restoration techniques, Image restoration model, Linear and Nonlinear image restoration techniques, Blind de-convolution.

**UNIT III:****Image Segmentation:**

Introduction to image segmentation, Point, Line and Edge Detection, Region based segmentation., Classification of segmentation techniques, Region approach to image segmentation, clustering techniques, Image segmentation based on thresholding, Edge based segmentation, Edge detection and linking, Hough transform.

**Image Compression:**

Introduction, Need for image compression, Redundancy in images, Classification of redundancy in images, image compression scheme, Classification of image compression schemes, Fundamentals of information theory, Run length coding, Shannon – Fano coding, Huffman coding, Arithmetic coding, Predictive coding, Transformed based compression, Image





**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**  
**DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING**

compression standard, Wavelet-based image compression, JPEG Standards.



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**  
**DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING**

**UNIT IV:****Basic Steps of Video Processing:**

Analog Video, Digital Video. Time-Varying Image Formation models: Three-Dimensional Motion Models, Geometric Image Formation, Photometric Image Formation, Sampling of Video signals, filtering operations.

**UNIT V:**

**Motion Estimation:** Optical flow, General Methodologies, Pixel Based Motion Estimation, Block-Matching Algorithm, Mesh based Motion Estimation, Global Motion Estimation, Region based Motion Estimation, Multi resolution motion estimation, Waveform based coding, Block based transform coding, Predictive coding, Application of motion estimation in Videocoding.

**TEXT BOOKS**

1. Digital Image Processing – Gonzaleze and Woods, 3<sup>rd</sup>Ed, Pearson, 2008.
2. Digital Video Processing – M. Tekalp, Prentice Hall International. 2<sup>nd</sup>Ed. 2015.

**REFERENCE BOOKS**

1. Digital Image Processing – S. Jayaraman, S. Esakkirajan, T. Veera Kumar – TMH, 2009.
2. Video Processing and Communication – Yao Wang, Joem Ostermann and Ya-quin Zhang. 1<sup>st</sup> Ed., PH Int, 2017
3. Digital Image Processing and Analysis-Human and Computer Vision Application with CVIP Tools – Scotte Umbaugh, 2nd Ed, CRC Press, 2011.

**Course Outcomes:**

- Defining the digital image, representation of digital image, importance of image resolution, applications in image processing.
- Know the advantages of representation of digital images in transform domain, application of various image transforms.
- Know how an image can be enhanced by using histogram techniques, filtering techniques etc
- Understand image degradation, image restoration techniques using spatial filters and frequency domain
- Know the detection of point, line and edges in images, edge linking through local processing, global processing.
- Understand the redundancy in images, various image compression techniques.
- Know the video technology from analog color TV systems to digital video systems, how video signal is sampled and filtering operations in video processing.
- Know the general methodologies for 2D motion estimation, various coding used in video processing.



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**  
**DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING**

<b>IV Year - I Semester</b>		<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>COMMUNICATION STANDARDS and PROTOCOLS</b> (Professional Elective 3)					

**Objective:**

- Acquire knowledge about transferring data into cloud using various Wired/Wireless communication technologies.

**Prerequisites:**

Basic knowledge on Digital numbering system; Micro Controller Peripheral Programming, interfacing different types of sensors using I2C, SPI, UART ; wired and wireless communications.

**Unit-I:**

**Introduction to Communication and Networking :** Communications, Signal Types and its characteristics (Analog/Digital), Data Transmission Types (Serial/Parallel), Communication Techniques (Asynchronous, Synchronous), Data Transmission Modes (Simplex, Half/Full Duplex), Network Topologies (Star, Ring, Mesh, Point to Point, Tree, Bus, Daisy chain, Multi drop) and its applications, Modulation need and types.

**Unit-II:**

**OSI Layers:** Communication Layers and its applications, Communication media (Twisted Pair, Coaxial, Fiber Optics), Introduction to Errors (Error types, Detection, Correction) and Flow Control and its applications.

**Unit-III:**

**Wired Communication Protocols: Ethernet** (Types, Socket, MAC, IP, ARP, ICMP, TCP, UDP, DHCP), CAN, Mod-bus (RTU, ASCII), UART (RS485, RS232), OFC and Advantages, Disadvantages and its applications, Introduction to Dial up Modems, Leased line modems.

**Unit-IV:**

**Wireless Communication Protocols:** Zigbee, Bluetooth, Wi-Fi, GPRS, GSM , NFC , IR, Satellite Communication. Advantages, Disadvantages and its applications.

**Unit-V:**

**Network Types:** Introduction to LAN, WAN, PAN, Internet and Intranet, sensor networks (wired/wireless) and its applications.

**Network Security :** Introduction to NAT, PAT, DNS, Network Routing algorithms, Introduction to Switch, Hub, Bridges and its working, Network Security and Introduction to Firewall and its applications.



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**  
**DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING**

**Text books:**

1. Introduction to data communication and networking by Wayne Tomasi, PearsonPrentice Hall,2005
2. Introduction to data communication and networking by Behrouz Forouzan ,4<sup>th</sup>Edition McGraw HillEducation,2017.
3. Basics of data communications by WilliamStallings.

**Reference books:**

1. Basics of computer networking by Thomas Robertazzi Stony BrookUniversity,2011
2. Wireless Networking Absolute Beginner's Guide by MichaelMiller:
3. Designing and Deploying 802.11n Wireless Networks by Jim Geier 2nd Edition, Kindle Edition.
4. CAN System Engineering from Theory to Practical Applications,2nd Edition,Springer,2013

**Course Outcomes:**

- Able to develop sensornetworks
- Able to communicate data via Wired/Wirelesscommunication
- Configure and test communicationtechnologies



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**  
**DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING**

<b>IV Year - I Semester</b>		<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>ANALOG IC DESIGN</b> <b>(Professional Elective 3)</b>					

**Course Objectives:**

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.
- Design and Develop the Analog CMOS Circuits for different Analog operations.
- Learn and understand the 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.

**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.



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**  
**DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING**

**TEXT BOOKS:**

1. Design of Analog CMOS Integrated Circuits- Behzad Razavi, TMH Edition, Second 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.

**Course Outcomes:**

After going through this course, the student will be able to

- Model and simulate different MOS Devices using small signal Model.
- Design and analyze any Analog Circuits in real time applications.
- Apply the concepts Analog Circuit Design to develop various Applications in Real Time.
- Analyze and compare different Open-Loop Comparators and Oscillators.



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**  
**DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING**

<b>IV Year - I Semester</b>		<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>SMART SENSORS</b> <b>(Professional Elective 3)</b>					

**OBJECTIVE:**

To make student to acquire the knowledge on types of sensors/transducers, working principles, selection procedure, applications of sensing systems

**UNIT – I**

**Introduction to Measurement:** Measurement units, applications, elements, choosing appropriate measuring instruments. Instrument Types and Performance Characteristics: Review of instrument types, Static characteristics, dynamic characteristics

**Error during measurement process:** Sources of systematic error, reduction and quantification of systematic errors, random errors, aggregation of measurement system errors.

**Calibration:** Calibration of measuring instruments, Primary calibration, secondary calibration and field calibration. Calibration methods for different parameters (temperature, pressure, humidity, flow...etc.). Automatic Calibration mechanisms.

**UNIT – II**

**Temperature Sensors:** Thermo-resistive, Resistance Temperature Detectors, Silicon Resistive, Thermistors, Semiconductor, Optical, Acoustic, Piezoelectric

**Humidity and Moisture Sensors:** Capacitive, Electrical Conductivity, Thermal Conductivity, Optical Hygrometer, Time Domain Reflectometer.

**Pressure and Force Sensors:** Mercury Pressure, Bellows, Membranes, and Thin Plates, Piezoresistive, Capacitive, Optoelectronic, Vacuum, Strain Gauges, Tactile, Piezoelectric Force

**Applications:** Case studies in processing industries, indoor environment monitoring in offices, cold storages

**UNIT – III**

**Occupancy and Motion Detectors:** Ultrasonic, Microwave Motion, Capacitive Occupancy, Visible and Near-Infrared Light, Far-Infrared Motion, PIR Motion, Position, Displacement, and Level Sensors: Potentiometric, Gravitational, Capacitive, Inductive and Magnetic, Optical, Ultrasonic, Radar

**Velocity and Acceleration Sensors:** Capacitive Accelerometers, Piezoresistive Accelerometers, Piezoelectric Accelerometers, Thermal Accelerometers, Heated-Plate Accelerometer, Heated-Gas Accelerometer, Gyroscopes, Piezoelectric Cables

**Applications:** Case studies in manufacturing industries, robotics

**UNIT – IV**

**Flow Sensors:** Pressure Gradient Technique, Thermal Transport, Ultrasonic, Electromagnetic, and Micro flow, Coriolis Mass Flow, Acoustic Sensors: Resistive Microphones, Fiber-Optic, Piezoelectric, Solid-State microphone, Light & Radiation Sensors: Photodiodes, Phototransistor, Photo resistors, Thermal detectors



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**  
**DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING**

**Chemical Sensors:** Metal-Oxide Chemical, ChemFET, Electro-chemical, Potentiometric, Conduct metric, Amperometric, Optical Chemical, Mass Detector

**Applications:** Case studies in processing industries, oil and gas industries, water SCADA, pharmaceutical industries

**UNIT – V**

**Introduction to wireless sensor networks,** Challenges for wireless sensor networks, Applications for wireless sensor networks, enabling technologies for wireless sensor networks.

**Single node architecture** – Hardware components, Energy consumption of Sensor nodes (only Operation states with different power consumption, Relationship between computation and communication, Power consumption of sensor and actuators is included), Deployment environments

**Sensor Network Architecture** - Sensor Network Scenarios, Optimization goals and figures of merit, Design principles of WSN, Service interfaces of WSNs, Gateway-concepts.

**TEXT BOOKS:**

1. Measurement and Instrumentation Principles - Morris, AlanS
2. An Introduction to Error Analysis by John R.Taylor
3. Sensor Technology Handbook, John S.Wilson
4. Holger Karl & Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks" John-Wiley,First-Edition-2014.

**REFERENCE BOOKS**

1. Mechanical Measurements – Beckwith, Marangoni,Lienhard
2. Measurement of Systems - Application and design - Earnest O.Doeblin
3. Electronic Instrumentation and Measurement Technique - Albert DHelfrick
4. Kazem Sohraby, Daniel Minoli, &Taieb Znati, "Wireless Sensor Networks- Technology, Protocols, AndApplications", John Wiley,2007.

**Course Outcomes :**The student will be able to

- Understand measuring parameters, measuring systems, effects ofenvironment, characteristics and parameters to be considered for designing aninstrument
- Understand different types of sensors/transducers, working principles,selection procedure, applications of sensingsystems
- Understand Challenges and applications of sensors and sensornetworks
- Select a sensor/sensing system for arequirement
- Test, install and collect the data from a group ofsensors.
- Derive sensor-based solution for differentapplications.





**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**  
**DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING**

<b>IV Year - I Semester</b>		<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>ADVANCED DIGITAL SIGNAL PROCESSING</b> <b>(Professional Elective 3)</b>					

**Course Objectives:**

The main objectives of the course are

- To study about discrete time systems and to learn about FFT algorithms.
- To study the design techniques for FIR and IIR digital filters
- To study the finite word length effects in signal processing
- To study the properties of random signal, Multirate digital signal processing and about QMF filters

**UNIT –I:** Review of DFT, FFT, IIR Filters and FIR Filters: Introduction to filter structures (IIR & FIR). Implementation of Digital Filters, specifically 2nd Order Narrow Band Filter and 1st Order All Pass Filter. Frequency sampling structures of FIR, Lattice structures, Forward prediction error, Back ward prediction error, Reflection coefficients for lattice realization, Implementation of lattice structures for IIR filters, Advantages of lattice structures.

**UNIT - II:** Non-Parametric Methods: Estimation of spectra from finite duration observation of signals, Nonparametric Methods: Bartlett, Welch & Blackman-Tukey methods, Comparison of all Non-Parametric methods

**UNIT – III:** Parametric Methods: Autocorrelation & Its Properties, Relation between auto correlation & model parameters, AR Models – Yule-Walker & Burg Methods, MA & ARMA models for power spectrum estimation, Finite word length effect in IIR digital Filters – Finite word-length effects in FFT algorithms.

**UNIT –IV:** Multi Rate Signal Processing: Introduction, Decimation by a factor D, Interpolation by a factor I, Sampling rate conversion by a rational factor I/D, Multistage Implementation of Sampling Rate Conversion, Filter design & Implementation for sampling rate conversion. Examples of up-sampling using an All Pass Filter.

**UNIT –V:** Applications of Multi Rate Signal Processing: Design of Phase Shifters, Interfacing of Digital Systems with Different Sampling Rates, Implementation of Narrow Band Low Pass Filters, Implementation of Digital Filter Banks, Sub-band Coding of Speech Signals, Quadrature Mirror Filters, Transmultiplexers, Over Sampling A/D and D/A Conversion.



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**  
**DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING**

**TEXT BOOKS:**

1. J.G.Proakis & D. G. Manolakis, “Digital Signal Processing: Principles, Algorithms & Applications”, 4th Edition, PHI, 2008.
2. Alan V Oppenheim & Ronald W Schaffer, “Discrete Time signal processing “, PHI. 2nd Edition, 1999.
3. Emmanuel C. Ifeache, Barrie. W. Jervis, “DSP – A Practical Approach”, 2nd Edition, Pearson Education, 2000.

**REFERENCE BOOKS:**

1. S. M .Kay, “Modern spectral Estimation: Theory & Application “, 1988, PHI.
2. P.P.Vaidyanathan, “Multi Rate Systems and Filter Banks”, Pearson Education.
3. Kaluri V. Rangarao, Ranjan K. Mallik, “Digital Signal Processing: A Practitioner’s Approach”, ISBN: 978-0-470-01769-2, 210 pages, November 2006 John Weley.
4. S.Salivahanan, A.Vallavaraj, C.Gnanapriya, “Digital Signal Processing”, 2000, TMH

**Course Outcomes:**

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

- Comprehend the DFT, FFT and IIR filters.
- To study the modern digital signal processing algorithms and applications.
- Have an in-depth knowledge of use of digital systems in real time applications
- Acquire the basics of multi rate digital signal processing and apply the algorithms for wide area of recent applications.
- Analyze the power spectrum estimation and Comprehend the Finite word length effects in Fixed point DSP Systems.





**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**  
**DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING**

**TEXTBOOKS:**

1. Augmented Reality – Principles and Practice, Dieter Schmalstieg and Tobias Höllerer, 1<sup>st</sup> Edition, Addison-Wesley
2. Practical Augmented Reality – A guide to the technologies, applications, and human factors for AR and VR, Steve Aukstakalnis, 1<sup>st</sup> Edition, Addison-Wesley
3. Understanding Augmented Reality, Concepts and Applications, Alan B. Craig, 1<sup>st</sup> Edition, Morgan Kaufman

**REFERENCE BOOKS:**

1. Handbook of Virtual Environments: Design, Implementation, and Applications, Kelly S. Hale and Kay M. Stanney, 2<sup>nd</sup> Edition, CRC Press
2. Designing Virtual Systems: The Structured Approach, Gerard Jounghyun Kim, Springer
3. Spatial Augmented Reality: Merging Real and Virtual Worlds, Oliver Bimber and Ramesh Raskar, 1<sup>st</sup> Edition, A K Peters/CRC press.

**Course Outcomes:**

At the end of the course, students will

- Understand the basics of Augmented Reality
- Understand human senses and their relationship to devices
- Understand various application scenarios of AR
- Understand software architecture



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**  
**DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING**

<b>IV Year - I Semester</b>		<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>SOFTWARE RADIO</b> <b>(Professional Elective4)</b>					

**Pre-requisite(s):** Basic knowledge of signal processing, concepts in wireless Communication and networks.

**Course Objectives:** This course enables the students to:

- Understand the basic components of software defined radio.
- Understand the distortion parameters and nonlinear Distortion in Transmitted Signals.
- Calculate power requirement in power amplifier for SDR.
- Understand Digital Pre-distortion Techniques for Linear/Nonlinear Distortion.
- Appraise Digital Pre-distortion Techniques.

**UNIT 1:** Basic components of software defined radios, Software defined radio architectures Part A, Software defined radio architectures- Part B.

**UNIT 2:** Distortion parameters, Sources and metrics of distortion in a transceiver, Nonlinear distortion and nonlinearity specifications, Power amplifiers: Nonlinear Distortion in Transmitted Signals.

**UNIT 3:** Power amplifier Line-up for linearity & power requirement calculations, Linearization Techniques for nonlinear distortion in SDR.

**UNIT 4:** Predistortion Techniques for nonlinear distortion in SDR.

**UNIT 5:** Digital Predistortion Techniques for Linear/Nonlinear Distortion.

**Textbook:**

1. Jeffrey H. Reed “Software Radio: A Modern Approach to radio Engineering”, Pearson Education Asia, 2002

**References:**

1. Sanjay Kumar, “Wireless Communication the Fundamental and Advanced Concepts” River Publishers, Denmark, 2015 (Indian reprint)
2. [https://onlinecourses.nptel.ac.in/noc18\\_ec01/preview](https://onlinecourses.nptel.ac.in/noc18_ec01/preview).

**Course Outcomes:** After the completion of this course, students will be to:

- Able to analyze the basic components of software defined radio.
- Demonstrate understanding about distortion parameters and nonlinear Distortion in Transmitted Signals
- Able to calculate power requirement in power amplifier for SDR
- Demonstrate understanding about Digital Pre-distortion Techniques for Linear/Nonlinear Distortion
- Design and analyze the various algorithms used for software defined radio.



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**  
**DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING**

<b>IV Year - I Semester</b>		<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>LOW POWER VLSI DESIGN</b> (Professional Elective 4)					

**Course Objectives:**

- 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, Introduction to Wallace Tree Multiplier.



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**  
**DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING**

**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.

**TEXT BOOKS:**

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, 1<sup>st</sup> edition, 2004

**REFERENCE BOOKS:**

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, Anatha Chandrakasan, Springer, 2005.

**Course Outcomes:**

Upon completing 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





**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**  
**DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING**

<b>IV Year - I Semester</b>		<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>EMBEDDED SYSTEMS</b> (Professional Elective 4)					

**Course Objectives:**

The main objectives of this course are given below:

- 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.







**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**  
**DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING**

<b>IV Year - I Semester</b>		<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>DSP PROCESSORS and ARCHITECTURES</b> (Professional Elective 4)					

**Course Objectives:**

- To recall the various techniques of digital signal processing.
- To introduce the architectural features of programmable DSP Processors of Texas Instruments (TI) and Analog devices (AD).
- To understanding the practical examples of DSP Processor architectures.
- To develop programming knowledge by using Instruction set of DSP Processors.
- To know the interfacing techniques to I/O devices and memory.

**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 Black fin Processor - The Black fin 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



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**  
**DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING**

**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: Woon-Seng Gan, Sen M. Kuo, Wiley-IEEE Press, 2007

**REFERENCE BOOKS:**

1. Digital Signal Processors, Architecture, Prog and Applications-B. Venkataramani and M. Bhaskar, 2002, TMH.
2. DSP Processor Fundamentals, Architectures & Features – Lapsley et al. 2000, S. Chand & Co.
3. Digital Signal Processing App Using the ADSP-2100 Family by The Applications Engineering Staff of Analog Devices, DSP Division, Edited by Amy Mar, PHI
4. 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.

**Course Outcomes:**

Upon the completion of course, student able to

- Understand the basic concepts of Digital Signal Processing.
- To differentiate the architectural features of General purpose processors and DSP processors.
- Understand the architectures of TMS320C54xx devices and ADSP 2100 DSP devices.
- Write the simple assembly language programs by using instruction set of TMS320C54xx.
- To interface the various devices to DSP Processors.



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**  
**DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING**

<b>IV Year - I Semester</b>		<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>MULTI MEDIA COMMUNICATION</b> <b>(Professional Elective 4)</b>					

**Course objectives:** This course will enable students to

- Define the Multimedia Communication Models
- Explain Multimedia Transport in Wireless Networks
- Solve the Security issues in multimedia networks
- Illustrate real-time multimedia network applications.
- Explain different network layer based application.

**Unit-I:** Introduction and tools used for MM content development , Media interaction, bimodality of human speech, Lip reading, speech driven talking heads, Lip synchronization, Lip tracking, Audio to visual mapping.

**Unit-II:** Bi-modal person verification, Joint AV coding, Multimedia processing, Digital media, Signal processing elements, Challenges in MM processing, Perceptual coding of Digital Audio.

**Unit-III:** Transform audio coders, Image coding, video coding, Water marking techniques, Organization, Storage and retrieval, ANNs for MMSP.

**Unit-IV:** Distributed MM systems, Multimedia processors, Multimedia OS, Multimedia communication standards, MPEG-1, MPEG-2, MPEG-4, MPEG-7.

**Unit-V:** Real time multimedia across Internet, packet audio/video multimedia transport across IP/ATM Network, Wireless multimedia, mobile multimedia access for internet, multimedia PCS.

**Text Book:**

1. Multimedia Communication Systems: Techniques and Standards, KR RAO et al, Pearson, 2002.
2. Insight into Mobile Multimedia Communication : D. BULL et al, Academic Press, 1999
3. Multimedia Systems Design : PK ANDLEIGH , K. THAKKAR, PHI, 2002
4. Multimedia, TAY VAUGHAN, 5/e, TMH, 2001

**Course Outcomes:**

- Develop the multimedia content using multimedia tools
- Understand various audio, video and joint coding techniques.
- Identify the requirements of real time multimedia transfer on IP networks.
- Study different types of multimedia processors



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**  
**DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING**

<b>IV Year - I Semester</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>0</b>	<b>0</b>	<b>3</b>	<b>1.5</b>
<b>INTERNET OF THINGS LAB</b>				

**List of Experiments:**

1. Introduction to Raspberry Pi Board/ Arduino/NodeMCU.
2. Familiarization with ARM keil MDK for programming and debugging an application on the PSoC 4 BLE chip and perform necessary software installation.
3. To interface Push button/Digital sensor (IR/LDR) with ARM keil MDK on PSoC 4 BLE chip and write a program to turn ON LED when push button is pressed or at sensor detection.
4. Set up a Bluetooth Low Energy (namely Bluetooth Smart) connection between the PSoC BLE kit and a smart phone and use an app to send and receive data to and from the BLE Pioneerkit.
5. To interface capacitor sensor (touch sensor) with smart phone and write a program to turn RGB LED ON/OFF when '1'/'0' is received from smart phone using Bluetooth.
6. Automatic street light control to control the street light (Turn on and off based on the light) using Arduino/ Node MCU/RaspberryPi
7. Smoke Detection using MQ-2 GasSensor
8. Detecting obstacle with IR Sensor and Arduino/ Node MCU/RaspberryPi
9. Arduino board interfacing with the temperature and humidity sensor and prints the output on LCD / serial monitor
10. Write an Arduino program for interfacing Arduino board with the Ultrasonic sound sensor and print the output on Serial monitor.

**Equipment required for Laboratories:**

Arduino/Node MCU/Raspberry Pi + PSoC 4 BLE Bluetooth Low Energy Pioneer Kit + Hardware, MQ-2 Gas Sensor, Ultrasonic sound sensor.



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**  
**DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING**

<b>IV Year - I Semester</b>		<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>0</b>	<b>0</b>	<b>3</b>	<b>1.5</b>
<b>MICROWAVE AND OPTICAL COMMUNICATION ENGINEERING LAB</b>					

**Minimum Twelve Experiments to be conducted:**

**Part-A (Any 7 Experiments (8 & 9 Compulsory))**

1. Reflex Klystron Characteristics.
2. Gunn Diode Characteristics.
3. Attenuation Measurement.
4. Directional Coupler Characteristics.
5. Impedance and Frequency Measurement.
6. Scattering parameters of Circulator.
7. Scattering parameters of Magic Tee.
8. Radiation Pattern of Horn and Parabolic Antennas.
9. Synthesis of Microstrip antennas (Rectangular Structure) Using any Industry standard Simulation Software.

**Part – B (Any 5 Experiments) :**

10. Characterization of LED.
11. Characterization of Laser Diode.
12. Intensity modulation of Laser output through an optical fiber.
13. Measurement of Data rate for Digital Optical link.
14. Measurement of NA.
15. Measurement of losses for Analog Optical link.

**Equipment required for Laboratories:**

1. Regulated Klystron Power Supply, Klystron mount
2. VSWR Meter
3. Micro Ammeter
4. Multimeter
5. CRO
6. GUNN Power Supply, Pin Modulator
7. Crystal Diode detector
8. Micro wave components (Attenuation)
9. Frequency Meter
10. Slotted line carriage
11. Probe detector
12. Wave guide shorts
13. SSTuner
14. Directional Coupler
15. E, H, Magic Tees
16. Circulators, Isolator
17. Matched Loads



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**  
**DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING**

18. Pyramidal Horn and Parabolic Antennas
19. Turntable for Antenna Measurements
20. Fiber Optic Analog Trainer based LED
21. Fiber Optic Analog & Trainer based laser
22. Fiber Optic Trainer
23. Fiber cables - (Plastic, Glass)