TECHNO INDIA UNIVERSITY
WEST BENGAL

Department of Electronics and Communication Engineering

Seventh Semester

Program: B.Tech. in ECE	**Year, Semester: 4th**, 7th .
Course Title: Career Advancement & Skill Development-VII : "Embedded C"	**Subject Code:** TIU-UEC-S405A
Contact Hours/Week: 0–0–2	**Credit:** 2

COURSE OBJECTIVE:

Enable the student to:

1. Understand Embedded Systems Basics: Introduce the fundamental concepts of embedded systems, including architecture, microcontrollers, and real-time system requirements.
2. Learn Embedded C Programming: Develop proficiency in writing and debugging C programs tailored for embedded systems, with emphasis on memory constraints and hardware interaction.
3. Work with Microcontroller Hardware: Gain hands-on experience interfacing with microcontroller peripherals such as GPIO, timers, ADCs, and communication protocols (UART, SPI, I2C).
4. Apply Embedded C in Real-Time Applications: Implement real-time embedded applications, focusing on task scheduling, interrupt handling, and performance optimization.
5. Design and Deploy Embedded Projects: Build, test, and deploy embedded projects that integrate hardware and software, demonstrating the complete development lifecycle.

COURSE OUTCOME:

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

CO-1:	Recall basic concepts of embedded systems and microcontroller architecture	K1
CO-2:	Describe the syntax, structure, and features of Embedded C programming.	K2
CO-3:	Explain how Embedded C interacts with hardware components like GPIO, timers, and interrupts	K2
CO-4:	Apply Embedded C programming to control basic hardware peripherals such as LEDs, switches, and displays	K3

CO-5:	Demonstrate the use of communication protocols (UART, SPI, I2C) in Embedded C applications	K3
CO-6:	Analyze the functionality and performance of Embedded C programs through simulation and testing tools.	K4

COURSE CONTENT:

MODULE 1:	**Introduction to Embedded Systems**	**6 Hours**
Definition and characteristics of embedded systems, Differences between embedded and general-purpose systems, Classification and applications of embedded systems, Overview of microcontroller vs microprocessor, Embedded system development life cycle (EDLC), Introduction to microcontroller architectures (e.g., 8051, AVR, PIC, ARM)		
MODULE 2:	**Basics of Embedded C Programming**	**4 Hours**
Basics of Embedded C Programming , Introduction to C language for embedded systems, Data types, variables, operators, and expressions, Control structures (if, switch, loops), Functions, arrays, strings, and pointers, Bit manipulation techniques, Memory management in embedded C		
MODULE 3:	**Microcontroller Programming Basics**	**6 Hours**
Microcontroller Programming Basics, icrocontroller components: CPU, RAM, ROM, I/O ports,Architecture and pin configuration of a sample microcontroller (e.g., 8051 or ATmega328),Programming tools: IDEs, compilers, and simulators, Writing and compiling first Embedded C program, Downloading code to microcontroller using programmer, LED blinking and basic I/O programming		
MODULE 4:	**Interfacing Digital I/O Devices**	**4 Hours**
Interfacing Digital I/O Devices, Interfacing switches, LEDs, buzzers, Interfacing 7-segment displays and LCD (16x2), Introduction to keypad interfacing, Debouncing techniques and input polling, Using timers and counters for delays and measurement		
MODULE 5:	**Interrupts and Communication Protocols**	**6 Hours**
Interrupts and Communication Protocols,Concept of interrupts and types of interrupts,Writing ISR (Interrupt Service Routines),External and internal interrupts programming,Introduction to UART, SPI, and I2C protocols,Serial communication: data transfer and receiving,Sensor interfacing using I2C/SPI		
MODULE 6:	**Embedded Systems Applications**	6 **Hours**
Embedded Systems Applications and Mini Project,PWM generation and applications (e.g., motor control),ADC (Analog to Digital Converter) interfacing, Real-time clock (RTC) integration, Introduction to real-time operating systems (RTOS) basics (optional),Mini projct: Design, development, and demonstration of an embedded application (e.g., temperature display, home automation, etc.)		
TOTAL LAB HOURS		**32 Hours**

Textbooks:

1. Embedded C Programming Author: Mark Siegesmund Publisher: Newnes
2. Programming Embedded Systems in C and C++ Author: Michael Barr Publisher: O'Reilly Media

3. AVR Microcontroller and Embedded Systems: Using Assembly and C Author: Muhammad Ali Mazidi, Sarmad Naimi, Sepehr Naimi Publisher: Pearson
4. Embedded Systems with ARM Cortex-M Microcontrollers in Assembly Language and C, Author: Yifeng Zhu, Publisher: E-Man Press LLC
5. The C Programming Language Author: Brian W. Kernighan and Dennis M. Ritchie Publisher: Prentice Hall

Department of Electronics and Communication Engineering

Program: B. Tech. in ECE (BEC)	**Year, Semester:** 4th Yr., 7rd Sem.
Course Title: RF and Mfcrowave Engineering	**Subject Code:** TIU-UEC-E405
Contact Hours/Week: 3–0–0 (L–T–P)	**Credit:** 3

COURSE OBJECTIVE:

Enable the student to:

1. **To introduce the fundamental concepts of microwave engineering**, including microwave properties and system components.
2. **To develop an understanding of transmission line theory and waveguides**, including their modes, cutoff frequencies, and impedance characteristics.
3. **To equip students with knowledge of impedance matching techniques** using the Smith chart and scattering matrix (S-matrix) analysis.
4. **To provide insights into the design and operation of passive and non-reciprocal microwave components**, such as resonators, couplers, isolators, and circulators.
5. **To familiarize students with microwave sources and their applications**, including klystrons, magnetrons, TWTs, and solid-state devices.

COURSE OUTCOME:

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

CO-1:	**Understand Microwave System Components** – Demonstrate knowledge of various microwave system components, their characteristics, and applications.	K2
CO-2:	**Analyze Microwave Transmission Lines** – Apply transmission line theory to analyze voltage and current distribution, impedance matching, and the behavior of waveguides.	K4
CO-3:	**Utilize Smith Chart and S-Matrix** – Interpret the Smith chart for impedance matching and analyze microwave networks using the scattering matrix (S-matrix).	K3
CO-4:	**Design Microwave Waveguides and Planar Structures** – Develop an understanding of wave propagation in planar lines, attenuation, dispersion, and lumped element design.	K4
CO-5:	**Evaluate Passive and Non-Reciprocal Components** – Analyze the working principles of passive microwave components like resonators, tees, couplers, filters, as well as non-reciprocal devices like isolators and circulators.	K5

CO-6:	**Understand and Explain Microwave Sources** – Explain the operation of microwave sources such as klystrons, magnetrons, TWTs, and understand the design of microwave amplifiers and oscillators.	K2

COURSE CONTENT :

MODULE 1:	**MICROWAVE PROPERTIES, WAVEGUIDES, TRANSMISSION LINE THEORY**	**8 Hours**
Microwave & its property, Rectangular and Circular Waveguide: modes, cutoff frequency; Transmission Line: Current and Voltage Distribution, Input impedance, Short Circuit and Open Circuit, Quarter Wave Transformer.		
MODULE 2:	**SMITH CHART, IMPEDANCE MATCHING, S-MATRIX**	**8 Hours**
Smith chart and impedance matching techniques, S-matrix: representation, properties, shift in reference planes, generalized S-matrix.		
MODULE 3:	**WAVE PROPAGATION IN PLANAR LINES, LUMPED ELEMENTS**	**8 Hours**
Wave propagation in planar lines: design, effective dielectric constant, attenuation, dispersion, power-handling capability; lumped elements and their design.		
MODULE 4:	**PASSIVE COMPONENTS**	**8 Hours**
Passive components: (i) Reciprocal Type: Resonators/cavities, Attenuators, Junction Tees, Magic Tee, Directional couplers, power splitters/combiners, filters; (ii) Non- reciprocal components: isolators, circulators and Gyrators.		
MODULE 5:	**MICROWAVE SOURCES**	**8 Hours**
Microwave sources: Klystron, Magnetron, TWTs, transistor amplifier and oscillator design, Gunn oscillator; Tunnel diode oscillator, microwave systems.		
TOTAL LECTURES		**40 Hours****

Books:

1. D. M. Pozar, "Microwave Engineering", Wiley
2. R.E. Collin, "Microwave Circuits", McGraw Hill
3. K. C. Gupta and I. J. Bahl, "Microwave Circuits", Artech house
4. D. M. Pozar, "Microwave Engineering", Wiley
5. R. E. Collin, "Foundations for Microwave Engineering", Wiley
6. S. Y. Liao, "Microwave Devices & Circuits", Prentice Hall
7. P. A. Rizzi, "Microwave Engineering: Passive Circuits", Prentice Hall
8. R. Ludwig & P. Bretchko, "RF Circuit Design", Pearson
9. K. C. Gupta, "Microwaves", New Age
10. M. Mitra, "Microwave Engineering", Dhanpat Rai
11. G. S. N. Raju, "Microwave Engineering", I. K. International
12. J. P. Agarwal, M. L. Sisodia & V. L. Gupta, "Microwave and Radar Engineering", New Age
13. E. C. Jordan & K. G. Balmain, "Electromagnetic Fields and Radiating Systems", McGraw Hill

Department of Electronics and Communication Engineering

Program:B.Tech in Electronics & Communication Engineering	**Year, Semester:** Final YR. 7th SEMESTER
Course Title: Digital Image and Video	**Subject Code:**
Contact Hours/Week: 3–0–0 (L–T–P)	**Credit:** 3

Course Objective :

The **course objective:** The course aims to provide students with foundational knowledge and practical skills in digital image and video processing, covering topics like image enhancement, segmentation, wavelet transforms, compression, and video coding. Students will learn to apply these techniques to analyze and process digital images and videos effectively.

Course Outcomes :

CO1: Understand the fundamentals of digital image sensing, acquisition, and pixel relationships.
CO2: Apply image enhancement techniques, including transformations and filters, to improve image quality.
CO3: Perform color image processing and apply techniques for segmentation and color corrections.
CO4: Use wavelets and multi-resolution techniques for advanced image processing and compression.
CO5: Implement video coding and segmentation techniques, including motion estimation and video object tracking.
CO6: Demonstrate the ability to design and implement image and video processing algorithms using software tools for real-world applications.

COURSE CONTENT :

MODULE 1:	**Digital Image Fundamentals and Image Enhancement**	**8 Hours**

Visual Perception: Elements of visual perception.
Image Sensing and Acquisition: Understanding the process of capturing images.
Image Sampling and Quantization: Digitization of images, pixel representation.
Basic Relationships Between Pixels: Neighborhood, adjacency, connectivity, and distance measures.
Gray Level Transformations: Contrast adjustments and various transformation techniques.
Histogram Equalization and Specifications: Contrast improvement through histogram techniques.
Smoothing and Sharpening Filters: Linear filters, order-statistics filters, first and second derivative filter

MODULE 2:	: **Frequency Domain Filters and Color Image Processing**	**8 Hours**

Two-Dimensional DFT and Its Inverse: Fundamentals of frequency domain filtering.
Frequency Domain Filters: Low-pass and high-pass filters in the frequency domain. Color Models: RGB, YUV, HSI models and their applications.
Color Transformations: Formulation, color complements, and color slicing.
Tone and Color Corrections: Techniques for adjusting tone and colors.
Color Image Smoothing and Sharpening: Methods for improving color images.
Color Segmentation: Segmentation techniques in color images.

MODULE 3:	**Wavelets, Multi-resolution, and Image Compression**	**8 Hours**

Fourier Transform and Uncertainty Principles: Time-frequency localization and its application in image processing.
Wavelet Transform: Continuous wavelet transform and wavelet bases.
Multi-resolution Image Analysis: Decomposition of images using wavelets and subband filter banks.
Wavelet Packets: Techniques for multi-level analysis and image compression.
Redundancy in Images: Types of redundancy (inter-pixel, psychovisual).
Lossless Compression: Predictive and entropy-based methods.
Lossy Compression: Transform coding and DCT-based compression techniques.
Compression Standards: JPEG and JPEG-2000.

MODULE 4:	**Image Segmentation**	**8 Hours**

Detection of Discontinuities: Techniques for edge and boundary detection.
Thresholding: Global and adaptive thresholding methods for segmentation.
Edge Linking and Boundary Detection: Methods to detect and link edges and boundaries.
Region-Based Segmentation: Techniques for dividing an image into meaningful regions.
Advanced Segmentation Techniques: Use of more complex algorithms for high-quality segmentation.

MODULE 5:	**Fundamentals of Video Coding and Video Segmentation**	**8 Hours**

Inter-frame Redundancy: Compression between frames to reduce data.
Motion Estimation Techniques: Full-search, fast search strategies, forward and backward motion prediction.
Frame Classification: Classification of frames into I, P, and B frames.
Video Sequence Hierarchy: Group of pictures, slices, macro-blocks, and blocks in video sequences.
Video Encoder and Decoder: Elements of a video encoding and decoding system.
Video Coding Standards: MPEG, H.26X standards for video compression.
Temporal Segmentation: Shot boundary detection and the distinction between hard-cuts and soft-cuts.
Motion-Based Spatial Segmentation: Techniques for segmenting video based on motion.
Video Object Detection and Tracking: Methods for detecting and tracking moving objects in video sequences.

Textbooks

1. "Digital Image Processing" by Rafael C. Gonzalez and Richard E. Woods
2. "Image Processing, Analysis, and Machine Vision" by Milan Sonka, Vaclav Hlavac, and Roger Boyle
3. "Fundamentals of Digital Image Processing" by Anil K. Jain
4. "DigitalVideo Processing" by A. M. Tekalp

Department of Electronics and Communication Engineering

Program:B.Tech in Electronics &Communication Engineering	**Year, Semester:** Final YR. 7th SEMESTER
Course Title: Electronic Measurement	**Subject Code:**TIU-UEC-E40#
Contact Hours/Week: 3–0–0 (L–T–P)	**Credit:** 3

Course Objective :

The **course objective** for an Electronics and Instrumentation course is to provide students with a comprehensive understanding of the principles, techniques, and applications of electrical measurements and instrumentation systems. The course aims to:

1. Equip students with the knowledge and skills to operate various electrical measurement instruments, including voltmeters, ammeters, wattmeters, and energy meters.
2. Enable students to measure and analyze electrical components like resistance, inductance, and capacitance using different measurement techniques.
3. Teach students about the design, working, and testing of instrument transformers such as current and potential transformers.
4. Provide hands-on experience with electronic measurement tools like oscilloscopes, multimeters, and spectrum analyzers for precise electrical parameter measurements.
5. Introduce students to transducers, their types, applications, and signal conditioning techniques for real-world measurement systems.
6. Explore advanced applications of instrumentation in emerging technologies, such as

Course Outcomes (COs)

1. **CO1: Understand the fundamental principles of electrical measurements**
   Students will demonstrate an understanding of electrical measurement instruments such as

voltmeters, ammeters, wattmeters, and energy meters, along with their error analysis and usage in practical applications.

2. **CO2: Apply appropriate methods for measuring resistance, inductance, and capacitance**
   Students will be able to measure low, medium, and high resistances, insulation resistance, and use AC bridges to measure inductance and capacitance.
3. **CO3: Analyze the working and performance of instrument transformers**
   Students will understand the design, working principles, and testing of current transformers (CTs) and potential transformers (PTs) and analyze their ratio and phase angle errors.
4. **CO4: Utilize electronic measurement devices and techniques effectively**
   Students will apply electronic voltmeters, multimeters, and oscilloscopes to measure various electrical parameters like time, frequency, and phase angle.
5. **CO5: Design and select transducers for measurement and instrumentation applications**
   Students will select suitable transducers for various applications, including strain gauges, LVDT, piezoelectric transducers, and smart sensors, and understand signal conditioning.
6. **CO6: Explore advanced instrumentation systems and emerging applications**
   Students will gain an understanding of cutting-edge technologies such as biometrics, nano-electromechanical systems, and flexible electronics, and apply instrumentation knowledge to these fields.

COURSE CONTENT:

MODULE 1:	**Electrical Measurements**	**6 Hours**
Standards of Measurement & Errors, Review of indicating and integrating instruments: Voltmeter, Ammeter,Ohmmeter – series & shunt type, Wattmeter, Analog & Digital Multimeter, Megger and Energy meter, Q-meter.		
MODULE 2:	**Measurement of Resistance, Inductance and Capacitance**	**4 Hours**
Measurement of low, medium and high resistances, insulation resistance measurement, AC bridges for inductance and capacitance measurement.		
MODULE 3:	**Instrument Transformers**	**4 Hours**
Current and Potential transformers, ratio and phase angle errors, design considerations and testing.		
MODULE 4:	**Electronic Measurements**	**8 Hours**
Electronic voltmeter, multimeter, wattmeter & energy meter. Time, Frequency and phase angle measurements using CRO; Spectrum & Wave analyzer. Digital counter, frequency meter, voltmeter, multimeter and storage oscilloscope		
MODULE 5:	**Instrumentation**	**8 Hours**
Transducers, classification & selection of transducers, strain gauges, LVDT, inductive & capacitive transducers, piezoelectric and Hall-effect transducers, thermisters, thermocouples, Resistance thermometers, photo-diodes & photo-transistors, encoder type digital transducers, signal conditioning and telemetry, basic concepts of smart sensors and application. Data Acquisition Systems		
MODULE 6:	**Systems applications**	**6 Hours**

Biometrics, Digital scent technology, Three-dimensional integrated circuit, Molecular electronics, Nano electromechanical systems, Electronic nose, Flexible electronics, E-textiles, Memristor, Thermal copper pillar bump, Spintronics.

Textbooks:

1. "Electrical and Electronic Measurements and Instrumentation" by A.K. Sawhney
2. "Principles of Electrical Measurement" by E. O. Doebelin
3. "Modern Electronic Instrumentation and Measurement Techniques" by Albert D. Helfrick and William D. Cooper
4. "Electronic Measurements and Instrumentation" by K. Lal Kishore
5. "Transducers and Instrumentation" by D. V. S. Murthy

Reference Books:

1. "Instrumentation Measurement and Feedback" by C. A. Parr
2. "Electronic Instrumentation" by H.S. Kalsi
3. "Electrical Measurement and Measuring Instruments" by S. K. Bhattacharya
4. "Measurement and Instrumentation Principles" by Alan S. Morris
5. "Introduction to Mechatronics and Measurement Systems" by David G. Alciatore and Michael B. Histand
6. "Principles of Measurement Systems" by John P. Bentley
7. "Sensors and Transducers" by D. Patranabis

Department of Electronics and Communication Engineering

Program: B. Tech. in ECE (BEC)	**Year, Semester:** 4th Yr., 7rd Sem.
Course Title: Power Electronics	**Subject Code:** TIU-UEC-E40#
Contact Hours/Week: 3–0–0 (L–T–P)	**Credit:** 3

COURSE OBJECTIVE :

Enable the student to:

1. Understand the characteristics and applications of power semiconductor devices.
2. Analyze and design power electronic converters.
3. Apply power electronics techniques in real-world applications.

COURSE OUTCOME :

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

CO-1:	Understand the characteristics and operation of semiconductor power devices	K2
CO-2:	Analyze the performance of single-phase controlled rectifiers	K4
CO-3:	Design and evaluate chopper circuits	K3

CO-4:	Understand the principles of single-phase inverters	K2
CO-5:	Explore switching power supplies and AC-AC converters	K4
CO-6:	Apply power electronics techniques to real-world applications	K3

COURSE CONTENT :

MODULE 1:	Characteristics of Semiconductor Power Devices:	**8 Hours**
Thyristor, power MOSFET and IGBT-Treatment should consist of structure, Characteristics, operation, ratings, protections and thermal considerations. Brief introduction to power devices viz. TRIAC, MOS controlled thyristor (MCT), Power Integrated Circuit (PIC) (Smart Power), Triggering/Driver, commutation and snubber circuits for thyristor, power MOSFETs and IGBTs (discrete and IC based). Concept of fast recovery and schottky diodes as freewheeling and feedback diode		
MODULE 2:	**Controlled Rectifiers: Single phase**	**8 Hours**
Study of semi and full bridge converters for R, RL, RLE and level loads. Analysis of load voltage and input current- Derivations of load form factor and ripple factor, Effect of source impedance, Input current Fourier series analysis of input current to derive input supply power factor, displacement factor and harmonic factor		
MODULE 3:	**Choppers:**	**8 Hours**
Quadrant operations of Type A, Type B, Type C, Type D and type E choppers, Control techniques for choppers – TRC and CLC, Detailed analysis of Type A chopper. Step up chopper. Multiphase Chopper.		
MODULE 4:	**Single-phase inverters**	**8 Hours**
Principle of operation of full bridge square wave, quasi-square wave, PWM inverters and comparison of their performance. Driver circuits for above inverters and mathematical analysis of output (Fourier series) voltage and harmonic control at output of inverter (Fourier analysis of output voltage). Filters at the output of inverters, Single phase current source inverter		
MODULE 5:	**Switching Power Supplies**	**8 Hours**
Integer cycle control and other AC to AC converters, Cycloconverters		
MODULE 5:		**8 Hours**
Analysis of fly back, forward converters for SMPS, Resonant converters - need, concept of soft switching, switching trajectory and SOAR, Load resonant converter - series loaded half bridge DC-DC converter. Applications: Power line disturbances, EMI/EMC, power conditioners. Block diagram and configuration of UPS, salient features of UPS, selection of battery and charger ratings, sizing of UPS. Separately excited DC motor drive. P M Stepper motor Drive		
TOTAL LECTURES		**40 Hours****

Books:

1. 1. Muhammad H. Rashid, “ Power electronics”, Prentice Hall of India.
2. 2. A Chakrabarti, “Fundamentals Of Power Electronics and Drives”, Dhanpat Rai & Co.
3. 3. Ned Mohan, Robbins, “Power electronics”, edition III, John Wiley and sons.
4. 4. P. C. Sen., “ Modern Power Electronics”, edition II, Chand & Co.
5. 5. V. R.Moorthi, “Power Electronics”, Oxford University Press.

6. 6. Cyril W., Lander," Power Electronics", edition III, McGraw Hill.
7. E. C. Jordan & K. G. Balmain, "Electromagnetic Fields and Radiating Systems", McGraw Hill

Department of Electronics and Communication Engineering

Program: B. Tech. in ECE (BEC)	**Year, Semester:** 4th Yr., 7rd Sem.
Course Title:Adaptive Signal Processing (Elective – III)	**Subject Code:** TIU-UEC-E407B
Contact Hours/Week: 3–0–0 (L–T–P)	**Credit:** 3

COURSE OBJECTIVE :

Enable the student to:

1. **To introduce the fundamental concepts of** adaptive filtering.
2. Understand the LMS algorithm (real and complex) and analyze its convergence.
3. Apply vector space concepts to adaptive filtering techniques.

COURSE OUTCOME :

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

CO-1:	Understand the fundamentals of adaptive filtering and estimation.	K2
CO-2:	Analyze the Wiener filter and LMS algorithm	K4
CO-3:	Explore LMS algorithm variants and frequency domain adaptive filters	K3
CO-4:	Apply vector space concepts to stochastic adaptive filtering	K4
CO-5:	Develop and analyze recursive least squares (RLS) filters	K4
CO-6:	Apply adaptive filtering techniques to real-world problems	K2

COURSE CONTENT :

MODULE 1:		**8 Hours**
General concept of adaptive filtering and estimation, applications and motivation, Review of probability, random variables and stationary random processes, Correlation structures, properties of correlation matrices		
MODULE 2:		**8 Hours**
Optimal FIR (Wiener) filter, Method of steepest descent, extension to complex valued The LMS algorithm (real, complex), convergence analysis, weight error correlation matrix, excess mean square error and mis-adjustment		
MODULE 3:		**8 Hours**

Variants of the LMS algorithm: the sign LMS family, normalized LMS algorithm, block LMS and FFT based realization, frequency domain adaptive filters, Sub-band adaptive filtering. Signal space concepts - introduction to finite dimensional vector space theory, subspace, basis, dimension, linear operators, rank and nullity, inner product space, orthogonality, Gram-Schmidt orthogonalization, concepts of orthogonal projection,orthogonal decomposition of vector spaces.		
MODULE 4:		**8 Hours**
Vector space of random variables, correlation as inner product, forward and backward projections, Stochastic lattice filters, recursive updating of forward and backward prediction errors, relationship with AR modeling, joint process estimator, gradient adaptive lattice.		
MODULE 5:		**8 Hours**
Introduction to recursive least squares (RLS), vector space formulation of RLS estimation, pseudo-inverse of a matrix, time updating of inner products, development of RLS lattice filters, RLS transversal adaptive filters. Advanced topics: affine projection and subspace based adaptive filters, partial update algorithms, QR decomposition and systolic array		
TOTAL LECTURES		**40 Hours****

Books:

1. S. Haykin, “Adaptive Filter Theory”, Prentice Hall, 1986.
2. C. Widrow and S. D. Stearns, “Adaptive Signal Processing”, Prentice Hall, 1984.

Department of Electronics and Communication Engineering

Program:B.Tech in Electronics &Communication Engineering	**Year, Semester:** Final YR. 7th SEMESTER
Course Title: Embedded System	**Subject Code: TIU-UEC-S40#**
Contact Hours/Week: 3–0–0 (L–T–P)	**Credit:** 3

Course Objective :

The **course objective** is to provide students with foundational knowledge and practical skills in embedded systems design. The course covers the architecture of microcontrollers, interfacing techniques, real-time programming, and the use of embedded software and hardware tools. Students will learn to design, develop, and troubleshoot embedded systems with a focus on performance, power efficiency, and application-specific requirements

CO-1:	Understand the basic concepts of embedded systems, including architecture, microcontroller cores, and memory types.	K1
CO-2:	Apply knowledge of interfacing techniques between analog and digital components in embedded systems.	K3
CO-3:	Develop real-time applications and software for embedded systems using real-time programming languages.	K4
CO-4:	Design and interface embedded systems with external peripherals and user interfaces.	K4
CO-5:	Evaluate and optimize the design of embedded systems based on performance, power, and cost tradeoffs.	K3
CO-6:	Use embedded system design tools and follow a structured development process for building embedded applications.	K2

COURSE CONTENT:

MODULE 1:	**Introduction to Embedded Systems and Microcontroller**	**9 Hours**

Introduction to Embedded Systems

- Definition and concepts of embedded systems
- Characteristics of embedded systems
- Examples of embedded systems (Automotive, Industrial, Consumer Electronics)
- Real-time systems

Microcontroller Architecture

- Basic microcontroller architecture and core features
- Introduction to popular microcontroller cores (ARM, PIC, AVR)
- Embedded memories (ROM, RAM, Flash, EEPROM)
- Memory management and types of memory in embedded systems

Interfacing Between Analog and Digital Blocks

- ADC and DAC operation
- Signal conditioning techniques (amplification, filtering, noise reduction)
- Introduction to digital signal processing (DSP) in embedded systems

MODULE 2:	**Subsystem Interfacing, External System Communication, and User Interfaces**	**9 Hours**

Subsystem Interfacing

- Interfacing sensors and actuators with microcontrollers
- Communication protocols: I2C, SPI, UART
- Digital and analog sensors interfacing

Interfacing with External Systems

- Wired communication (RS232, USB)
- Wireless communication (Bluetooth, Wi-Fi)
- Data transmission to/from external systems (PCs, other embedded devices)

User Interface Design

- Human-machine interface (HMI) principles
- Input/output interfacing (buttons, LEDs, touchscreens)
- Display interfacing (LCD, OLED)

MODULE 3:	**Design Considerations and Real-Time Software for Embedded Systems**	**9 Hours**

Design Considerations

- Design tradeoffs: Performance vs power consumption, cost vs complexity
- Thermal considerations and process compatibility
- Reliability and durability in various environments (industrial, automotive, medical)

Real-Time Systems

- Characteristics of real-time systems
- Real-time programming languages: C, C++
- Interrupt handling and scheduling in real-time applications

Real-Time Operating Systems (RTOS)

- Introduction to RTOS
- Task scheduling and time management
- Resource management and synchronization in embedded systems
- Application of RTOS (FreeRTOS, VxWorks)

MODULE 4:	**Embedded System Design Tools, Development Process, and Applications**	**9 Hours**

Embedded System Design Tools

- Hardware Description Languages (HDLs): Verilog, VHDL
- Simulation tools and debugging techniques (Keil, MPLAB, Proteus)
- IDEs and compilers for embedded systems (IAR Embedded Workbench, GCC)

Embedded System Development Process

- Software development life cycle for embedded systems
- Verification, validation, and testing techniques
- Prototyping and iterative design

Emerging Applications of Embedded Systems

- Applications in automotive, robotics, and IoT
- Medical and industrial embedded systems
- Future trends in embedded systems (AI, 5G, etc.)

Textbooks

1. "Embedded Systems: Introduction to ARM Cortex-M Microcontrollers" by Jonathan W. Valvano
2. "Embedded Systems: Architecture, Programming and Design" by Raj Kamal
3. "Embedded Systems Design: A Unified Hardware/Software Introduction" by Frank Vahid and Tony Givargis
4. "Real-Time Systems: Design and Analysis" by Phillip A. Laplante
5. "Embedded Systems: A Contemporary Design Tool" by James K. Peckol

Reference Books

1. "Embedded Systems: Principles and Practice" by David E. Simon
2. "The Art of Designing Embedded Systems" by Jack Ganssle
3. "Programming Embedded Systems in C and C++" by Michael Barr and Anthony Massa
4. "Principles of Embedded Systems Design" by Steve Heath
5. "Introduction to Mechatronics and Measurement Systems" by David G. Alciatore and Michael B. Histand

Department of Electronics and Communication Engineering

Program: B.Tech. in ECE	**Year, Semester: 4th**, 7th.
Course Title: Object-Oriented Programming	**Subject Code:**TIU-UES-E40#
Contact Hours/Week: 2–0–0	**Credit:** 2

COURSE OBJECTIVE:

Enable the student to:

1. Be introduced with the fundamentals of Object-Oriented Programming (OOP) using Java.
2. Learn about language specific features of the Java programming language.
3. Be introduced with Python programming for data analysis, machine learning, and data visualization.
4. Be equipped with advanced skills in machine learning and computer vision using Python.

COURSE OUTCOME:

On completion of the course, the student will be able:

CO-1	Understand fundamental concepts of object oriented programming using Java	K2
CO-2	Apply the concepts of execution handling, Java collection framework and File I/O operation of Java.	K3
CO-3	Interpret multithread and concurrency, Java networking and UI design features of Java.	K3
CO-4	Analyze python programming for data analysis, machine learning, and data visualization.	K4
CO-5	Apply the knowledge of python programming for advanced machine learning techniques.	K3
CO-6	Demonstrate computer vision with mediapipe based on the knowledge of python programming	K3

COURSE CONTENT:

MODULE 1:	**Object-Oriented Programming with Java - Basics**	**6 Hours**
Introduction to OOP Concepts: Classes and Objects, Encapsulation and Abstraction, Inheritance, Polymorphism Java Basics: Setting up Java Environment, JVM – JRE, Code compilation and execution, Basic Syntax, Data Types,'this'/ 'new' keyword, memory-management, garbage collector, Static and Final Keywords, Control Structures (if-else, switch-cases, loops). Java Classes and Objects: Creating Classes and Objects, Constructors, Method Overloading. Inheritance and Polymorphism: Super-classes and Subclasses, Overriding Methods, Abstract Classes and Interfaces, Inner Classes, Anonymous Classes		
MODULE 2:	**Language specific features of Java**	**6 Hours**
Execution Handling: Try-Catch-Finally Block, Exception class, Inbuilt exception, Custom Exceptions Java Collections Framework:List, Set, Map Interfaces, ArrayList, HashSet, HashMap, Implementations File I/O in Java:Reading from and Writing to Files Multithreading and Concurrency: Creating Threads: Synchronization, Deadlocks Java Networking:Working with Sockets, Client-Server Communication, RMI Java Database Connectivity (JDBC):Connecting to Databases, Executing SQL Queries UI Design: Java Swing, JavaFX Testing: Unit Testing with JUnit		
MODULE 3:	**Python Programming for Data Analysis and Machine Learning**	**6 Hours**

Python Basics:Python Syntax, Data Structures (Lists, Tuples, Dictionaries), Functions and Modules Data Analysis with Pandas:DataFrames and Series, Data Cleaning and Preparation, Aggregation and Grouping. Numerical Computations with NumPy:Arrays and Matrices, Mathematical Operations Data Visualization with Matplotlib:Basic Plotting, Customizing Plots, Subplots and Layouts. Introduction to Machine Learning with Scikit-Learn:Supervised and Unsupervised Learning, Model Training and Evaluation, Feature Engineering		
MODULE 4:	**Advanced Python for Machine Learning and Computer Vision**	**6 Hours**
Advanced Machine Learning with Scikit-Learn:Hyperparameter Tuning, Ensemble Methods Deep Learning with YOLO (You Only Look Once):Introduction to YOLO, Object Detection, Implementing YOLO with Python Computer Vision with MediaPipe:Overview of MediaPipe, Hand and Face Detection Time Series Analysis and Forecasting:Time Series Data Handling, ARIMA and LSTM Models		
TOTAL LAB HOURS		**36 Hours**

Books:

James Gosling, The Java Programming Language, 3rd Edison,Pearson Education

Mark Lutz, Learning Python: Powerful Object-Oriented Programming, 5/E Paperback, O'Reilly

Supplementary Reading:

Dr. R. Nageswara Rao, Machine Learning in Data Science Using Python, Dreamtech Press

James Gosling, The Java Language Specification (Java Series), 1st edition, Addison Wesley

Department of Electronics and Communication Engineering

Program: B. Tech. in ECE (BEC)	**Year, Semester:** 4th Yr., 7rd Sem.
Course Title:Artificial Intelligence and Soft Computing	**Subject Code:** TIU-UCS-E427
Contact Hours/Week: 3–0–0 (L–T–P)	**Credit:** 3

COURSE OBJECTIVE:

Enable the student to:

1. To introduce the fundamental concepts of **Artificial Intelligence**
2. Understand the Fuzzy sets and applications.
3. Apply computing techniques for AI optimization

COURSE OUTCOME:

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

CO-1:	Understand the various searching techniques, constraint satisfaction problem and example problems - game playing techniques.	K2
CO-2:	Apply these techniques in applications which involve perception, reasoning and learning.	K4
CO-3:	Understand Fuzzy sets and applications.	K3
CO-4:	Understand different neural network algorithms.	K4
CO-5:	Develop and evaluate neural network architectures	K4
CO-6:	Apply evolutionary computing techniques for AI optimization	K2

COURSE CONTENT:

MODULE 1:	**Introduction**	**8 Hours**
Agents – Problem formulation – uninformed search strategies – heuristics - informed search strategies – constraint satisfaction Logical agents – propositional logic – inferences – first-order logic – inferences in first order logic – forward chaining – backward chaining - unification - resolution planning with state-space search – partial-order planning – planning graphs – planning and acting in the real world.		
MODULE 2:	**Soft Computing**	**8 Hours**
Fuzzy Sets and Applications: Crisp sets, definition, operations, and properties. Fuzzy sets, introduction, types of fuzzy sets, membership functions, some definitions, operations, examples, measures of fuzziness. Fuzzy logic controller, Mamdani approach, Takagi-Sugeno approach, examples, advantages and disadvantages of FLC. Fuzzy clustering, methods, Fuzzy C-Means Clustering and Entropy based clustering, examples.		
MODULE 3:	**Neural networks and Applications**	**8 Hours**
Neurons, transfer functions, layers of neurons, static & dynamic neural networks, types of training of neural networks.		
MODULE 4:	**Multi-Layer Feed Forward Neural Network,**	**8 Hours**
forward computation and training using Back-propagation algorithm, example, steps to be followed for designing a suitable neural network, advantages and disadvantages of NN.		
MODULE 5:	**Radial Basis Function Network,**	**8 Hours**
forward computation and training using Back-propagation algorithm.Introduction to Self-organizing Map, Recurrent Neural Network. Evolutionary Computation techniques and Applications: Deficiencies of Classical traditional techniques, Algorithmic descriptions of a few evolutionary algorithms like Genetic Algorithm, Particle Swarm Optimization.		
TOTAL LECTURES		**40 Hours****

Books:

1. A. Konar, “Artificial Intelligence and Soft Computing”, CRC Press
2. S. Haykin, “Neural Networks”, Pearson
3. Ritch & Knight, “Artificial Intelligence”, Tata McGraw Hill
4. D. K. Pratihar, “Soft Computing, Fundamentals and Applications”, Narosa

Department of Electronics & Communication Engineering

Program: B.Tech. in ECE	**Year, Semester:** 4th, 7th.
Course Title:RF & Microwave Engineering Lab	**Subject Code:**TIU-UEC-L405
Contact Hours/Week: 0–0–3	**Credit:** 1.5

COURSE OBJECTIVE:

Enable the student to:

6. Develop a fundamental understanding of RF and microwave engineering principles.
7. Equip with practical skills in RF and microwave measurement techniques.
8. Analyze and design RF and microwave circuits for real-world applications.
9. Explore the applications of RF and microwave technology in communication and radar systems.

COURSE OUTCOME:

On completion of the course, the student will be able:

CO-1	Understand Fundamental Concepts:Describe the principles and working of RF and microwave components, including transmission lines, waveguides, and antennas.	K2
CO-2	Apply Theoretical Knowledge: Perform experiments to measure and analyze key parameters such as VSWR, reflection coefficient, and impedance matching in RF circuits.	K3
CO-3	Analyze System Performance: Interpret S-parameters and other performance characteristics of microwave devices such as circulators, directional couplers, and filters.	K4
CO-4	Design and Implement RF Circuits: Develop and test simple RF/microwave circuits using simulation and hardware tools, ensuring optimal performance.	K3
CO-5	Evaluate Measurement Techniques: Compare different microwave measurement techniques using network analyzers, spectrum analyzers, and power meters to determine system efficiency.	K4
CO-6	Demonstrate Problem-Solving Skills: Troubleshoot and optimize microwave circuits and systems based on experimental data and theoretical calculations.	K4

COURSE CONTENT:

MODULE 1:	**MICROWAVE SOURCES AND SEMICONDUCTOR DEVICES**	**15 Hours**
Study of Reflex Klystron characteristics, Study of Gunn diode characteristics		
MODULE 2:	**MICROWAVE MEASUREMENT TECHNIQUES**	**15 Hours**
Measurement of frequency and wavelength of a microwave signal, Measurement of VSWR and reflection coefficient of a standing wave pattern in a waveguide		

MODULE 3:	**MICROWAVE PASSIVE COMPONENTS**	**12 Hours**
Study of Directional Coupler characteristics, Measurement of Unknown Impedance		
MODULE 4:	**ANTENNAS AND RADIATION PATTERNS**	**6 Hours**
Measurement of Radiation Pattern of Horn Antenna		
TOTAL LAB HOURS		**48 Hours**

Books:

1. D. M. Pozar, "Microwave Engineering", Wiley.
2. R.E. Collin, "Microwave Circuits", McGraw Hill
3. S. Y. Liao, "Microwave Devices & Circuits", Prentice Hall.
4. K. C. Gupta, "Microwaves", New Age.
5. M. Mitra, "Microwave Engineering", Dhanpat Rai.
6. G. S. N. Raju, "Microwave Engineering", I. K. International.

Department of Electronics & Communication Engineering

Program: B. Tech. in ECE	**Year, Semester:** 4^{th} Yr., 7th Sem.
Course Title: Project 1	**Subject Code:** TIU- UEC- P401
Contact Hours/Week: 0–0–4 (L–T–P)	**Credit:** 4

Course Objectives:

- To develop problem-solving skills through research and practical implementation.
- To enhance technical knowledge in real-world applications.
- To improve project management, teamwork, and communication skills.
- To document and present the project findings effectively.

COURSE OUTCOME:

CO-1	Identify and define an engineering problem through literature survey and industry requirements.	**K2**
CO-2	Formulate project objectives, methodology, and work plan.	**K3**
CO-3	Design, develop, and implement innovative solutions using appropriate tools and techniques.	**K3**
CO-4	Analyze and evaluate project outcomes using experimental results, simulations, or prototypes.	**K4**
CO-5	Prepare technical documentation, research reports, and project presentations.	**K3**
CO-6	Demonstrate teamwork, ethical practices, and project management skills.	**K2**

COURSE CONTENT:

Phase 1: Project Proposal & Planning
Phase 2: System Design & Development
Phase 3: Implementation & Experimentation
Phase 4: Report Writing & Final Presentation