IV Year I Semester

OPTICAL COMMUNICATION AND NETWORKS

(Professional Elective –III)

Subject Code: UGEC7T0120	**L**	**T**	**P**	**C**
IV Year/ I Semester	**3**	**0**	**0**	**3**

Pre requisites: To take this course the students should have the knowledge of

- Communication Theory
- Digital Communications

Course Objectives: This course provides a full understanding of

1. The components and the design and operation of optical fiber communication systems. The principles of wavelength division multiplexed (WDM) systems.
2. The characteristics and limitations of system components like laser diodes, external modulators, optical fiber, optical amplifiers and optical receivers
3. The factors affecting the performance of both analog and digital transmission systems are studied.

SYLLABUS

UNIT-I **[12 Hrs]**

OPTICAL FIBER WAVEGUIDES : Introduction, Advantages of Optical Fiber Communication, Ray Theory Transmission, Total Internal Reflection, Acceptance Angle, Numerical Aperture, Skew Rays, Step Index and Graded Index Fibers, Single Mode Fibers - Cut Off Wavelength, Mode Field Diameter and Spot Size.

UNIT – II **[10 Hrs]**

SIGNAL DERADATION IN OPTICAL FIBERS : Attenuation - Absorption, Scattering and Bending losses, Core and Cladding losses. Signal Distortion in Fibers – Modal Delay, Group delay, Material Dispersion, Waveguide Dispersion, Polarization Mode Dispersion.

UNIT – III **[10 Hrs]**

OPTICAL SOURCES AND PHOTO DETECTORS : LED'S - Direct and Indirect Band Gaps, LED Structures, Light Source Materials, Quantum Efficiency and LED Power. Laser Diodes - Laser Diode Modes and Threshold Conditions, Laser Diode Rate Equations, Resonant Frequencies, Narrow spectral width, FP resonator. Physical Principles of Photodiodes - PinPhotodetector, Avalanche Photodiode. Structures for InGaAs APDs, Temperature Effect on Avalanche Gain.

UNIT IV **[10Hrs]**

FIBER FABRICATION AND COUPLING : Fiber Fabrication - Outside Vapor Phase Oxidation, Vapor Phase Axial Deposition, Modified Chemical Vapor Deposition,

Plasma Activated Chemical Vapor Deposition. Source to Fiber Power Launching, Fiber Splicing, Optical Fiber Connectors.

Unit-V **[10Hrs]**

WDM CONCEPTS AND COMPONENTS : Overview of WDM - Operational Principles of Wavelength Division Multiplexing, WDM Standards, DWDM. Passive Optical Couplers – Two by Two Fiber Coupler. Isolators and Circulators, Fiber Grating Filters – Grating Basics, Fiber Bragg Grating.

Unit-VI **[10Hrs]**

OPTICAL NETWORKS : Network Concepts, SONET/SDH - Transmission Formats and Speeds, Optical Interfaces, SONET/SDH Rings, SONET/SDH Networks.

Course Outcomes: Upon completion of the course, students will be able to

COs	Description	Blooms Level
CO 1	Explain the operation and signal attenuation of optical fibre.	II- Understanding
CO 2	Compare the operation of different Optical Sources and Optical detectors.	IV- Analyzing
CO 3	Analyze different techniques used for the fabrication of Optical Fibers and Fiber Coupling.	IV- Analyzing
CO 4	Examine WDM Concept used in Optical Communication	IV- Analyzing
CO 5	Analyze various Optical Networks and Components.	IV- Analyzing

Mapping of COs to POs

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO3	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	3	3	3	-	-	-	-	-	-	-	-	-	-	-

Text Books:

T1. Gerd Keiser, "Optical fiber Communication", McGraw Hill. 5th Edition, 2014.

T2. P. Chakravarthy , "Fiber Optic Communications", McGraw Hill 2015.

References:

R1. John Powers, "Fiber Optic Systems", Irwin Publications, 1997.

R2. Howes M.J., Morgen, D.V John, "Optical Fiber Communication", Wiely Publications.

SPEECH PROCESSING

(Professional Elective -III)

Subject Code :UGEC7T0220 **L T P C**

IV Year/ I Semester **3 0 0 3**

Pre-requisites:Students should have prior knowledge of

- Signals & Systems
- Random Variables & Stochastic Processes
- Digital Signal Processing

Course objectives : The objectives of this course are:

1. To provide students with the knowledge of basic characteristics of speech signal in relation to production of speech by humans.
2. To describe basic algorithms of speech analysis common to many applications of speech signal processing.
3. To give foundation for applications of speech signal processing (enhancement and coding).

SYLLABUS

UNIT I: Speech Production [12Hrs]

Speech processing; The speech chain: Speech production process (Lungs, Larynx and Vocal folds, Vocal tract), Speech perceiving process; Applications of Digital Speech signal processing; Phonetic representation of speech: Vowels, Diphthongs, Semi vowels, Nasals, Unvoiced fricatives, Voiced fricatives, Voiced and unvoiced stops; Digital model for speech production (Source-Filter model of speech production).

UNIT II: Time Domain Methods for Speech Processing [10Hrs]

Time domain parameters of Speech signal; Methods for extracting the speech parameters (Energy, Average Magnitude, Zero crossing Rate); Silence Discrimination using Zero crossing Rate and energy; Short Time Auto Correlation Function; Pitch period estimation using Auto Correlation Function.

UNIT III: Frequency Domain Methods for Speech Processing [10Hrs]

Short-Time Fourier Transform (STFT); Sampling the STFT in Time and Frequency; The Speech Spectrogram; homomorphic speech analysis: Definition of the Cepstrum and complex Cepstrum, Short-Time Cepstrum, computation of Cepstrum, pitch extraction using homomorphic speech processing.

UNIT IV: Linear Predictive Analysis of Speech [10Hrs]

Linear prediction of speech and the speech model; computing the prediction coefficients: auto correlation, formulation of Linear prediction coding equations, Solution of Linear prediction coding equations; The Levinson Durbin recursion, LPC spectrum; Application of Linear prediction coding parameters: Pitch detection using Linear prediction coding parameters

UNIT V: Speech Enhancement [10Hrs]

Nature of Interfering Sounds; Speech Enhancement (SE) Techniques: Basic principles of Spectral Subtraction; Wiener Filtering; Wiener filtering for noise reduction; Adaptive noise cancellation, Statistical-Model-based method: Maximum-likelihood estimator for speech enhancement; Applications of speech enhancement.

UNIT VI: Speech Coding [12Hrs]

Sampling and quantization of speech (PCM); Adaptive Differential PCM Systems; Delta Modulation; Digital speech coding; Open-Loop Coders: The Two-State Excitation Model, Residual-Excited Linear Predictive Coding, Mixed Excitation Systems; Closed-Loop Coders: Predictive Coding, Analysis-by-Synthesis Coding, Multi-Pulse Excitation Linear Prediction (MPLP), Code-Excited Linear Prediction (CELP)

Course outcomes

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

COs	Description	Bloom's Level
CO 1	Outline the basic characteristics of speech signal in relation to speech production and model the speech production system.	II-Understanding
CO 2	List different speech parameters.	IV-Analyzing
CO 3	Apply various algorithms for speech enhancement.	III-Applying
CO 4	Explain different types of speech coding techniques.	II-Understanding

Mapping of COs to POs

POs	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
CO 1	3	3												
CO 2	3	3	3											
CO 3	3	3	3											
CO 4	3	3	3											

Textbooks:

T1. Lawrence R. Rabiner and Ronald W. Schafer, "Introduction to Digital Speech Processing" now Publishers Inc. Hanover, USA, 2007

T2 Douglas O Shaughnessy, "Speech Communications Human and Machine" 2nd Edition, IEEE Press, 2000.

References:

R1 Philipos C. Loizou, "Speech Enhancement" 2ndEdition, CRC Press, Taylor & Francis Group, 2013

R2 L. R. Rabiner and R.W. Schafer, "Digital Processing of Speech Signals" Prentice-Hall Inc. USA, 1978

INDUSTRIAL IOT

(Professional Elective-III)

Subject Code: UGEC7T0320	**L**	**T**	**P**	**C**
IV Year / I Semester	**3**	**0**	**0**	**3**

Prerequisites

- Sensors & Applications
- Modern Wireless Communications
- Embedded System with ARM

Course Objective

1. To understand the concepts of Internet of Things and its communication protocols, Applications.
2. To make students aware of resource management and security issues in Internet of Things.
3. To understand the concepts of Industrial Internet of Things, its importance and applications.

SYLLABUS

UNIT I

INTERNET OF THINGS DEFINITIONS AND FRAMEWORKS: Definition of Internet of Things, History of IoT, IoT Frameworks,Basic Nodal Capabilities, and Structural Aspects of the IoT

Communication Technologies of IOT: Sensor Technology, RFID Technology, Satellite Technology.

UNIT II

LAYER 1/2 CONNECTIVITY: WIRELESS TECHNOLOGIES FOR THE IoT: WPAN Technologies for IoT/M2M - Zigbee/IEEE 802.15.4, Radio Frequency for Consumer Electronics (RF4CE), Bluetooth and its Low-Energy Profile, IEEE 802.15.6 WBANs, NFC, IPv6 OVER LOW-POWER WPAN (6LoWPAN).

IoT Applications / Examples: Smart Metering/Advanced Metering Infrastructure, e-Health/Body Area Networks,Home Automation and Smart Cards.

UNIT III

Designing Industrial Internet Systems: Introduction, The Concept of the IIoT, The Proximity Network, WSN Edge Node - Network Protocols, Low-Power Technologies, Designing Low-Power Device Networks, Legacy Industrial Protocols, RS232 Serial Communications, Field Bus Technologies

UNIT IV

Modern Communication Protocols and technologies: Industrial Ethernet, Encapsulated Field Bus, Standard Ethernet, Z-Wave, Wi-Fi Backscatter, Thread, Industrial Gateways

Middleware Transport Protocols and Software patterns: TCP/IP, UDP, Reliable Transport Protocol (RTP), CoAP (Constrained Application Protocol). MQTT, XMPP, AMQP, DDS, DTN.

UNIT V

Middleware Industrial IoT Platforms:IIoT conceptual diagram, Need of IIoT middleware, Middleware Architecture.

IIoT WAN Technologies and Protocols: WAN technologies offered by service providers, IIoT Device Low-Power WAN Optimized Technologies for M2M: SigFox, LoRaWAN, nWave, Dash7, Low Power Wi-Fi, LTE Category-M, Millimeter Radio.

UNIT VI

Industry 4.0: Defining and the need of Industry 4.0 along with its characteristics, the value chain, Benefits to Business, Industry 4.0 Design Principles and their Building Blocks, Industry 4.0 Reference Architecture.

Smart Factories: Introduction of smart factories and its action, Importance of smart manufacturing, real-World Smart Factories, Industry 4.0: The Way Forward.

Course Outcomes: Upon completion of the course, students will be able to:

Cos	Description	Bloom's Level
CO 1	Summarize the Internet of Things and it's communication technologies.	II-Understanding
CO 2	Explain Different technologies and applications of IoT.	II-Understanding
CO 3	Examine the Designing of Industrial Internet Systems	IV-Analyzing
CO 4	Identify Modern Communication and Middleware Transport Protocols for Industrial IoT.	III-Applying
CO 5	Importance of Industry 4.0 Smart factories in Industrial IoT.	V-Evaluating

Mapping of COs to POs

POs	1	2	3	4	5	6	7	8	9	10	11	12
CO 1	3	3	3									
CO 2	3	3										
CO 3	3	3	3									
CO 4	3	3	3									
CO 5	3	3	3									

Text Books:

T1. Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", Willy Publications

T2. "Industry 4.0: The Industrial Internet of Things", by Alasdair Gilchrist (Apress)

References:

R1. Parikshit N. Mahalle& Poonam N. Railkar, "Identity Management for Internet of Things", River Publishers.

R2. Sabina Jeschke Christian BrecherHoubing Song Danda B. Rawat Editors "Industrial Internet of Things Cybermanufacturing Systems".

R3. Introduction to Industry 4.0 and Industrial Internet of Things, By Prof. SudipMisra,IITKharagpur. https://nptel.ac.in/courses/106/105/106105195/#(or) https://archive.nptel.ac.in/courses/106/105/106105195/

R4. https://drive.google.com/file/d/17CPu--DdQHwUGzcbjDdNZbEcvHQ56-Cf/view

FPGA ARCHITECTURES

(Professional Elective-III)

Subject Code : **UGEC7T0420** **L T P C**

IV Year/ I Semester **3 0 0 3**

Prerequisites.

- Digital Logic Design
- Digital Design through Verilog HDL

Course Objective

1. Familiarization of various complex programmable logic devices of different families.
2. to study Field programmable gate arrays and realization techniques.
3. to study different case studies using one hot design methods.

SYLLABUS

Unit-I **[8 Hrs]**

Field Programmable Gate Arrays Classes: Organization of FPGAs, FPGA Programming Technologies, Programmable Logic Block Architectures, Programmable Interconnects, Programmable I/O blocks in FPGAs, Dedicated Specialized Components of FPGAs, and Applications of FPGAs

Unit-II **[6 Hrs]**

Essentials and SRAM Programmable FPGA: Introduction, Programming Technology, Device Architecture, The Xilinx XC2000, XC3000 and XC4000 Architectures, FPGA implementation for combinational and sequential circuits with case studies. FPGA debugging using chip scope analyzer with case studies.

Unit-III **[6 Hrs]**

Anti-Fuse Programmed FPGAs: Introduction, Programming Technology, Device Architecture, the Actel ACT1, ACT2 and ACT3 Architectures.

Unit-V **[8 Hrs]**

Erasable Programmable Logic Devices: Programming Technology: Logic Structures Using EPROM Transistors, Device Architecture: Basic Concepts, Macrocell Architecture, Logic Array, Programmable Flip-Flops, Programmable Clock, Control Block, Operating Requirements for EPLDs, Architectural Evolution in Array-Based PLDs.

UNIT-V **[7 Hrs]**

Design Applications for Systems: A Fast Video Controller, A Position Tracker for a Robot Manipulator, A Fast DMA Controller, Designing Counters with ACT Devices, Designing Adders and Accumulators with the ACT Architecture

UNIT-VI advanced FPGA design: Architecting Speed- High Throughput, Low Latency, Timing, Architecting Area- Rolling Up the Pipeline, Control-Based Logic Reuse, Resource Sharing, Impact of Reset on Area, Architecting Power- Clock Control, Input Control, Reducing the Voltage Supply.

Course Outcomes: Upon completion of the course, students will be able to

CO'S	**Description Blooms Level**	**Blooms Level**
C01	Outline various architectures and FPGAs.	II-Understanding
C02	Illustrate the SRAM Programmable, Anti-Fuse Programmed and EPROM programmable FPGAs	II-Understanding
C03	Use FPGAs to implement complex digital systems.	III-Apply
C04	Optimize FPGA based digital systems design in terms of area , power and performance.	IV Analyzing

Mapping of Cos to Pos

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1					3				2					3
CO2			3								2			3
CO3			3								2			3
CO4	3	3			3									3

Text Books:

T1. Stephen M. Trimberger, "Field Programmable Gate Array Technology", Springer International Edition.

T2. Steve Kilts, "Advanced FPGA Design Architecture, Implementation, and Optimization". John Wiley & Sons, Inc., India

Reference Books

R1. John V. Oldfield, Richard C. Dorf, "Field Programmable Gate Arrays", Wiley India.

MICROWAVE ENGINEERING

(Professional Elective – III)

Subject Code :UGEC7T0520	**L**	**T**	**P**	**C**
IV Year / I Semester	**3**	**0**	**0**	**3**

Prerequisites : Students should have prior knowledge of

- Electromagnetic Waves.

Course Objective

1. The student should gain proficiency in using s-parameters in designing passive and active microwave circuits.
2. The student should understand the function, design, and integration of the major components oscillator, modulator, power amplifier, antenna, low-noise amplifier, filter, and mixer.

SYLLABUS

UNIT I **[12 Hrs]**

RF & MICOWAVE ENGINEERING : Introduction to Microwave, Microwave Frequencies, Microwave Applications

RECTANGULAR WAVEGUIDES**:** Introduction,Solutions of Wave equations in Rectangular Coordinates**,** Modes in Rectangular Waveguides,Impossibility of TEM Waves in Hollow Waveguides, Dominant and Degenerate Modes, Sketches of TM and TE mode fields in the cross section, Mode Characteristics - Phase and Group Velocities, Wave lengths and Impedance Relations; Power Transmission and power losses in rectangular Guide.

Unit –II **[10 Hrs]**

PASSIVE MICROWAVE DEVICES: Attenuators, Microwave Hybrid Circuits: Waveguide Tees, Magic Tees (Hybrid Tees), Hybrid Rings (Rat-Race Circuits), Directional Couplers: Two-Hole Directional Couplers,Bethe-Hole Coupler, S-Matrix of a Directional Coupler, Faraday Rotation, Ferrite Components- Gyrator, Isolator, Circulator

UNIT III **[10 Hrs]**

MICROWAVE LINEAR-BEAM TUBES (O TYPE): Introduction to Microwave Linear-Beam Tubes (O Type), Classification of Linear Beam Tubes (O Type), Conventional Vacuum Triodes, Tetrodes, and Pentodes, Klystrons -Reentrant Cavities, Velocity Modulation Process, Bunching Process, Output Power and Beam Loading (Qualitative treatment). Reflex Klystrons–Velocity Modulation, Power Output and Efficiency (Qualitative treatment).

UNIT IV **[8 Hrs]**

MICROWAVE CROSSED-FIELD TUBES (M TYPE): Introduction, Classification of Cross-field tubes (M type), Magnetron Oscillators – Cylindrical Magnetron-Equations of electron motion, Cyclotron angular frequency, Power output and Efficiency.

UNIT V **[12 Hrs]**

MICROWAVE SOLID STATE DEVICES: Introduction, Classification, Applications. Transferred Electron Devices (TEDs) – Introduction, Gunn-Effect Diodes – Background, Gunn Effect, Ridley-Watkins-Hilsum (RWH) Theory, Mode of Operation. Detector Diode and PIN Diode. Avalanche Transit Time Devices -Introduction, IMPATT Diodes-Physical Structures, Negative Resistance. TRAPATT Diodes – Physical Structures, Principle of Operation.

UNIT VI **[10 Hrs]**

MICROWAVE MEASUREMENTS: Introduction, Description of Microwave Bench– Different blocks and their features, Precautions; Power Measurement–Calorimetric and Bolometer Method. Insertion loss and Attenuation measurements, VSWR Measurement, Impedance Measurement, Frequency Measurement.

Course Outcomes

Upon Completing the course, student will be able to

COs	Description	Bloom's Level
CO 1	Examine the different propagation modes of EM waves in guided structures	IV- Analyzing
CO 2	Analyze network parameters of microwave passive components.	IV- Analyzing
CO 3	Determine the output power and efficiency of various types of microwave tubes.	V- Evaluating
CO 4	Compare Transferred Electron Devices and Avalanche Transit Time devices	II- Understanding
CO 5	Measure the characteristics of microwave components	V- Evaluating

Mapping of COs to POs

POs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO 1	3	3												
CO 2	3	3												
CO 3	3													
CO 4	3	3	3	1									2	
CO 5	3	3											3	

Text Books

T1. R E Collin, "Foundation for Microwave Engineering", John Wiley & Sons, 2nd Edition, 2007

T2. S Y LIAO, "Microwave Devices and Circuits", PHI, 3rd Edition, 2003.

Reference Books

R1. Annapurna Das, Sisir K. Das, "Microwave engineering", McGraw-Hill Higher Education, 2008

R2. David M.Pozar, "Microwave Engineering", 3rd Edition, John Wiley & Sons, 2009.

MODERN SATELLITE COMMUNICATIONS

(Professional Elective – IV)

Subject Code: UGEC7T0620	**L**	**T**	**P**	**C**
IV Year/ I Semester	**3**	**0**	**0**	**3**

Prerequisites: Students should have prior knowledge of

- Communication Systems - I
- Communication Systems - II

Course Objective: The objectives of this course are

- To introduce the basic concepts of satellite orbital mechanics.
- To make the students equip with knowledge on satellite segment and earth segment.
- To expose them various methods of satellite access techniques and tradeoffs that typically occurring satellite system design.

SYLLABUS

UNIT I **[10 Hrs]**

ORBITAL MECHANICS AND LAUNCHERS: Orbital Mechanics, Look Angle Determination, Orbital Perturbations, Launches and Launch Vehicles, Orbital Effects in Communication System Performance.

UNIT II **[8 Hrs]**

SATELLITES: Attitude and Orbit Control System (AOCS), Telemetry, Tracking, Command, and Monitoring (TTC&M), Power Systems, Communications Subsystems, Equipment Reliability and Space Qualification.

UNIT III **[8 Hrs]**

SATELLITE LINK DESIGN AND MULTIPLE ACCESS: Basic Transmission Theory, System Noise Temperature and G/T Ratio, Design of Downlinks, UpLink Design, Design for Specified C/N. Frequency Division Multiple Access (FDMA) – Intermodulation products, Time Division Multiple Access (TDMA), TDMA Frame Structure.

UNIT IV **[8 HRS]**

LOW EARTH ORBIT AND NGSO SATELLITE SYSTEMS

Orbit Considerations, Coverage and Frequency Considerations, Delay and Throughput Considerations, System Considerations.

UNIT V **[8 Hrs]**

SATELLITE NAVIGATION AND THE GLOBAL POSITIONING SYSTEM

GPS Position Location Principles, GPS Receivers and Codes, GPS Navigation Message, GPS Receiver Operation, GPS C/A Code Accuracy, Differential GPS.

UNIT VI **[8 Hrs]**

INTER PLANETARY MISSIONS

Mars Orbiter mission- Mission Objectives, Scientific objectives, Spacecraft design, Payload, Telemetry and command, Communications, Launch of Mars Orbiter mission. Chandrayaan- Objectives, Goals, Specifications, Payload, Earth orbit burns, Lunar orbit insertion, Impact of the MIP on the lunar surface, Results.

Course Outcomes: Upon completion of the course, students will be able to

COs	Description	Bloom's Level
CO 1	Illustrate orbital mechanics	II - Understanding
CO 2	Outline the components of satellite subsystems and satellite link design.	II- Understanding
CO 3	Identify multiple access techniques used for communicating with satellite.	III- Applying
CO 4	Discuss the implementation of NGSO satellite systems	II - Understanding
CO 5	Illustrate the operation of GPS and inter planetary missions.	II- Understanding

Mapping of COs to POs:

POs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3	3	2											
CO2	3	2	3											
CO3	3	2												
CO4	3	2	2											
CO5	3	3												

Text Books

T1. Timothy Pratt and Jeremy Allnutt, "Satellite Communications", 3rd Edition, Wiley Publications, 2019.

T2. M. Richharia, "Satellite Communications Systems", 2nd Edition, McGraw-Hill, 1999.

T3. Datta, Jayati, Chakravarty, S. C. "Chandrayaan-1 India's First Mission to Moon" .

Reference Books

R1. D.C.Agarwal, "Satellite Communications", Khanna Publishers,1989.#

R2. https://en.wikipedia.org/wiki/Chandrayaan-1

COMPUTER VISION

(Professional Elective -IV)

Subject Code : UGEC7T0720 **L T P C**

IV Year/ I Semester **3 0 0 3**

Prerequisite

- Digital Image Processing

Course Objective

- To build detailed models of the image formation process
- To develop mathematical techniques to invert these to recover the quantities of interest

SYLLABUS

UNIT-I: Introduction to Computer Vision [10 Hrs]

Introduction, what is computer vision? A brief history, Image formation Geometric primitives and transformations, Geometric primitives, 2D transformations, 3D transformations 3D rotations 3D to 2D projections, Lens distortions, Photometric image formation, Lighting, Reflectance and shading, Optics, The digital camera, Sampling and aliasing, Computer Vision: Algorithms and Applications.

Pyramids and wavelets, Interpolation Decimation, Multi-resolution representations Wavelets Application: Image blending Geometric Transformations Parametric Transformations Mesh-based warping Application: Feature-based morphing Global Optimization Regularization

UNIT-II: Feature Detection [10 Hrs]

Feature detection and matching Points and patches Feature Detectors Feature Descriptors Feature Matching Feature Tracking Application: Performance-driven animation Edges, Edge detection Edge linking Application: Edge editing and enhancement Lines Hough transforms, Vanishing points Application: Rectangle detection

Segmentation Active Contours Snakes, Scissors Level Sets Application: Contour tracking and rotoscoping Watershed Graph-based segmentation K-means and mixtures of Gaussians Application: Medical image segmentation.

UNIT-III: Motion Estimation [10 Hrs]

Dense motion estimation Translational Alignment Hierarchical motion estimation Fourier-based alignment Incremental Refinement Parametric Motion Application: Video stabilization Learned motion models Spline-based motion Application: Medical image registration Optical Flow Multi-frame motion estimation Application: Video Denoising Application: De-interlacing Layered Motion Application: Frame interpolation Transparent layers and reflections

UNIT-IV: Image Stitching [10 Hrs]

Motion models Planar perspective motion Application: Whiteboard and document scanning Rotational panoramas Gap closing Application: Video summarization and compression Cylindrical and spherical coordinates Global Alignment Bundle Adjustment Parallax Removal Recognizing Panoramas Direct vs. feature-based alignment Compositing Choosing a compositing surface Pixel selection and weighting (de-ghosting): Photomontage

UNIT-V: Computational Photography [10 Hrs]

Photometric calibration Radiometric response function Noise level estimation Vignetting Optical blur (spatial response) estimation High dynamic range imaging Tone mapping Application: Flash photography Super-resolution and blur removal Color image demosaicing Application: Colorization Image matting and compositing Blue screen matting Natural image matting Optimization-based matting Smoke, shadow, and flash matting Video matting Texture analysis and synthesis Application: Hole filling and inpainting Application: Non-photorealistic rendering

UNIT-VI: Recognition [10 Hrs]

Object detection Face detection Pedestrian detection Face recognition Eigenfaces Active appearance and 3D shape models: Personal photo collections Instance Recognition Geometric Alignment Large Databases Application: Location recognition Category Recognition Bag of words Part-based models Recognition with segmentation Application: Intelligent photo editing Context and scene understanding Learning and large image collections Application: Image search, Recognition databases and test sets

Course Outcomes : By the end of the course the student will be able to

Cos	Description	Blooms Level
CO 1	Outline the importance of computer vision and apply geometric and wavelet transforms on images	III- Applying
CO 2	Apply algorithms on images for feature detection and motion estimation	III- Applying
CO 3	Apply algorithms to stitch images for panoramic view	III- Applying
CO 4	Apply algorithms on image and video for matting and inpainting	III- Applying
CO 5	Apply algorithms on images for various object detection and recognition tasks	III- Applying

Mapping of COs to POs

POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1									3					
CO 2						3								
CO 3						3								
CO 4							3				3			
CO 5											3			

Text Books

T1. Richard Szeliski, "Computer Vision: Algorithms and Applications" FIRST EDITION, Springer

T2. David Forsyth and Jean Ponce, "Computer Vision: A Modern Approach", Pearson; 2nd edition (14 February 2012)

Reference Books

R1. R.J. Schalkoff, "Digital Image Processing and Computer Vision", Wiley , 1988

R2. D.H.Ballard&C.M.Brown, "Computer Vision", Prentice Hall; 1st Edition (May 1,1982)

INDUSTRIAL AUTOMATION

(Professional Elective-IV)

Subject Code: UGEC7T0820	**L**	**T**	**P**	**C**
IV Year / I Semester	**3**	**0**	**0**	**3**

Prerequisites

- Fundamentals of Analog Electronics
- Digital Logic Design
- Electronic Instrumentation

Course Objective:

- To introduce Industrial Automation Concepts and its importance.
- To familiarize students with design of automated systems for Industries.

SYLLABUS

UNIT-I **[8 Hrs]**

Introduction to Industrial Automation :Production Systems: Facilities, Manufacturing Support System, And Automation in Production Systems: Automated Manufacturing Support Systems Computerised Manufacturing Support System, Reasons for Automating, Manual Labour in Production Systems, Automation Principles and Strategies. Introduction to Automation: - Basic Elements of Automated System Advanced Automation Functions, Levels of Automation.**(T1)**

UNIT-II **[8 Hrs]**

Hardware Components for Automation and Process Control : Characteristics and Quality Attributes of an embedded system, Application-specific embedded system-washing machine, Digital Camera & Domain -specific examples of embedded system-Automotive.**(T1)**

UNIT-III **[10 Hrs]**

COMPUTER AIDED MEASUREMENT AND CONTROL SYSTEMS: Role of computers in measurement and control, Elements of computer aided measurement and control, man-machine interface, computer aided process control hardware, process related interfaces, Communication and networking, Industrial communication systems, Data transfer techniques, Computer aided process control software and Computer based data acquisition system, Internet of things (IoT) for plant automation **(T2)**

Unit-IV **[8Hrs]**

Programmable Logic Controllers: Introduction to Micro Computers, Programmable Logic Controllers, PLC Programming, Ladder diagram, PLC

Communications and Networking, PLC Selection, PLC Installation, Advantages PLCs **(T2)**

UNIT-V **[8 Hrs]**

DISTRIBUTED CONTROL SYSTEM: Overview of DCS, DCS software configuration, DCS communication, DCS supervisory computer tasks, DCS integration with plc and computers, features of DCS, advantages of DCS.**(T2)**

UNIT-VI: **[8 Hrs]**

INDUSTRIAL ROBOTICS: Robot Anatomy And Related Attributes, Robot Control Systems, End Effectors, Applications Of Industrial Robots, Joint Drive Systems, Sensors In Robotics, Robot Programming, Robot Accuracy And Repeatability**(T1)**

Course Outcomes: By the end of the course the student will be able to

COs	Description	Blooms Level
CO1	Understand different basics required for industrial automation.	II -Understanding
CO2	Understand the concepts of sensors to automate process control	II -Understanding
CO3	Apply different data transfer techniques for computer aided measurements.	III -Applying
CO4	Analyze the working PLCs and Industrial Robots	III -Aalysis

Mapping of COs to POs:

POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3					2						3		
CO 2	3					2						3		
CO 3	3	3	2		2	2						3		
CO 4	3	3	2		2	2						3		

Text Books:

T1. "Automation Production Systems and Computer Integrated Manufacturing" by Mikell P. Groover, 4th Edition, Pearson Publishers.

T2. "Industrial Instrumentation and Control" By. S.K. Singh. The McGraw Hill Companies

Reference Books:

R1. Industrial control handbook by Parr, Newnes publications; 3rd edition.

R2. Programmable logic controller, Dunning, Delmar Thomson Learning, 2001 2nd edition.

ASIC DESIGN
(PROFESSIONAL ELECTIVE –IV)

Subject Code: UGEC7T0920	**L**	**T**	**P**	**C**
IV Year/ I Semester	**3**	**0**	**0**	**3**

Prerequisites

- VLSI Design

Course Objectives

- To motivate the student to be an entry-level industrial standard ASIC designer.
- To give an understanding of issues and tools related to ASIC design

SYLLABUS

UNIT-I **[8 Hrs]**

Introduction to ASICs: Types of ASICs: Full custom ASICs, Standard cell based ASICs, Gate array based ASICs, Channeled gate array, Channelless gate array, Structured gate array, Design flow, Case study, Economics of ASICs, ASIC cell libraries.

UNIT-II **[8 Hrs]**

ASIC Library Design and Programmable ASICs : Library cell design, Library architecture, Gate Array Design,Standard Cell Design, Logical effort, The Anti fuse, Static RAM, EPROM and EEPROM technology,Practical Issues,PREP benchmarks.

UNIT-III **[8Hrs]**

Programmable ASIC Logic Cells :Actel ACT:ACT1,Shannon's Expansion theorem, logic module,ACT2 and ACT3 logic modules, timing model and critical path, ACTEL logic module analysis, Xilinx LCA:XC3000 CLB,XC4000 logic block, Xilinx CLB analysis, Altera flex, Altera MAX :Logic expanders, Timing model, Power dissipation in Complex PLDs.

UNIT-IV **[9 Hrs]**

Simulation, Synthesis and Static Timing Analysis: Types of Simulation: Gate level simulation, Switch level simulation, Transistor level simulation, Synthesis: Finite state machine synthesis, Memory synthesis, Performance driven
Synthesis, Static Timing Analysis:Hold time, Entry delay, Exit delay and external set up time.

UNIT-V **[10 Hrs]**

Testing: The importance of test, Boundary scan test: BST cells, BST registers, Instruction decoder, TAP controller, Boundary scan controller, Faults, Fault simulation: serial fault simulation, Parallel fault simulation, Concurrent fault simulation, Automatic test pattern generation, Scan test, Built in self test.

UNIT-VI **[10 Hrs]**

ASIC Construction: Physical design, System partitioning, Floor planning, Placement, Physical design flow, Global routing, Detailed routing, Circuit extraction and DRC.

Course Outcomes : Upon completion of the course the students will able to

CO'S	**Description Blooms Level**	**Blooms Level**
C01	Explain the different ASIC designs.	II -Understanding
C02	Analyze the architecture and Performance of Programmable ASICs	IV- Analyzing
C03	Elaborate the simulation, synthesis and Testing of ASICs withconstraints.	V Synthesis
C04	Outline the various aspects of physical design	II -Understanding

Mapping of COs to Pos

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1			3		3									
CO2	3	3			3								3	3
CO3		3	3	3	3				3			3	3	3
CO4														3

Text Books

T1. M.J.S.Smith, "Application Specific Integrated Circuits", Pearson Education, 2010.

T2. Farzad Nekoogar and FaranakNekoogar, "From ASICs to SOCs: A Practical Approach", Prentice Hall PTR, 2003.

Reference Books

R1. G.Hachtel, F. Somenzi, "Logic Synthesis and Verification Algorithms" Springer; 2013

R2. Pak K. Chan/Samiha Mourad, "Digital Design Using Field Programmable Gate Arrays", Pearson Low Price Edition.

RADAR ENGINEERING

(Professional Elective –IV)

Subject Code: UGEC7T1020	**L**	**T**	**P**	**C**
IV Year/ I Semester	**3**	**0**	**0**	**3**

Prerequisites: Students should have prior knowledge of

- Electromagnetic Waves
- Microwave Engineering

Course Objective

1. To provide an understanding of the basic concepts, operation, applications of radar systems
2. To provide an understanding of the techniques necessary to analyze the performance of radar systems.

SYLLABUS

UNIT I **[8 Hrs]**

RADAR EQUATION: Radar Equation, Radar Block Diagram and Operation, Applications of Radar, Prediction of Range Performance, Minimum Detectable Signal, Receiver Noise Probability Density Functions, SNR, Integration of Radar Pulses, Radar Cross-section of Targets (simple targets-sphere, cone-sphere), Transmitter Power, PRF and Range Ambiguities, System Losses, Propagation Effects.

UNIT II **[8 Hrs]**

CW AND FREQUENCY MODULATED RADAR: The Doppler Effect, CW Radar-Block Diagram, Isolation between Transmitter and Receiver, Non-Zero IF Receiver, Receiver Bandwidth Requirements, Applications of CW Radar. FM-CW Radar - Range and Doppler Measurement, Block Diagram and characteristics. FM-CW Altimeter, Multiple Frequency CW Radar.

UNIT III **[10 Hrs]**

MTI AND PULSE DOPPLER RADAR: Introduction, MTI Radar with power amplifier transmitter, MTI Radar with power oscillator transmitter, Delay line Cancellers, Multiple or staggered PRF, Range gated Doppler filters, Limitation to MTI performance, Non coherent MTI, Pulse Doppler Radar, MTI from a Moving Platform.

UNIT IV **[8 Hrs]**

TRACKING RADAR: Tracking with Radar, Sequential Lobing, Conical Scan, Monopulse Tracking Radar-amplitude comparison monopulse, Phase comparison monopulse. Tracking in range, Acquisitions.

UNIT V **[8 Hrs]**

RADAR Receivers: Lens Antennas, Phased array Antennas, Radar Receivers- Noise Figure and Noise Temperature, Mixers, Low Noise front-ends, Radar , Duplexer and Receiver Protectors.

UNIT VI **[8 Hrs]**

MODERN RADARS: Synthetic aperture Radar-Resolution of SAR, Range equation, Equipment considerations. Air surveillance Radar, Bistatic Radar, Radar Networks.

Course outcomes

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

COs	Description	Bloom's Level
CO 1	Outline the concept of Radar Equation	II - Understanding
CO 2	Analyze the operation of various types of Radars	IV - Analyze
CO 3	Identify the functions of Radar Receivers.	III - Applying
CO 4	Summarize the principles of Advanced Radars.	II - Understanding

Mapping of COs to POs:

POs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO 1	3	3												
CO 2	3	3												
CO 3	3	3												
CO 4	3													

Text Book

T1. Merrill I skolnik, "Introduction to Radar Systems', McGraw Hill, 2nd Edition,2007.

T2. G S N Raju, "Radar Engineering and Fundamentals of Navigational Aids", IK international Publishers, 2008

Reference Books

R1. Peyton Z Peebles Jr. (2004), "Radar Principles", John Wiley Inc.

FUNDAMENTALS OF 5G COMMUNICATIONS
(Professional Elective –V)

Subject Code : UGEC7T1120	**L**	**T**	**P**	**C**
IV Year/ I Semester	**3**	**0**	**0**	**3**

Pre requisites

- Modern Wireless Communications

Course Objectives: In this course it is aimed to introduce to the students about

- a comprehensive overview of the current state of the 5G landscape, likely use cases
- a wide range of technology options and potential 5G system architectures, to spectrum issues

UNIT-I

Concepts of 5G Systems : Historical Trend for Wireless Communication -Mobile Communications Generations: 1G to 4G –Evolution of LTE Technology to Beyond 4G –Pillars of 5G –Standardization Activities -Use cases and Requirements–System Concept –Spectrum and Regulations: Spectrum for 4G –Spectrum Challenges in 5G – Spectrum Landscape and Requirements –Spectrum Access Modes and Sharing Scenarios

UNIT – II

5G ARCHITECTURE : 5G Architecture: Software Defined Networking –Network Function Virtualization –Basics about RAN Architecture –High-Level Requirements for 5G Architecture –Functional Architecture and 5G Flexibility –Physical Architecture and 5G Deployment

UNIT – III

Millimeter Wave Communication: Spectrum and Regulation, Channel Propagation –Hardware Technologies for mmW Systems –Deployment Scenarios – Architecture and Mobility –Beamforming –Physical layer Techniques, Transmission Schemes

UNIT – IV

MACHINE TYPE COMMUNICATION : Use cases and Categorization of MTC, MTC Requirements, Data and Control for short packets, Non-Orthogonal access Protocols, Massive MTC: Design principles, technology components, summary of mMTC, Ultra-reliable Low-latency MTC: Design principles, technology components.

UNIT – V

Device-to-Device COMMUNICATION : D2D: from 4G to 5G –Radio Resource Management for Mobile Broadband D2D –Multi-hop D2D Communications for Proximity and Emergency Services –Multi-operator D2D Communication

UNIT VI: 5G Radio Access Technologies

Access Design Principles for Multi-user Communications –Multi-carrier with Filtering – Non-orthogonal Schemes for Efficient Multiple Access –Radio Access for Dense Deployments –Radio Access for V2X Communication –Radio Access for Massive Machine-type Communication.

Course Outcomes: Upon completion of the course, students will be able to

COs	Description	Bloom's Level
CO 1	Describe and explain the evolution of 5G, system concepts and spectrum challenges	II - Understanding
CO 2	Illustrate and explain the 5G functional and physical architecture and its requirements Explain the architecture, Beamforming and hardware technologies for mmW communications	III - Applying
CO 3	Describe and explain the requirements and fundamental techniques for MTC and D2D Communication	IV - Analyzing
CO 4	Compare and explain various radio access technologies for 5G networks	III - Applying

Mapping of COs to POs:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO2	2	2	3	-	-	-	-	-	-	-	-	-	-	-
CO3	3	2	3	-	-	-	-	-	-	-	-	-	-	-
CO4	3	2	2	-	-	-	-	-	-	-	-	-	-	-
CO5	3	2	3	-	-	-	-	-	-	-	-	-	-	-

Text Books

T1. Asif Oseiran, Jose F. Monserrat and Patrick Marsch, "5G Mobile and Wireless Communications Technology", Cambridge University Press, 2016.

T2. Jonathan Rodriquez, "Fundamentals of 5G Mobile Networks", Wiley, 2015

References

R1. Patrick Marsch, Omer Bulakci, Olav Queseth and Mauro Boldi, "5G System Design –Architectural and Functional Considerations and Long Term Research", Wiley, 2018

DIGITAL SIGNAL PROCESSORS AND ARCHITECTURE

(Professional Elective -V)

Subject Code: UGEC7T1220	**L T P C**
IV Year/ I Semester	**3 0 0 3**

Pre-Requisites

- Digital Signal Processing

Course Objectives

1. To outline the architectures of different types of DSP Processors.
2. To implement basic DSP algorithms on different DSP processor.

SYLLABUS

UNIT-I **[10 Hrs.]**

INTRODUCTION TO PROGRAMMABLE DSPs: Introduction, Basic Architectural Features, DSP Computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Address Generation Unit, Programmability and Program Execution, Speed Issues, Features of External Interfacing.

UNIT-II **[10 Hrs.]**

PROGRAMMABLE DIGITAL SIGNAL PROCESSOR (TMS320C54XX): Introduction, Bus Structure, CPU and Internal memory and Memory Mapped Registers, Data Addressing Modes and Memory Space of TMS320C54XX, Program Control, Instructions and Programming, On chip Peripherals, and Interrupts of TMS320C54XX, Pipeline Operation of TMS320C54XX.

UNIT-III **[10 Hrs]**

DEVELOPMENT TOOLS FOR DSP IMPLEMENTATIONS: Introduction, DSP Development Tools, DSP System Design Kit, Software for Development, The Assembler and Assembly Source File, the Linker and Memory Allocation, the C/C^{++} Compiler, Code Composer Studio, DSP Software Development Example.

UNIT-IV **[10 Hrs]**

IMPLEMENTATION OF DSP ALGORITHMS: Introduction, Q-Notation, FIR, IIR Filters, Interpolation and Decimation, 2-Point, 4-Point and 8-Point DFT Computation, Butterfly Computation, Overflow and Scaling, Bit Reversed Index Generation.

UNIT-V **[8 Hrs]**

ADVANCED PROCESSORS: Features of TMS320C62X Processors, Internal Architecture, CPU and Data Paths of TMS320C62X Processors, Addressing Modes, memory architecture, External memory Access, Pipeline Operation, Peripherals, **Overview of MotorolaDSP563XX Processor**: - Data ALU, Multiplier Accumulator,

Address Generation Unit, Program Control Unit, JTAG TAP and On CE module, On Chip, Peripherals, and Memory internal Buses and DMA.

UNIT-VI **[8 Hrs]**

APPLICATIONS OF PROGRAMABLE DSP DEVICES: Introduction,DSP Based Biotelemetry system, Speech Processing System, Image processing System, DSP Based Power meter.

Course Outcomes

Upon completion of the course, students will be able to

COs	Description	Bloom's Level
CO 1	Outline the fundamentals of programmable DSPs	II-Understanding
CO 2	Explain the architectures TMS320C (54XX, 62X) and MotorolaDSP563XX Processor	II-Understanding
CO 3	Make use of IDE &DSP processors for implementation of signal processing algorithms	III-Applying
CO 4	Apply the DSP Processors in Different fields of Engineering.	IV-Analyzing

Mapping of COs to POs

POs	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
CO 1	3													
CO 2	3		3	3										
CO 3	3		3	3	3									
CO 4	3		3	3	3	3	3							

Text Books

T1. Avtar Singh, S.Srinivasan"DSP Implementation using DSP microprocessor with Examples from TMS32C54XX", THAMSON 2004.

T2. B.VenkataRamani and M. Bhaskar, "Digital Signal Processors, Architecture, and Programming", TMH, 2004.

Reference Books

R1. Lapsley et al. "DSP Processor Fundamentals, Architectures & Features", S. Chand & Co, 2000.

R2. Jonathen Stein, "Digital signal processing", John Wiley 2005.

Advanced Embedded Systems Processors

(Professional Elective -V)

Subject Code: UGEC7T1320	**L**	**T**	**P**	**C**
IV Year / I Semester	**3**	**0**	**0**	**3**

Prerequisites

- Digital Logic Design
- Embedded Systems with ARM

Course Objectives

- To introduce the concepts of Embedded and Real-time operating systems
- To understand the design aspects of Embedded systems related to hardware, software and tesing.
- To familiarize Design of Embedded System in different Domain-Specific IoT.

UNIT-I **[8 Hrs]**

INTRODUCTION:Embedded systems overview, Design challenges, Embedded Processor Technology, IC Technology, Design Technology, Trade-offs.

UNIT-II **[8 Hrs]**

Embedded Hardware & Firmware Design and Development: Hardware Design: Analog & Digital Electronic Components, Serial Communication Devices (I2C, SPI, CAN), Electronic Design Automation (EDA) Tools, The PCB Layout Design
Firmware Design: Embedded Firmware Design approaches, Development Languages, ISR Concept, Interrupt Service Mechanism, Basic concepts Embedded C and Sample programs.

UNIT-III **[8 Hrs]**

Real-Time Operating System : Operating System Basics, Types of O.S, Kernel Architecture, Tasks, process and Threads, Task Scheduling, Threads, Process Scheduling, Task Communication & Synchronization, Examples of handheld & Real-time Operating systems.

UNIT- IV **[8 Hrs**]

Hardware Software Co-Design &Testing : Fundamental Issues in Hardware-Software Co-Design, Hardware Software Trade-offs, Integration of Hardware & Firmware. Testing: Quality Assurance and testing of the Design, Testing on Host Machine, Simulators, Emulators, Laboratory tools.

UNIT–V **[8 Hrs]**

The Embedded Product Development Life Cycle (EDLC) : What is EDLC, Why EDLC, Objectives of EDLC, Different Phases of EDLC, EDLC Approaches (Modeling the EDLC).

UNIT-VI: **[10 Hrs]**

Developing Internet of Things : IoT Design Methodology, Domain-Specific IoTs, Case Studies

Case Study-1 (Home Automation): Smart Lighting, Smart Appliances, Intrusion Detection, Smoke/gas Detectors.

Case Study-2 (Cities): Smart Parking, Smart Lighting, Smart Roads, Surveillance

Case Study-3 (Environment): Weather Monitoring, Air Pollution Monitoring, Forest Fire Monitoring, River Floods Detection

Case Study-4 (Agriculture & Lifestyle): Smart Irrigation, Green House Control, Wearable Electronics.

Course Outcomes: By the end of the course, the student will be able to

COs	Description	Blooms Level
CO1	Outline concepts of embedded systems and various Processor and IC Technologies associated with them.	II - Understanding
CO2	Build a basic model of Embedded System by studying all Hardware Components and Software Requirements required	III-Applying
CO3	Outline basic concepts of RTOS.	II – Understanding
CO4	Test an Embedded System by learning Hardware Software Co-Design Approaches and Testing Tools	VI – Creating
CO5	Summarize Life Cycle of an Embedded Product Development	II – Understanding
CO6	ExamineEmbedded System applications using IoT.	IV -Analyzing

Mapping of COs to POs:

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3		3									2		
CO2	1	3	3		3							3	3	3
CO3		3	3									3		
CO4		3			3	2						3		
CO5		3	3		3									
CO6		3			3				2			3	3	

Text Books

T3. Frank Vahid, Tony D. Givargis, "Embedded system Design: A Unified Hardware/Software Introduction", John Wily & Sons Inc., 2002. (Unit-I)

T4. Shibu. K.V, "Introduction to Embedded systems" by -Tata McGraw Hill Education Private limited, 2009. (Unit-II,III & IV)

T5. Vijay Madisetti and ArshdeepBahga, "Internet of Things (A Hands-onApproach)", 1st Edition, VPT, 2014. (Unit-V & VI)

References

R5. Embedded systems Architecture by Tammy Noergaard, Elsevier Publications, 2005.

R6. Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", 1 st Edition, Academic Press, 2014.

LOW POWER VLSI

(Professional Elective –V)

	L	T	P	C
Subject Code : UGEC7T1420				
IV Year/ I Semester	**3**	**0**	**0**	**3**

Prerequisites

- VLSI Design
- Microprocessors

Course Objective:

- To expose the students to the low voltage device modeling.
- To design Low voltage, low power VLSI CMOS circuit design.

Syllabus

UNIT-I **[8 Hrs]**

Needs for Low Power VLSI and Sources of power dissipation: Needs for Low Power VLSI and Sources of power dissipation: Charging and Discharging Capacitance, CMOS Leakage Current, Static Current, Principles of Low Power Design, Low Power Figure of Merits.

UNIT-II **[10 Hrs]**

Low Power Design Approaches: Low-Power Design through Voltage Scaling – VTCMOS circuits, MTCMOS circuits, Architectural Level Approach – Pipelining and Parallel Processing Approaches. Switched Capacitance Minimization Approaches System Level Measures, Circuit Level Measures, Mask level Measures. Adiabatic Logic Circuits: Adiabatic Charging, Adiabatic Amplification, Adiabatic Logic Gates.

UNIT-III **[10 Hrs]**

Circuit Level Power Reduction Techniques : Transistor and Gate Sizing-Sizing an Inverter Chain, Transistor and Gate Sizing for Dynamic Power Reduction and Transistor Sizing for Leakage Power Reduction, Equivalent Pin Ordering, Network Restructuring and Reorganization-Transistor Network Restructuring, Partitioning and Reorganization, Special Latches and Flip-flops-Self-gating, Combinational and Double Edge Triggered Flip-flops, Low Power Digital Cell Library-Cell Sizes and Spacing and Varieties of Boolean Functions, Adjustable Device Threshold Voltage

UNIT-IV **[8 Hrs]**

Logic Level Power Reduction Techniques : Gate Reorganization, Signal Gating, Logic Encoding- Binary versus Gray Code and Bus Invert Encoding, State Machine Encoding- Transition Analysis, Output Don't-care Encoding and Design Trade-offs in

State Machine Encoding. Pre computation Logic-Precomputation Condition, Alternate Precomputation Architectures and Design Issues in Precomputation Logic Technique.

UNIT-V **[8 Hrs]**

Architecture and System Level Power Reduction Techniques: Power and Performance Management- Microprocessor Sleep Modes, Performance Management and Adaptive Filtering, Switching Activity Reduction-Guarded Evaluation, Bus Multiplexing and Glitch Reduction by Pipelining, Parallel Architecture with Voltage Reduction, Flow Graph Transformation -Operator Reduction and Loop Unrolling.

UNIT-VI **[10 Hrs]**

Special Techniques: Power Reduction in Clock Networks-Clock Gating, Reduced Swing Clock, Oscillator Circuit for Clock Generation, Frequency Division and Multiplication and Other Clock Power Reduction Techniques, CMOS Floating Node-Tristate Keeper Circuit and Blocking Gate, Low Power Bus-Low Swing, Charge Recycling Bus and Delay Balancing, Low Power Techniques for SRAM -SRAM Cell-Memory Bank Partitioning, Pulsed Word line and Reduced Bit line Swing, Case Study: Design of an FIFO Buffer.

Course Outcomes

On successful completion of the course the students will be able to

CO'S	**Description Blooms Level**	**Blooms Level**
CO1	Model the characteristics for low power circuits	III-Applying
CO2	Acquire the knowledge in various low power design approaches and techniques	III Applying
CO3	Illustrate the various power reduction techniques in circuit level	II-Understanding
CO4	Analyze the logic level design issues.	IV-Analyzing
CO5	Develop power reduction techniques in digital circuits	III-Applying

Mapping of COs to POs:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3		3									2		3
CO2	3	3										2		3
CO3			3									2		3
CO4					3							2		3
CO5	3	3												3

Text Books:

T1. Gary K. Yeap, "Practical Low Power Digital VLSI Design", Kluwer Academic Press, 2002

T2. Kiat-Seng Yeo, Kaushik Roy, "Low-Voltage, Low-Power VLSI Subsystems", TMH

Reference Books

R1. Sung-Mo Kang, Yusuf Leblebici, "CMOS Digital Integrated Circuits - Analysis and Design" TMH, 2011.

R2. AnanthaChandrakasan, "Low Power CMOS Design", IEEE Press/Wiley International, 1998

EMI/EMC
(Professional Elective –V)

Subject Code : UGEC7T1520	**L**	**T**	**P**	**C**
IV Year/ I Semester	**3**	**0**	**0**	**3**

Prerequisites:
- Electromagnetic Waves
- Microwave Engineering

SYLLABUS

UNIT – I **[8 Hrs]**

Natural and Nuclear Sources of EMI / EMC: History, Concepts and Definitions of EMI/EMC, Electromagnetic environment, Practical experiences and concerns, frequency spectrum conservations, An overview of EMI / EMC, Natural and Nuclear sources of EMI and Biological effects of EMI

UNIT – II **[8 Hrs]**

EMI from Apparatus, Circuits and Open Area Test Sites: Electromagnetic emissions, Noise from relays and switches, Non-linearity in circuits, passive intermodulation, Cross talk in transmission lines, Transients in power supply lines, Open area test sites and measurements.

UNIT – III **[10 Hrs]**

Radiated and Conducted Interference Measurements and ESD: Anechoic chamber, TEM cell, GTEM Cell, Characterization of conduction currents / voltages, Conducted EM noise on power lines, Conducted EMI from equipment.

UNIT – IV **[8 Hrs]**

ESD, Grounding, Shielding, Bonding, and EMI filters: ESD, Electrical fast transients / bursts, Electrical surges, Principles and types of grounding, Shielding, and bonding, Characterization of filters, Power lines filter design.

UNIT – V **[10 Hrs]**

Cables, Connectors and Components: EMI suppression cables, EMC connectors, EMC gaskets, Isolation transformers, opto isolators, Transient and Surge Suppression Devices.

UNIT – VI **[8 Hrs]**

EMC Standards: Standards for EMI and EMC, MIL Standards, IEEE/ANSI standards, CISPR/IEC standards, FCC regulations, Euro norms, British Standards, EMI/EMC standards in JAPAN..

Course Outcomes : Upon completion of the course, students will be able to

COs	Description	Bloom's Level
CO 1	Understand EMC regulation and methods of eliminating interferences	II-Understanding
CO 2	Understand the concept of filtering and shielding	II-Understanding
CO 3	Explain about the Methods of grounding of cable shield	II-Understanding
CO 4	Understand about electrostatic discharge and standards	II-Understanding

Mapping of COs to POs

POs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO 1	2	2		2					2				2	
CO 2	3	3				2	2			3	1		2	
CO 3	2								1					
CO 4	3	3		3					3					

TEXT BOOKS:

T1. C.R. Pal., "Introduction to Electromagnetic Compatibility", Ny John Wiley, 1992.

T2. "Electromagnetic Interference and Compatibility", IMPACT series, IIT-Delhi, Modules1-9.

REFERENCE BOOKS:

R1. Dr. V.P. Kodali, IEEE Publication, "Engineering Electromagnetic Compatibility", Printed in India by S. Chand & Co. Ltd., New Delhi, 2000.

R2. Henry W. Ott, "Electromagnetic Compatibility Engineering", John Wiley & Sons, 2009

Communication Networks
(Job Oriented Elective)

Subject Code: UGEC7T1620	**L**	**T**	**P**	**C**
IV Year/ I Semester	**2**	**0**	**2**	**3**

Prerequisites: Students should have prior knowledge of

- Communication Theory
- Digital CommunicationS

Course Objective: The objectives of this course are

- To introduce the basic concepts of Computer Networks.
- To understand the working of different layers of the Computer Networks.

SYLLABUS

Unit-I

Introduction : Uses of Computer Networks, Reference Models – OSI reference model and TCP/IP reference model.

Introduction to MATLAB Programming – import and export operations, elements, plotting, Java Classes, The Guide.

Unit-II

Physical Layer: Guided Transmission – Twisted Pairs, Coaxial Cable & Fiber Optics; Wireless Transmission – Microwave transmission.

Digital Communication System Simulation using MATLAB.

Unit-III

Data Link Layer : Data Link Layer design issues; Sliding Window protocols; Multiple Access protocols – carrier sense multiple access protocols, Network Topologies.

Network Topologies, like star, ring, mesh, simulation using MATLAB.

Unit-IV

The Network Layer : Network Layer design issues; Routing Algorithms – Shortest Path algorithm, Flooding, Distance Vector routing, Link State Routing, Multicast routing; AODV Routing.

Simulation of Network Routing algorithms using MATLAB

Unit-V

The Transport Layer : The transport service, Elements of transport protocols, the internet transport protocols: Introduction to UDP, Introduction to TCP, TCP Header, TCP Connection Establishment, and connection release.

Simulation of transfer of data from one computer to another using MATLAB.

Unit-VI

The Application Layer : Domain Name System, Electronic Mail, The World Wide Web, Streaming audio and video, Voice-over-IP.
OFDM system simulation using MATLAB.

Course Outcomes: Upon completion of the course, students will be able to

COs	Description	Bloom's Level
CO 1	Illustrate the basic concept of Computer Networks	II - Understanding
CO 2	Outline the components of physical layer.	II- Understanding
CO 3	Identify various protocols used in data link layer.	III- Applying
CO 4	Discuss the operation of network layer.	II - Understanding
CO 5	Illustrate the functioning of application layer.	II- Understanding

Mapping of COs to POs:

POs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3	3	2											
CO2	3	2	3											
CO3	3	2												
CO4	3	2	2											
CO5	3	3												

Textbooks

T1. Computer Networks---- Andrew S TANENBAUM, 4th Edition. Pearson Education/PHI.

T2. Network Modeling, Simulation and Analysis in MATLAB --- Dac-Nhuong Le, Abhishek Kumar Pandey et al, WILEY publishing, 2019.

Reference Books:

R1. Data Communications and Networking----- Behrouz A. Forouzan. Third Edition TMH.

R2. An Engineering Approach to Computer Networks-S.Keshav, 2nd Edition, Pearson Education.

DEEP LEARNING

(Job Oriented Elective)

Subject Code : UGEC7T1720	**L**	**T**	**P**	**C**
IV Year/ I Semester	**2**	**0**	**2**	**3**

Prerequisites

- Mathematics
- Machine Learning

Course Objectives: The objective of the course is

1. To provide exposure on the advances in the field of deep learning
2. To apply for real world problems.

SYLLABUS

UNIT I **[8 Hrs]**

Introduction: Various paradigms of learning problems, Perspectives and Issues in deep learning framework, review of fundamental learning techniques. Feed forward neural network: Artificial Neural Network, activation function, multi-layer neural network.

UNIT II **[8 Hrs]**

Training Neural Network: Risk minimization, loss function, back propagation, regularization, model selection, and optimization.

UNIT III **[8 Hrs]**

Conditional Random Fields: Linear chain, partition function, Markov network, Belief propagation, Training CRFs, Hidden Markov Model, Entropy.

UNIT IV **[8 Hrs]**

Deep Learning: Deep Feed Forward network, regularizations, training deep models, dropouts, Convolution Neural Network, Recurrent Neural Network, Deep Belief Network.

UNIT V **[8 Hrs]**

Probabilistic Neural Network: Hopfield Net, Boltzmann machine, RBMs, Sigmoid net, Auto encoders.

UNIT VI **[8 Hrs]**

Deep Learning research: Object recognition, sparse coding, computer vision, natural language processing. Deep Learning Tools:Keras, Pytorch.

Course Outcomes: Upon completion of the course the students will able to

COs	Description	Blooms Level
CO 1	Demonstrate the fundamental principles, theory and approaches of artificial neural networks.	II -Understanding
CO 2	Illustrate the various learning algorithms in artificial neural network	II -Understanding
CO 3	Develop different network models on conditional fields	III- Applying
CO 4	Illustrate the deep learning concepts	II -Understanding
CO 5	Demonstrate the probabilistic neural network concepts	II -Understanding
CO 6	Identify new application requirements in the field of computer vision.	III- Applying

Mapping of COs with POs:

POs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO 1	3													
CO 2														
CO 3			3										3	
CO 4				3	3						3			
CO 5												3		
C0 6	3													

Text Books

T1. Goodfellow, I., Bengio,Y., and Courville, A., "Deep Learning", MIT Press, 2016..

T2. Bishop, C. ,M., "Pattern Recognition and Machine Learning", Springer, 2006.

Reference Books

R1. Yegnanarayana, B., "Artificial Neural Networks", PHI Learning Pvt. Ltd, 2009.

R2. Golub, G.,H., and Van Loan,C.,F., Matrix Computations, JHU Press,2013.

R3. Satish Kumar, Neural Networks: A Classroom Approach, Tata McGraw-Hill Education, 2004.

R4. Ravindran, K. M. Ragsdell , and G. V. Reklaitis , "ENGINEERING OPTIMIZATION: Methods and Applications" , John Wiley & Sons, Inc., 2016

R5. Antoniou, W. S. Lu, "PRACTICAL OPTIMIZATION Algorithms and Engineering Applications", Springer, 2007.

MANAGEMENT SCIENCE

Subject Code : UGEC7T1820	**L**	**T**	**P**	**C**
IV Year/ I Semester	**3**	**0**	**0**	**3**

Prerequisites:

- General awareness about Principles of Management.
- To have an insight about Production and Operations Management.
- To be able to acquire knowledge about Human Resource Management, Marketing, Strategic Management.

Course Objectives:

2. To create awareness about different Managerial concepts like Management, Production, Marketing, Human Resource and Strategic Management.
3. To make the students equip with knowledge on techniques of PERT and CPM in project management.

SYLLABUS

UNIT-I **[8 Hrs]**

Introduction to Management : Concept and importance of Management, Functions of management, Evaluation of Management thought, Fayol's principles of Management, Maslow's need hierarchy & Herzberg's two factor theory of Motivation, Decision making process, Designing organizational structure, Principles of Organization, Types of organization structures.

UNIT-II **[8 Hrs]**

Operations Management : Plant Location Principles and types of plant Layout , Work study, Materials Management: Objectives - Need for inventory control-Inventory control techniques EOQ , ABC, HML, SDE, VED and FSN analysis.

UNIT-III **[8 Hrs]**

Human Resources Management (HRM): Concepts of HRM, Basic functions of HR manager, Job Evaluation and Merit Rating, Performance Appraisal, Methods of Performance appraisal Concepts Compensation.

UNIT-IV **[8 Hrs]**

Marketing Management: Functions of marketing, Marketing Mix, Marketing strategies based on Product life cycle, Channels of distribution (Place), Promotional Mix.

UNIT-V **[10 Hrs]**

Project Management (PERT/CPM): Network analysis, Program Evaluation and Review Technique (PERT), Critical path method (CPM) - Identifying critical path, Difference between PERT & CPM (simple problems).

UNIT-VI **[8 Hrs]**

Strategic Management: Mission, Goals, objectives, policy, strategy, Environmental scanning, SWOT analysis, Steps in strategy formulation and implementation Generic strategy alternatives.

Course Outcomes:

Upon completing the course, student will be able to

COs	Description	Blooms Level
CO 1	Understand the fundamentals of Management with specific insight as its function and role	Understanding
CO 2	Learn the concepts of production, Management of human Resources and Management of Marketing activities along with business environment	Understanding
CO 3	Apply the problem solving skills to demonstrate logical solution to real life problems	Applying
CO 4	Create the awareness of business strategies to deal with the dynamic business environment	Creating

Mapping of COs to POs:

POs	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
CO 1	-	-	-	-	-	-	-	-	2	-	-	-	-	-
CO 2	-	-	-	-	-	2	-	-	-	-	-	-	-	-
CO 3	-	-	-	-	-	-	-	-	-	-	2	-	-	-
CO 4	-	-	-	-	-	-	-	-	-	-	2	-	-	-

Text Books:

T1. Dr. Arya Sri, "Management Science", TMH 2011.

T2. L.M. Prasad, "Principles & Practices of Management" Sultan chand & Sons, 2007.

Reference Books:

R1. K. Aswathappa and K. Sridhara Bhat, "Production and Operations Management", Himalaya Publishing House, 2010.

R2. Philip Kotler Philip Kotler, Kevin Keller, Mairead Brady, Malcolm Goodman, Torben Hansen, "Marketing Management" Pearson Education Limited, 2016.

ENTREPRENEURSHIP AND START-UP ECO SYSTEM

Subject Code : UGEC7K1920	**L**	**T**	**P**	**C**
IV Year/ I Semester	**1**	**0**	**2**	**2**

Prerequisites

- General Awareness about Innovation and Design Thinking

Course Objectives

4. To promote entrepreneurship among the students and drive them towards establishing Start-ups

SYLLABUS

Unit-I **[6 Hrs]**

Small Business: An Overview : What Is Small Business, Workforce Diversity and Small Business Ownership, The Value of Diversity to Business Secrets of Small Business Success, Competitive Advantage, Getting Started on the Right Foot, Understanding the Risks of Small Business Ownership, What Is Business Failure?, Causes of Business Failure, Business Termination versus Failure , Mistakes Leading to Business Failure, Failure Rate Controversy, A Model of the Start-Up Process

Unit-II **[9 Hrs]**

Planning in Small Business: Relationship between Social Responsibility, Ethics, and Strategic Planning Social Responsibilities of Small Business Economic Responsibility Legal Obligations Ethical Responsibility Philanthropic Goodwill Ethics and Business Strategy Codes of Ethics, Ethics under Pressure Strategic Planning Mission Statement Environmental Analysis Competitive Analysis Strategic Alternatives Goal Setting and Strategies Control Systems Strategic Planning in Action Every Business Needs a Plan The Purpose The Practice: Guidelines for Writing a Business Plan Business Plan Contents Cover Page Table of Contents Executive Summary Company Information Environmental and Industry Analysis Products or Services Marketing Research and Evaluation Manufacturing and Operations Plan Management Team Timeline Critical Risks and Assumptions Benefits to the Community Exit Strategy Financial Plan Appendix Review Process Business Plan Mistakes

UNIT-III **[11 Hrs]**

Small Business Finance : Small Business Finance, Initial Capital Requirements, Defining Required Assets, The Five "C's" of Credit, Additional Considerations, Basic Financial Vocabulary, Forms of Capital: Debt and Equity, Other Loan Terminology, How Can You Find Capital?, Loan Application Process, Sources of Debt

Financing, What if a Lender Says "No"? Sources of Equity Financing, Choosing a Lender or Investor, The Legal Environment, Small Business and the Law, Laws to Promote Fair Business Competition, Laws to Protect Consumers, Laws to Protect People in the Workplace, Licenses, Restrictions, and Permits, Contract Law for Small Businesses, Elements of a Contract, Contractual Obligations, Laws to Protect Intellectual Property, Patents, Copyrights, Trademarks, Global Protection of Intellectual Property,

UNIT-IV: [10 Hrs]

Small Business Marketing: Strategy and Research Small Business Marketing, Marketing Concept Of Purple Cows, Marketing Strategies for Small Businesses, Setting Marketing Objective, Developing a Sales, Forecast, Identifying Target Markets, Understanding Consumer Behavior, Market Research, Market Research Process, Limitations of Market Research Small Business Marketing: Product Using Your Marketing Mix Product: The Heart of the Marketing Mix Developing New Products Inventor's Paradox Importance of Product Competitive Advantage Packaging Purchasing for Small Business Purchasing Guidelines Purchasing Basics Selecting Suppliers Make-or-Buy Decision Investigating Potential Suppliers Managing Inventory How Much Inventory Do You Need? Costs of Carrying Inventory Controlling Inventory Reorder Point and Quantity Visual Control Economic Order Quantity ABC Classification Electronic Data Interchange Just-in-Time Materials Requirements Planning

UNIT-V [8 Hrs]

Human Resource Management : Hiring the Right Employees,Job Analysis, Job Description, Job Specifications, Employee Recruitment, Advertising for Employees, Employment Agencies, Internet Job Sites,Executive Recruiters (Headhunters), Employee Referrals, Relatives and Friends, Other Sources, Selecting Employees, Application Forms and Résumés, Interviewing, Testing, Temporary Employees and Professional Employer Organizations, (PEOs) Placing and Training Employees, Employee Training and Development, Ways to Train, Compensating Employees, Determining Wage Rates, Incentive-Pay Programs, Benefits, When Problems Arise: Employee Discipline and Termination Disciplinary Measures Dismissing Employees

UNIT-VI: [8 Hrs]

Operations Management : Elements of an Operating System Control Systems, Types of Operations Management, Operations Management for Manufacturing Businesses, Operations Management for Service Businesses, What Is Productivity? Ways to Measure Manufacturing Productivity, Ways to Measure Service Productivity, What about Scheduling Operations? Scheduling Methods, Routing, Sequencing, Dispatching, Quality-Centered Management, Six Sigma in Small Business, Quality

Circles, How Do You Control Operations? Feedforward Quality Control, Concurrent Quality Control, Feedback Quality Control,

- After the completion of each unit the students should come up with a business proposal comprising of the keywords and concepts learnt in that Unit
- A final report must be presented covering all the concepts in the course along with a detailed Business plan

Course Outcomes : Upon Completing the course, student will be able to

COs	Description	Blooms Level
CO 1	Understand expansive and deep appreciation of entrepreneurship, and its pivotal role in the economy.	II- Understanding
CO 2	Approach entrepreneurship with clarity and focus	II- Understanding
CO 3	Apply enhanced understanding of the key success factors as well as possible risks and potential mitigation strategies.	III- Applying
CO 4	Identify the opportunities and challenges of entrepreneurship more effectively with the additional insights available	III- Applying

Mapping of Cos to Pos

POs	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
CO 1									*					
CO 2						*								
CO 3						*								
CO 4							*							
CO 5											*			
CO 6											*			

Text Books

T1. TIMOTHY S. HATTEN, "Small Business Management Entrepreneurship and Beyond" FIFTH EDITION , South-Western Cengage Learning

T2. Peter Thiel, " Zero to One: Notes on Startups, or How the Build the Future", Crown Publishing Newyork

Reference Books

R1. Peter F Drucker, "Innovation and Entrepreneurship: Practice and Principles" Routledge, 2012

R2. Clayton M Christensen, "The Innovator's Solution: Creating and Sustaining Successful Growth" Harvard Business School Press, 2003