Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Name of the Faculty: Science & Technology

NEP 2020 Compliant Curriculum Syllabus

ELECTRONICS & TELECOMMUNICATIONENGINEERING

Name of the Course: Third Year B. Tech (Sem.– V & VI)

(Syllabus to be implemented from w.e.f. AY-2025-26)

PUNYASHLOK AHILYADEVI HOLKARSOLAPUR UNIVERSITY, SOLAPUR

FACULTY OF SCIENCE& TECHNOLOGY

Electronics & Telecommunication Engineering

Programme Educational Objectives and Outcomes

A. Program Educational Objectives

1. To make students competent for professional career in Electronics & allied fields.
2. To build strong fundamental knowledge amongst student to pursue higher education and continue professional development in Electronics & other fields
3. To imbibe professional ethics, develop team spirit and effective communication skills to be successful leaders and managers with a holistic approach.
4. To nurture students to be sensitive to ethical, societal & environmental issues while conducting their professional work.

B. Program Outcomes

Electronics & Telecommunication Engineering Graduate will be able to –

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader indiverse teams, and in multidisciplinary settings.
10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance**: Demonstrate knowledge and understanding of engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

C. Program Specific Outcomes

1. **Solid foundation** : Graduates will be able to attain a **solid foundation** in Electronics and Tele-Communication Engineering with an ability to function in multidisciplinary environment.
2. **Techniques and Skills**: Graduates will be able to use **techniques and skills** to design, analyze,synthesize, and simulate Electronics and Communication Engineering components and systems.
3. **Developing Programs:** Graduate will be capable of **developing programs** in Assembly, Highlevel and HDL languages using contemporary tools for software development.

PUNYASHLOK AHILYADEVI HOLKAR SOLAPUR UNIVERSITY, SOLAPUR

FACULTY OF SCIENCE & TECHNOLOGY

T. Y. B. Tech (Electronics & Telecommunication Engineering)

NEP 2020 Compliant Curriculum With effect from 2025-2026

Semester –V

Distribution	*Course Code*	*Name of the Course*	*Engagement Hours*			*Credits*	*FA*	*SA*			*Total*
			L	*T*	*P*		*ESE*	*ISE*	*ICA*	*OE/ POE*	
PCC	ENTPCC-07	Electromagnetic Field Theory	3			03	70	30			100
PCC	ENTPCC-08	Digital Signal Processing	3		2	04	70	30	25		125
PCC	ENTPCC-09	Microcontrollers andApplications	3		2	04	70	30	25	25	150
PEC	ENTPEC-01	Programme Elective Course-I	3		2	04	70	30	25		125
AEC	AEC-02	Creativity and Design Thinking	1		2	02	50*		25		75
OE	OE-03	Interdisciplinary MiniProject	1		2	02			25	25	50
MDM	ENTMDM-03	MD Minor-III	2		2	03	70	30	25		125
		Total	**16**		**12**	**22**	**400**	**150**	**150**	**50**	**750**

*** MCQ examinations**

BSC- Basic Science Course ESC- Engineering Science Course,

PCC- Programme Core Course, AEC- Ability Enhancement Course,

IKS- Indian Knowledge System, CC- Co-curricular Course,

VSEC-Vocational and Skill Enhancement Course

PUNYASHLOK AHILYADEVI HOLKAR SOLAPUR UNIVERSITY, SOLAPUR

FACULTY OF SCIENCE & TECHNOLOGY

T. Y. B. Tech (Electronics & Telecommunication Engineering)

NEP 2020 Compliant Curriculum With effect from 2025-2026

Semester –VI

Distribution	*Course Code*	*Name of the Course*	*Engagement Hours*			*Credits*	*FA*	*SA*			*Total*
			L	*T*	*P*		*ESE*	*ISE*	*ICA*	*OE/ POE*	
PCC	ENTPCC-10	Advanced Mobile Communication	3			03	70	30			100
PCC	ENTPCC-11	Electronics System Design	2		2	03	70	30	25	25	150
PCC	ENTPCC-12	Optical Communication	3			03	70	30	25		125
PEC	ENTPEC-02	Programme Elective-II	3		2	04	70	30	25	25	150
PEC	ENTPEC-03	Programme Elective-III	3		2	04	70	30	25		125
SEC	ENTSEC-02	Hardware Mini Project			4	02			25	50	75
MDM	ENTMDM-04	MD Minor-IV	2		2	03	70	30	25		125
		Total	**16**		**12**	**22**	**420**	**180**	**150**	**100**	**850**

BSC- Basic Science Course ESC- Engineering Science Course,

PCC- Programme Core Course, AEC- Ability Enhancement Course,

IKS- Indian Knowledge System CC- Co-curricular Courses ,

VSEC-Vocational and Skill Enhancement Course

Basket of Program Elective Course (PEC)

PEC/Sem	Course code and name
ENTPEC - 01/ V	ENTPEC – 01A: Digital Logic Design ENTPEC – 01B: Fundamentals of Image Processing
ENTPEC - 02/ VI	ENTPEC – 02A: VLSI Design ENTPEC – 02B: Digital Image Processing
ENTPEC - 03/ VI	ENTPEC – 03A: Embedded Systems ENTPEC – 03B Pattern Recognition
ENTPEC - 04/ VII OR	ENTPEC – 04A: CMOS VLSI ENTPEC – 04B: Computer Vision
ENTPEC - 04/ VII	MOOC Courses offered by NPTEL/SWAYAM ENTPEC – 04C : <As per the list provided by BoS>
ENTPEC - 05/ VIII OR	ENTPEC – 05A: Advanced Embedded System ENTPEC – 05B: Image Processing Applications
ENTPEC - 05/ VIII	MOOC Courses offered by NPTEL/SWAYAM ENTPEC – 05C: <As per the list provided by BoS>

Basket of Multidisciplinary Minor (MDM)

A) Multidisciplinary Minor in "Controllers and Applications"

Semester	Course Code	Course Title
III	ENTMDM-01A	Digital Techniques
IV	ENTMDM-02A	8051 Microcontroller
V	ENTMDM-03A	PIC Microcontroller
VI	ENTMDM-04A	Advanced Microcontrollers
VII	ENTMDM-05A	Programmable Logic Controller

B) Multidisciplinary Minor in "Internet of Things"

Semester	Course Code	Course Title
III	ENTMDM-01B	Sensor Technology
IV	ENTMDM-02B	Fundamentals of IoT
V	ENTMDM-03B	IoT Networks and Security
VI	ENTMDM-04B	Industrial IoT
VII	ENTMDM-05B	IoT Cloud Platform

Multidisciplinary Minors are for the students of Other Program

Semester V

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
T. Y. B. Tech (Electronics & Telecommunication Engineering)

Semester-V (as per NEP) w.e.f. 2025-26

ENTPCC- 07 : Electromagnetic Field Theory

Teaching Scheme:
Lectures – 3 Hours/week, 3 credits

Examination Scheme:
ESE – 70 Marks
ISE – 30 Marks

Course Objectives:

1. To learn basic coordinate system, significance of divergence, gradient, curl and its applications to EM Waves.
2. To familiarize with the different concepts of electrostatic and magneto static fields.
3. To describe Maxwell's equations for different fields.
4. To expose the students to the ideas of EM waves and propagation through different media.

Course Outcomes: At the end of this course, student will be able to –

1. Apply divergence, gradient, curl to EM waves for different coordinate systems.
2. Use Electrostatic laws to calculate various parameters of the Electrostatic field
3. Determine various parameters of magneto static fields using Magnetostatic laws.
4. Apply Maxwell's equations for static, Time varying and Harmonic fields.
5. Understand EM waves and propagation through different media.
6. Illustrate transmission line parameters using Smith chart.

Section – I

Unit 1: Vector calculus **(06)**

Scalars and vectors, vector algebra, vector differentiation and integration, coordinate systems and transformation.

Unit2: Electrostatics **(08)**

Coulomb's law & electric field intensity, electric field intensity for different charge configurations, Electric flux and flux density, Gauss's law and its applications, divergence theorem, boundary conditions for electrostatic field.

Unit 3: Static magnetic field **(07)**

Biot Savart's law and its applications, Ampere's circuital law and its applications, Stroke's theorem, magnetic flux density, boundary conditions for magneto static field

Section – II

Unit 4: Maxwell's equations **(06)**

Displacement current and conduction current density, Maxwell's equations in integral form and point form for static case, time varying field, harmonically varying field.

Unit 5: Electromagnetic wave propagation **(07)**

Helmholtz Wave equation, Wave propagation in lossless media, Conductor, and Dielectric media. Wave equation for conducting and dielectric media, modification in wave equations for sinusoidal time variations, skin effect, Poynting theorem.

Unit 6: Transmission lines **(08)**

Transmission line sections as circuit elements, Transmission line equations using circuit theory, transmission line primary constant (R,L,C,G) and secondary (Z0, γ) constant, reflection coefficient, transmission coefficient, VSWR, Smith Chart and solution of transmission line problems using Smith Chart.

- **Text Books:**

1. Electromagnetic Engineering, William Hyte, 7th Edition, Tata McGraw Hill
2. Electromagnetic Waves, R.K. Shevgaonkar, Tata McGraw Hill
3. Electromagnetics by John D. Kraus - McGraw Hill Third Edition
4. Electromagnetic field theory & Transmission Lines, GSN Raju, Pearson Education

- **Reference Books:**

1. Electromagnetic Schaum's outline series by J.A.Edminister - Tata McGraw Hill
2. Problems and solutions in electromagnetic, William Hyte, Tata McGraw Hill
3. Electromagnetic Waves and Transmission Lines, Rao, Prentice Hall India Publications
4. Applied Electromagnetics by F. Ulaby (2001 Media Edition) – PHI

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
T. Y. B. Tech (Electronics & Telecommunication Engineering)

Semester-V (as per NEP) w.e.f. 2025-26

ENTPCC- 08 : Digital Signal Processing

Teaching Scheme:
Lectures – 3 Hours/week, 3 credits
Practicals –2 Hours/week, 1 credit

Examination Scheme:
ESE – 70 Marks
ISE – 30 Marks
ICA– 25Maks

Course Objectives:

1. To provide a foundational understanding of Digital Signal Processing principles and its significance in applications.
2. To introduce mathematical tools such as Discrete Fourier Transform and Fast Fourier Transform for analyzing and processing signals.
3. To develop skills in the design and implementation of digital filters (FIR and IIR) for various signal processing applications.
4. To equip students with knowledge of efficient computational methods and system realization techniques for DSP systems.
5. To explore the practical applications of DSP in fields like audio processing, telecommunications, radar, and biomedical engineering.

Course Outcomes: At the end of this course, student will be able to –

1. **Describe** the core concepts of DSP, including stability, correlation, and digital transfer functions.
2. **Apply** DFT and FFT techniques for frequency domain analysis and filtering of signals.
3. **Analyze** and **solve** problems related to long sequence filtering using overlap-save and overlap-add methods.
4. **Design** and **implement** FIR and IIR filters using various techniques
5. **Develop** realization structures for FIR and IIR filters using direct, cascade, and parallel forms.
6. **Evaluate** DSP applications in focusing on audio, telecommunication, and radar systems.

Course Prerequisite:

Student shall have knowledge of signals and system, basic knowledge of mathematics and transforming tools like Fourier transform, Laplace and Z-transform.

Section - I

Unit 1: Introduction to DSP Systems (03 Hrs.)

Overview of DSP and its industry applications, Basic elements of DSP and its requirements, advantages of Digital over Analog signal processing, correlation, digital transfer function, Stability considerations in DSP

Unit 2: Discrete Fourier Transform (06 Hrs.)

Frequency domain sampling and reconstruction of discrete-time signals, Properties of DFT and relation between DFT and Z transform, computation of DFT & IDFT, DFT as a linear transformation, circular convolution

Unit 3: Signal Filtering and Analysis (06 Hrs.)

Linear filtering using DFT, Long sequence filtering methods: Overlap-Save Method & Overlap-Add Method, Frequency analysis of signals using DFT

Unit 4: FFT Algorithm (06 Hrs.)

Radix-2 FFT algorithm for the computation of DFT and IDFT, decimation in time (DIT) and decimation in frequency (DIF) algorithms.

Section II:

Unit 5: FIR Filter Design (06 Hrs.)

Introduction to FIR filters, Gibbs phenomenon, Linear phase conditions: impulse and phase and group delays, design of FIR filters using fourier series method and windows techniques, windows as rectangular, trigular, hanning, hamming, blackmann

Unit 6: IIR Filter Design (06 Hrs.)

Concept of analog filter design, Characteristic of Butterworth filter, IIR Filter Design by Impulse Invariance, IIR Filter Design by Bilinear Transformation, warping effect. (problems on filter design up to 3rd order only),

Unit 7: Realization of DSP Systems (06 Hrs.)

Realization techniques for discrete-time systems: **FIR Filters**: Direct form, cascade form Structure **IIR Filters**: Direct form, cascade form, parallel form, Finite word length effect in IIR filter design

Unit 8: DSP Applications **(03 Hrs.)**

Applications of DSP in : Audio processing, Telecommunications, Radar and signal processing, Biomedical Signal Processing

---

Internal Continuous Assessment:

ICA consists of Minimum 08 experiments performed from given list.

Experiments with Course Outcomes:

1. **Signal Generation and Visualization (CO1)**
    - **Objective**: Generate and visualize basic signals, including sine, cosine, sinc, exponential, unit impulse, unit step, and unit ramp, in the time domain.
    -
2. **DFT and IDFT Computation (CO2)**
    - **Objective**: Compute the DFT and IDFT of a given discrete-time signal and verify Parseval's theorem.
3. **Circular Convolution Using DFT (CO2)**
    - **Objective**: Perform circular convolution using DFT and compare the results with linear convolution.
4. **Overlap-Save Method (CO3)**
    - **Objective**: Implement the overlap-save method to filter long data sequences efficiently.
5. **Overlap-Add Method (CO3)**
    - **Objective**: Implement the overlap-add method for efficient filtering of long data sequences.
6. **FIR Filter Design Using Fourier Series Method (CO4)**
    - **Objective**: Design FIR filters using the Fourier series method and evaluate their magnitude and phase responses.
7. **FIR Filter Design Using Windows (CO4)**
    - **Objective**: Design FIR filters using windows techniques and evaluate their magnitude and phase responses.
8. **Impulse Invariant IIR Filter Design (CO4)**
    - **Objective**: Design a Butterworth IIR filter using the impulse invariant method and analyze its frequency response.
9. **Butterworth IIR Filter Design (CO4)**
    - **Objective**: Design a Butterworth IIR filter using the bilinear transformation method and analyze its frequency response.

10. **Frequency Analysis of Real Signals (CO6)**:
    - **Objective**: Perform frequency analysis of real-world signals (e.g., audio, ECG or EEG) using FFT.

Text Books:

1. Digital Signal Processing – Principles, Algorithms and Applications John G Proakis-4th edition, Pearson Education
2. Digital Signal Processing by S Salivahanan, A Vallavaraj & C Gnanapriya –2nd edition, TMH.
3. Discrete time signal Processing A.V. Oppenheim & R.W. Schafer.- Low price edition, John Wiley

Reference Books:

1. Digital Signal Processing Ramesh Babu -4th Edition, Scientic Publication.
2. Digital Signal Processing Dr. Shaila D. Apte, Second edition, Wiley India.
3. Essentials of Digital Signal Processing using MATLAB Vinay K. Ingle & John G. Proakis, Cengage Learning, 2012
4. Digital Signal Processing- A Practical Approach, E. C. Ifleachor and B. W. Jervis, Second Edition, Pearson education.
5. Theory and Application of Digital Signal Processing Digital Rabiner & Gold- First edition, Prentice Hall
6. Digital Signal Processing S. Palani & D. Kalaiyarasi, Ane's Student Edition, Ane Books Pvt. Ltd New Delhi

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
T. Y. B. Tech (Electronics & Telecommunication Engineering)

Semester-V (as per NEP) w.e.f. 2025-26

ENTPCC- 09 : Microcontrollers and Applications

Teaching Scheme:
Lectures – 3 Hours/week, 3 credits
Practicals –2 Hours/week, 1 credit

Examination Scheme:
ESE – 70 Marks
ISE – 30 Marks
ICA– 25Maks
POE**–25Maks**

This course introduces Basics of microcontroller's theory which includes internal details of MCS51 series , PIC Microcontroller and Arduino Interfacing for various Sensors. The course also introduces Assembly level as well Embedded C Level programming aspects of both microcontrollers, Memory interfacing and Interfacing various I/O devices

---

Course Prerequisite:

Student shall have knowledge of Digital Electronics.

Course Objectives:

1. To provide an introduction to microcontroller families and details of MCS51.
2. To describe core features and peripheral features of Microcontrollers.
3. To explain and practice assembly language and Embedded C programming techniques.
4. To demonstrate hardware interfacing for I/O devices.

Course Outcomes:

At the end of this course, Students will be able to,

1. Differentiate between CISC and RISC Microcontroller architectures.
2. Describe the fundamental features and operation of 8051 microcontroller.
3. Develop an application program for microcontroller hardware interfacing using assembly and C languages.
4. Describe the architecture, memory organization and features of PIC16f877A.
5. Explain the various core and peripheral features of PIC16f877A.
6. Develop programming for Arduino to interface with various sensors.

Section-I

Unit 1: Introduction of Microcontroller (04)

Introduction, Microprocessor and Microcontrollers, CISC & RISC Microcontroller, Harvard and von Neumann architecture, Software development cycle for microcontroller

Unit 2: The 8051 Architecture and Instructions (08)

8051 Microcontroller Hardware, Addressing modes, Instruction set ,Input / Output Pins, External Memory, Counters and Timers, Serial Data Input/ output, interrupts.

Unit 3: Programming Microcontroller (8051) (09)

Programming in assembly and C for Input/ Output Ports, Serial Port Programming, Timer Programming and Interrupt Programming. Programs for Interfacing Switches, LED, Relay, Buzzer, LCD display, Matrix keyboard, 7-Segment display.

Section-II

Unit 4: PIC16F877A Architectural and Features (09)

Introduction, Architecture, features, Functional pin description, various registers, Program memory and data memory organization, Input / output ports, Interrupts, various kinds of RESET, Configuration word and Instruction Set.

Unit 5: PIC 16F877A Microcontroller Core Features (07)

Timers, Capture/ compare / PWM (CCP) Modules in PIC 16F877A, Internal ADC, Watchdog Timer. Universal Synchronous Asynchronous Receiver Transmitter (USART) module.

Unit 6: Arduino Interfacing for various Sensors (05)

Introduction to Arduino, Arduino IDE setup and installation. Interfacing of LED, Ultrasonic Sensor, PIR Sensor, IR Sensor and Temperature Sensor.

- **Internal Continuous Assessment (ICA):**

ICA consists of minimum Eight Practical based upon above curriculum. Minimum eight experiments based on 8051(Four Experiments), PIC 16F877A (Two Experiments) and Arduino (Two Experiments). Students should be introduced to assembly and embedded C programming and minimum two practical's should be taken using embedded C programming

- **Suggested List of Practical's:**
  1. Arithmetic and Logic operations
  2. Interfacing of Switches, LEDs and Buzzer.
  3. Interfacing of Matrix Keyboard
  4. Interfacing of LCD Display.
  5. Use of Timer for generation of time delays
  6. Use of Timer as counter.
  7. Interfacing of Stepper motor.
  8. Speed control of DC Motor using PWM.
  9. Use of ADC of PIC Microcontrollers.
  10. Use of Interrupts for any Application.
  11. Use of CCP Module of PIC Controller
  12. Serial communication.
  13. Interface sensors like Ultrasonic Sensor and PIR Sensor with Arduino.
  14. Interface sensors like IR Sensor and Temperature Sensor with Arduino.
  15. Any one Industrial application using Microcontroller.

- **Text Books:**

1. The 8051 Microcontroller Architecture, programming and Applications by Kenneth Ayala Penram International (Third Edition)
2. The 8051 Microcontroller and Embedded systems by Muhammad Ali Mazidi Pearson Education Asia LPE (Second Edition)
3. Designs with PIC Microcontrollers by John B. Peatman Pearson Education Asia LPE
4. PIC Microcontroller & Embedded Systems – Mazidi – Pearson Education
5. Microcontrollers [Theory and Applications] by Ajay V Deshmukh- Tata McGraw Hill Education. Education
6. Arduino: The Complete Guide to Arduino for beginners- James Arthur Daniel Jones

- **Reference Books:**

1. Programming and customizing the 8051 microcontroller by Myke Predko.
2. Data sheets of MCS51 family microcontrollers, PIC 16F877A Flash microcontrollers,
3. 8051 Microcontroller by I Stott, Mackenzie, Rathel & Phan – Fourth Edition - Pearson
4. Designing & Customizing of PIC Microcontrollers by Mike Predcko.
5. Programming and Interfacing with Arduino -Dr. Yogesh Misra ,CRC press.
6. Beginning Arduino", Michael Mcroberts, Second Edition, Apress Publishing.

Program Elective Course (PEC)

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
T. Y. B. Tech (Electronics & Telecommunication Engineering)

Semester-V (as per NEP) w.e.f. 2025-26

ENTPEC- 01 A : Digital Logic Design

Teaching Scheme:
Lectures – 3 Hours/week, 3 credits
Practicals –2 Hours/week, 1 credit

Examination Scheme:
ESE – 70 Marks
ISE – 30 Marks
ICA– 25Maks

Course Objectives:

1. To demonstrate the use of codes and k-map minimization techniques in digital circuits.
2. To design combinational logic circuits using logic gates.
3. To illustrate the use and significance of logic IC families and flip-flops in digital circuits.
4. To design asynchronous and synchronous sequential logic circuits.
5. To apply concepts of state machines for designing digital applications.

Course Outcomes: At the end of this course, students will be able to –

1. Demonstrate the use of codes and k-map minimization techniques in digital circuits.
2. Design combinational logic circuits using logic gates.
3. Illustrate the use and significance of logic IC families and flip-flops in digital circuits.
4. Design asynchronous and synchronous sequential logic circuits.
5. Apply concepts of state machines for designing digital applications.

Section-I

Unit 1: Codes and Simplification technique: [07 Hrs]

Principles of combinational logic: Standard representation for Logical Function, canonical forms, don't care conditions, minimization techniques using Karnaugh map up to 4 variables only, hazards and hazard free circuit.

Unit 2: Combinational Circuit Design: [07 Hrs]

Half and Full Adder, Half and Full Subtractor, Code converters (binary to gray and gray to binary, BCD to 7 segment), IC 7447, MUX, DEMUX, encoder, decoder, Multiplexer (Tree) and Demultiplexer (Tree), magnitude comparator.

Unit 3: Logic Families and Flip flops: **[07 Hrs]**

Logic family -Introduction to logic families, Characteristics/Parameters of Digital ICs. Flip flop NAND Latch, Flip-Flop: D, SR, JK and T (Characteristic table, excitation table and characteristic equation), Race around condition, Master Slave J-K flip-flop, flip-flop conversion.

Section II

Unit 4: Shift Registers: **[07 Hrs]**

Synchronous and synchronous sequential circuits, Shift register (modes of operation), 4-bit bidirectional shift register, universal shift registers, Ring counter, Johnson counter.

Unit 5: Counters: **[07 Hrs]**

Design of ripple counter using flip-flop, 4 bit up/down counter, mod –N counter, Design of Synchronous counter using Flip-Flop, 4 bit up/down counter, mod –N counter.

Unit 6: State Machines: **[07 Hrs]**

Moore and Mealy machines, representation techniques, state diagram, state assignment, state reduction, implementation using flip flops.

Internal Continuous Assessment (ICA):

Experiments: -

Minimum 8 experiments from the following.

1. Implementation of SOP and POS logical functions using universal gates.
2. Implementation of full adder, and full subtractor using logic gates.
3. Code conversion using logic gates or logic ICs: BCD to Binary, Binary to Gray, Gray toBinary.
4. Design and implementation of 2 – bit digital comparator using logic gates and functional
5. Verification of 4 bit digital comparator using IC 7485.
6. Design and implementation of 1 decimal digit BCD adder using IC 7483.
7. (i) Verification of functionality of multiplexer.
   (ii) Design and implement combinational logic function using multiplexer ICs.
8. (i) Verification of functionality of decoder
   (ii) Design and implement combinational logic function using decoder IC.
9. Verification of the functionality BCD to 7 segment decoder/drive
10. Implement S-R, D, J-K, T flip flops using logic gates.
11. Functional verification of universal shift registers using IC 7495.
12. Design and implementation of Ring counter using shift register.

13. Design and implementation of Johnson counter using shift register.
14. Design and implementation of Pulse train generator using IC 7495.
15. Functional verification of ripple counter using IC 7490.

Text books:

1. Digital Design - M. Morris Mano - Pearson Education (3rd Edition)
2. Digital Principles – Leach, Malvino, TMH (6th Edition).
3. Fundamental of Digital Circuits- Anand Kumar- Prentice Hall of India Pvt. Ltd.
4. Digital Electronics – Dr. R. S. Sedha – S. Chand Publications (3rd Revised Edition).
5. Digital System, Principles and Applications, Ronald J. Tocci, PHI
6. Digital Electronics- Anil K Maini, Wiley Publication.

Reference Books:

1. Digital Design Principles and Application - Wakerly – Pearson Education
2. Digital Electronics - Gothman - (PHI)
3. Digital Logic and Computer Design - Morris Mano - Pearson Education
4. The Principles of Computer hardware- Alan Clements (3rd Edition), Oxford Press.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
T. Y. B. Tech (Electronics & Telecommunication Engineering)

Semester-V (as per NEP) w.e.f. 2025-26

ENTPEC- 01 B : Fundamentals of Image Processing

Teaching Scheme:
Lectures – 3 Hours/week, 3 credits
Practicals –2 Hours/week, 1 credit

Examination Scheme:
ESE – 70 Marks
ISE – 30 Marks
ICA– 25Maks

This course covers fundamental notions in image and video processing, as well as covers most popular techniques used, such as edge detection, motion estimation, segmentation, and case studies.

Course Prerequisite:

Student shall have knowledge of Digital Signal Processing

Course Objectives:

1. To introduce to student concept of image & color fundamental concept.
2. To introduce to student fundamentals of Digital Image Processing in spatial and transform domain.
3. To introduce to student time and frequency domain techniques for image enhancement.
4. To make student realize need of image transformation & image compression techniques.
5. To make student understand different basic image analysis techniques
6. To make student understand different application areas of Digital Image Processing.

Course Outcomes:

After completion of syllabus students should be able to

1. Describe and performs basic operations on image processing.
2. Explain the use of two-dimensional transforms in image processing.
3. Apply various image enhancement techniques to enhance image quality.
4. Apply various image segmentation and morphology techniques to process images.
5. Demonstrate the ability to restore degraded images using appropriate models and filters.
6. Examine applications of digital image processing.

Section I

Unit 1: Digital Image Processing fundamentals (08 Hrs.)

Components of Image Processing System, Fundamental steps in Digital Image Processing, Image acquisition, sampling and quantization, image resolution, basic relationship between pixels, color images, RGB, HSI and other models

Neighborhood Processing**:** Averaging filters, order statistics filters, high pass filters and high boost filters.

Unit 2: Image Enhancement in Spatial domain (07 Hrs.)

Spatial Domain: Point Processing: Digital Negative, contrast stretching, thresholding, gray level slicing, bit plane slicing, log transform and power law transform.

Unit 3:- Image Enhancement in Frequency domain (06 Hrs)

Frequency Domain: DFT for filtering, Ideal, Gaussian and Butterworth filters for smoothening and sharpening and Homomorphic filters.

Section II

Unit 4:- Image Segmentation (08 Hrs.)

Introduction-Edge detection, Edge linking and boundary detection – Thresholding – Region based segmentation – Region growing – Region splitting and merging- Watershed segmentation algorithm.

Unit 5: Two dimensional transforms & Histogram Modeling (07 Hrs.)

Discrete Fourier Transform, Discrete Cosine Transform, KL Transform

Histogram Modeling: Histogram equalization and histogram specification**.**

Unit 6: Image Processing Applications (06 Hrs.)

Applications in fingerprinting, Face detection, medical applications such as tumor detection, Remote sensing.

Internal Continuous Assessment (ICA):

Minimum Six Laboratory experiments must be conducted on above topics for ICA.

- **Text Books:**

1. Gonzales and Woods--Digital Image Processing, Pearson Education, India, Third Edition
2. Milan Sonka ‘Image Processing, Analysis & Machine Vision’ Thomson Publication.
3. A. I. Bovik --Handbook on Image and Video Processing", Academic Press.

- **Reference Books:**

1. Anil K. Jain, ―Fundamentals of Image Processing, Prentice Hall of India, First Edition, 1989.
2. John W. Woods, ―Multidimensional Signal, Image and Video Processing, Academic Press 2012
3. B. Chandra & D.D. Majumdar -Digital Image Processing and Analysis- - PHI pub., First Edition
4. Kazi Kutubuddin Sayyad Liyakat -KSK Approach: AI Drive IoT based Decision Making, Lambert Publications - ISBN: 978-620-8-426

Ability Enhancement Course

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
T. Y. B. Tech (Electronics & Telecommunication Engineering)

Semester-V (as per NEP) w.e.f. 2025-26

AEC- 02 : Creativity and Design Thinking

Teaching Scheme:
Lectures – 1 Hours/week, 1 credits
Practicals –2 Hours/week, 1 credit

Examination Scheme:
ESE – 50 Marks
ICA– 25Maks

Course Prerequisite:

Students shall know basic understanding of product development and entrepreneurship and fundamental knowledge of project management and economics.

Course Objectives

1. To introduce students to the concepts of creativity, innovation, and design thinking process.
2. To develop problem-solving skills using divergent and convergent thinking approaches for iterative design methodologies.
3. To familiarize students with prototyping methods and their applications in iterative design methodologies.
4. To emphasize sustainable design principles and their integration into product development processes.

Course Outcomes:

1. Elaborate the critical design thinking skills needed to either improve an existing product or design a new product.
2. Demonstrate the ability to generate and evaluate creative ideas using ideation techniques.
3. Apply Creativity and Prototyping to refine product designs effectively.
4. Analyze and apply sustainable design principles into the engineering design process.

SECTION I

Unit 1: Introduction to Creativity and Design Thinking (4 Hrs)

Creativity and Innovation: Definition, importance, and characteristics, Design Thinking Process, Empathize, Define, Ideate, Prototype, Test, Barriers to Creativity and Techniques to Overcome them.

Unit 2: Ideation and Concept Development (3Hrs)

Exploring Problem-Solving Approaches: Divergent and convergent thinking, Creative Ideation Methods: Different Method of Idea Generation such as Brainstorming, SCAMPER, TRIZ, Mind

Mapping, Transforming Ideas into Concepts: Concept sketching, storytelling, and visualization techniques.

SECTION II

Unit 3: Creativity and Prototyping (4 Hrs)

Creativity in Design: Applying creativity, brainstorming, and concept generation in problem-solving, Prototyping Methods and Strategies: Low-fidelity vs. high-fidelity prototypes, rapid prototyping, and iterative design, Real-Life Applications: Case studies on Real-life applications demonstrating customer-driven designs and meeting product specifications.

Unit 4: Sustainable Design and Product Development (5Hrs)

Design for Environment Principles: Applying environmental sustainability throughout the product life cycle., Product Development Processes: Selecting and implementing staged, spiral, and agile development models based on project needs. Case Studies: Sustainable product development in the electrical engineering domain.

TERM WORK

Term work should be based on assignments (Case studies) based on the above topics.

1. Presentations — Idea pitching and storytelling exercises.
2. Mini-Projects — Hands-on prototyping and testing (e.g., designing a sustainable electrical product)..
3. Group Discussions — Exploring innovative business models and their applications.
4. Participation — engaging in designs thinking workshops and brainstorming sessions.

TEXT BOOK

1. Product Design and Development by Karl T. Ulrich and Steven D. Eppinger, Tata McGraw Hill.
2. Design Thinking: Understanding How Designers Think and Work by Nigel Cross.
3. Creative Confidence by Tom Kelley and David Kelley.

REFERENCE BOOKS

1. Product Design for Engineers by Devdas Shetty, Cengage Learning.
2. Product Design by Kevin Otto and Kristin Wood, Pearson Education.
3. Sustainable Design: A Critical Guide by David Bergman.
4. The Art of Innovation by Tom Kelley.
5. Entrepreneurship by Robert D. Hisrich, Michael Peters, and Dean Shepherd, Tata McGraw Hill.

Open Elective

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
T. Y. B. Tech (Electronics & Telecommunication Engineering)

Semester-V (as per NEP) w.e.f. 2025-26

OE- 03 : Interdisciplinary Mini Project

Teaching Scheme:	**Examination Scheme:**
Lectures – 1 Hours/week, 1 credits	**ICA – 25 Marks**
Practical –2 Hours/week, 1 credit	**OE– 25Maks**

Course Prerequisite:

Students shall know basic knowledge in core engineering disciplines, familiar with programming languages/CAD design, understanding of project management principles.

Course Objectives

1. To introduce students to foster interdisciplinary collaboration among engineering students for familiarize students with cutting-edge technologies and trends in engineering.
2. To encourage the application of diverse engineering principles to enhance technical, analytical, and problem-solving skills through project-based learning to find innovative solutions.
3. To equip students with the knowledge of ethical considerations and sustainable development principles in engineering.
4. To develop project management, documentation, and presentation skills.

Course Outcomes:

1. Apply interdisciplinary knowledge, teamwork and collaboration skills to design and implement innovative solutions to engineering problems.
2. Develop integration to emerging technologies in engineering and their applications into project design and development.
3. Apply ethical principles and sustainable development goals in engineering design.
4. Produce and present a comprehensive project report with proper documentation.

SECTION I

Unit 1: Introduction to Interdisciplinary Projects (4 Hrs)

Definition and significance of interdisciplinary projects, Importance of interdisciplinary projects in engineering, Overview of project management: Planning, execution, and evaluation, Team formation and role allocation.

Unit 2: Problem Identification and Scope Definition (3 Hrs)

Techniques for identifying real-world problems, Defining project scope, objectives, and deliverables, Feasibility analysis: Technical, economic, and environmental considerations.

SECTION II

Unit 3: Design and Development Process (3 Hrs)

System design and architecture, Integration of core engineering disciplines (electrical, mechanical, electronics, computer science), Prototyping and testing methodologies.

Unit 4: Ethics and Sustainability in Engineering Projects (3 Hrs)

Ethical considerations in engineering design and implementation, Sustainable development goals and their relevance to engineering projects.

Unit 5: Project Documentation and Presentation (2 Hrs)

Writing technical reports: Structure and guidelines, Effective presentation techniques, Intellectual property rights and patent filing basics.

TERM WORK

Students will work in teams of maximum 3-4 members to complete a mini-project. The project should integrate at least two engineering disciplines. Assesment can be done on Project Proposal, Mid-Term Review, Mid-Term Review, Presentation and Viva.

TEXT BOOK

1. Project Management for Engineering and Technology by David L. Goetsch, Pearson Education.
2. Interdisciplinary Engineering Design Education by Michael A. Stylios, Springer.
3. Project Management: A Systems Approach to Planning, Scheduling, and Controlling by Harold Kerzner.
4. Interdisciplinary Research: Process and Theory by Allen F. Repko and Rick Szostak.

REFERENCE BOOKS

1. Product Design for Engineers by Devdas Shetty, Cengage Learning.
2. Engineering Project Management by Nigel J. Smith.
3. Emerging Technologies: From Hype to Impact by Bruno Salgues.
4. Sustainable Engineering: Principles and Practice by David T. Allen and David R. Shonnard.

Multidisciplinary Minors

A) Multidisciplinary Minor in "Controllers and Applications"

Semester	Course Code	Course Title
V	ENTMDM-03A	PIC Microcontroller

B) Multidisciplinary Minor in "Internet of Things"

Semester	Course Code	Course Title
V	ENTMDM-03B	IoT Networks and Security

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
T. Y. B. Tech (Electronics & Telecommunication Engineering)

Semester-V (as per NEP) w.e.f. 2025-26

ENTMDM- 03 A : PIC Microcontroller

Teaching Scheme:
Lectures – 2 Hours/week, 2 credits
Practicals –2 Hours/week, 1 credit

Examination Scheme:
ESE – 70 Marks
ISE – 30 Marks
ICA– 25Maks

This course focuses on the study of PIC microcontroller. It introduces special features of PIC Microcontroller. It also briefs the students about interfacing of PIC with various I/O devices like Switches, Displays, A to D converter, D to A converter LED, LCD to PIC microcontroller. The students learn and get practiced with Programming language (Embedded C) used for Embedded System design using microcontrollers. They will be able to use the advanced fast microcontroller in electronics engineering related fields.

Course Prerequisite: Student should have knowledge of basic 8051 Microcontroller. Knowledge of Assembly language would be helpful. For the PIC 16F877 programming a basic knowledge of C programming is required.

Course Objectives:

1. To expose the students to the fundamentals of PIC Microcontroller 16F877 architecture and its Peripherals.
2. To introduce the advanced features in PIC Microcontroller 16F877.
3. To make student develop and practice assembly language and C language programming Techniques
4. To enable student demonstrate and perform hardware interfacing and design.

Course Outcomes:

At the end of the course, the student shall be able to,

1. Describe how PIC microcontroller and its peripherals function.
2. Interpret advanced features in PIC Microcontroller 16F877.
3. Program an embedded system in assembly and C.
4. Design, implement and test embedded systems for real-time applications

---

SECTION I

Unit 1: Introduction to PIC Microcontrollers (08)

The PIC Microcontrollers: Overview of PIC family, PIC 16F877- features, architecture, functional pin description, program memory and data memory organization, STATUS register, OPTION_REG, Power Control Register (PCON), Addressing modes, Special features of CPU-Oscillator section, RESET.

Unit 2: PIC Microcontroller Programming (07)

Instruction set, Assembly Language and C programming. I/O Ports, timers and counters, Interrupts, Watchdog timer.

SECTION II

Unit 3: Peripheral Programming and Serial Communication (08)

Analog-to-digital converter (A/D) module, Capture / Compare / PWM Modules Master synchronous serial port (MSSP), Universal Synchronous Asynchronous Receiver Transmitter (USART), SPI, I2C.

Unit 4: Interfacing and Applications (07)

Interfacing of devices- LED, Keyboard, 7-segment display, LCD display, and DC motor, automation and control industrial application.

Internal Continuous Assessment:

ICA consists of minimum eight practical's based upon above curriculum. Minimum four practicals should be taken using embedded C programming.

List of Practical's:

1) Arithmetic and Logic operations
2) Interfacing of Switches, LEDs and Buzzer.
3) Interfacing of LCD Display.
4) Use of Timer for generation of time delays
5) Use of Timer as counter.
6) Use of ADC of PIC Microcontroller.
7) Use of Interrupts for any Application
8) Interfacing of Stepper motor.

9) Speed control of DC Motor.

10) USART Serial communication.

Text Books:

1) Ajay V Deshmukh – Microcontrollers Theory and Applications, Tata McGraw Hill

2) PIC Microcontroller and Embedded Systems Using Assembly and C for PIC18- Muhammad Ali Mazidi

3) 123 PIC Microcontroller Experiments for the Evil Genius – by Myke Predko

Reference Books:

1) John .B. Peatman , "Design with PIC Microcontroller", Prentice Hall, 1997.

2) Data sheets of PIC 16F87X family microcontrollers

3) Data sheets of AVR microcontroller ATmega 328

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
T. Y. B. Tech (Electronics & Telecommunication Engineering)

Semester-V (as per NEP) w.e.f. 2025-26

ENTMDM- 03 B : IoT Networks and Security

Teaching Scheme:
Lectures – 2 Hours/week, 2 credits
Practicals –2 Hours/week, 1 credit

Examination Scheme:
ESE – 70 Marks
ISE – 30 Marks
ICA– 25Maks

COURSE OBJECTIVES:

1. To study the Architecture of IoT.
2. To study the Design of IoT.
3. To study the IoT communications and Networks.
4. To study the IoT security concern.
5. To Study the healthcare monitoring of objects.

COURSE OUTCOMES: At the end of this course, students will be able to

1. To explain the Architecture of Internet of Things.
2. To use Design of IoT networks
3. To describe IoT communications and Networks
4. To describe different IoT security
5. To describe the health monitoring of different objects.

Section-I

Unit 1: IoT Architecture (08)

Sensing Layer: Network Interface Layer, Data Processing Layer, Application Layer, IoT Challenges, Design Challenges (Connectivity, Power Requirements, Complexity, Storage and Computational Capability, Data Extraction from complex environment), IoT Levels (Level 1 to Level 6- Structure).

Unit 2- IoT Design (07)

Physical design of IoT, Logical Design of IoT, IoT Enabling technologies, Design challenges in IoT, Development challenges in IoT, Key Features of Internet of Everything (IoE), IoE elements.

Section -II

Unit 3: Communication in IoT and Networks (08)

M2M Communication, Participatory Sensing – Industrial IoT and Automotive IoT (Theory), IoT data transmission (UDP, TCP/IP), Representational State Transfer (REST), Zigbee / IEEE 802.15.4, 6LoWPAN, IPv4, IPv6, ThingSpeak.

Unit 4: Security in IoT (07)

Importance of IoT Security, Types of IoT security, IoT Security Risk to address, IoT Attack types, Security requirements for IoT systems (confidentiality, integrity, and availability), IoT privacy challenges. Case study on: Vehicle health Monitoring, Bridge Health Monitoring, Building Health Monitoring.

Internal continuous Assessment (ICA):

ICA shall be based on minimum 8 Experiments from the list mentioned below to be performed using LPC1768 / Arduino / NodeMCU /Raspberry Pi / Simulation software.

1. Installation and initial set up of Hardware.
2. Study of S/W.
3. Study of Python IDE for programming in python.
4. Interfacing motors (DC/Stepper/Servo)
5. Reading sensor values and plotting them on the PC / LCD
6. Interfacing of Camera for capturing and storing the image.
7. Interfacing of Finger-Print Scanner/Sensor for capturing and storing the image.
8. Data transfer using MQTT & CoAP.
9. Interfacing sensor and sending data to the cloud using Wifi.
10. Data Acquisition System.
11. NodeMCU based system.
12. ThingSpeak based system.
13. Case study on any IoT enabled system.

Text Books:

1. Internet of Things: A Hands-on approach, Arshdeep Bahga, Vijay Madisetti, Universities Press.
2. IoT Security, Kazi Kutubuddin Sayyad Liyakat, Lap-Lambart Publications, ISBN: 978-620-8-42099-4.
3. IoT Architecture and Design Principles, Raj Kamal, McGraw Hill Education.
4. Modern Approaches for IoT Security: ANN and KK Approach Study, Kazi Kutubuddin Sayyad Liyakat, Lap-Lambart Publications, ISBN: 978-620-8-42081-9.

5. Building the IoT with IPv6 and MIPv6, Daniel Minoli, Wiley Publication, ISBN: 978-1-118-47347-4, Willy Pub
6. IoT in Healthcare Applications, Kazi Kutubuddin Sayyad Liyakat, Research Beacon Publication, ISBN: 978-819-8-28887-5.

Reference Books:

1. Security and Privacy in Internet of Things (IoTs): Models, Algorithms, and Implementations, Edited by Fie Hu, CRC Press.
2. The Internet of Things: Applications and Protocols, Wiley publications. Author(s): Oliver Hersent, David Boswarthick, Omar Elloumi
3. IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things, David Hanes, Gonzelo Salgueiro, Patrick Grossetete, Robert Barton, and Jerome Hentry, Cisco Pres, 2017.
4. Learning Internet of Things, Peter Waher, PACKT publishing, BIRMINGHAM – MUMBAI 4.
5. AI Driven IoT Based Decision Making: KSK Approach, Kazi Kutubuddin Sayyad Liyakat, Lap-Lambart Publications, ISBN: 978-620-8-42085-7.
6. Architecting the Internet of Things, Bernd Scholz-Reiter, Florian Michahelles, ISBN 978-3-642- 19156- 5 e-ISBN 978-3-642-19157-2, Springer.

Semester VI

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
T. Y. B. Tech (Electronics & Telecommunication Engineering)

Semester-VI (as per NEP) w.e.f. 2025-26

ENTPCC- 10 : Advanced Mobile Communication

Teaching Scheme:
Lectures – 3 Hours/week, 3 credits

Examination Scheme:
ESE – 70 Marks
ISE – 30 Marks

Course Prerequisite:

Student shall have knowledge of basics of analog and digital telecommunication

Course Objectives:

1. To recognize cellular concept in mobile communication.
2. To describe the mobile radio propagation, cellular system design.
3. To assess OFDM & MIMO techniques used in mobile communication.
4. To explain the mobile communication evolution of 2G to 5G GSM mobile technologies.
5. To explain CDMA digital cellular standard & IMT–2020 technologies.
6. To review of 4G & 5G next generation technology.

Course Outcomes: At the end of this course, student will be able to –

1. explain cellular systems, working and hand off strategies implemented in mobile communication.
2. analyze various losses in mobile radio propagations and define multiple access schemes sharing radio spectrum.
3. review OFDM & MIMO techniques used in mobile communication.
4. demonstrate GSM - architecture, frame structure, system capacity and services provided.
5. explain CDMA digital cellular standard & IMT–2020 technologies.
6. describe mobile communication evolution of 2G to 5G technologies

---

Section-I

Unit 1: Introduction to wireless communication systems (08Hrs)

The Cellular Engineering Fundamentals : Introduction, Frequency Re-use, Channel Assignment Strategies, Handoff Strategies, Interference and System Capacity, runking and Grade of service, Co-channel Interference (CCI), Adjacent Channel Interference (ACI), Cell Splitting, Sectoring, Microcell Zone concept, Repeaters.

Unit 2: Mobile Radio Propagation (06Hrs)

Large scale path loss, Free space propagation model, ground reflection model (two ray model), Practical Link Budget using path loss model, Small scale fading and multipath small scale multipath propagation

Unit 3: OFDM & MIMO Techniques in Wireless Communications (07Hrs)

Introduction to OFDM, OFDM Block Diagram, MIMO Wireless Communication, Benefits of MIMO Technology, MIMO OFDM Building Block, STBC: Almounti code, Capacity Comparisons of SISO, SIMO, MISO, and MIMO.

Section II

Unit 4: GSM (07Hrs)

GSM Network architecture, signaling protocol architecture, identifiers, channels, Frame structure, speech coding, authentication and security, call procedure, handoff procedure, services and features.Mobile data networks, GPRS and higher data rates.

Unit 5: CDMA digital cellular standard (IS-95) & IMT – 2020 (06Hrs)

Frequency and channel specifications of IS-95, forward and reverse CDMA channel, packet and frame formats, mobility and radio resource management. IMT 2000 & IMT Advanced, IMT 2020,capabilities.

Unit 6: 4G (LTE) & 5G Next Generation Technology (08Hrs)

Introduction to 4G, LTE Architecture, Elements of LTE-EPS, LTE Radio/air interfaceModulation and features, LTE Channels, Introduction to 5G, 5G CN Architecture, Radio/air interface, features.

Text Books:

1. Wireless Communications - Theodore S. Rappaport, PHI, PTR Publication.

2. Principles of Wireless Networks – Kaveh Pahlavan, Prashant Krishnamurthy, PHI.

3. Fundamentals of Wireless Communication-David Tse & Pramod Viswanath, Cambridge University Press.

4. MIMO Wireless Communications, Ezio Biglieri, Cambridge University Press.

5. Mobile Communications – Jochen Schiller, Pearson Education, Second Edition.

Reference Books:

1. Mobile and Personal Communication Systems and Services – Raj Pandya, PHI.
2. Beyond 3G Bringing Networks, Terminals and the Web Together- Martin Sauter, John Wiley & Sons.
3. Advanced Wireless Communications-Savo G. Glisic, John Wiley & Son
4. Wireless Communication and Network –Upena Dalal, OXFORD higher Education
5. 4G Roadmap and Emerging Communication Technologies – Young Kyun Kim and Ramjee Prasad –Artechhouse.
6. 5G NR: The Next Generation Wireless Access Technology- By Erik Dahlman, StefanParkvall, Johan Skold
7. GSM Network: GPRS evolution one step towards UMTS, Jochim Tisal, John Wiley & Sons.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
T. Y. B. Tech (Electronics & Telecommunication Engineering)

Semester-VI (as per NEP) w.e.f. 2025-26

ENTPCC- 11 : Electronics System Design

Teaching Scheme:	**Examination Scheme:**
Lectures – 2 Hours/week, 2 credits	**ESE – 70 Marks**
Practical – 2 Hours/week, 1 credit	**ISE – 30 Marks**
	ICA– 25 Marks
	OE – 25 Marks

This course introduces construction, characteristics of power electronics devices and its applications. The course also introduces design of different electronics systems such as frequency synthesizer, frequency counter, time period measurement. This course also covers design of industrial controllers and aspects of PLC & automation.

Course Prerequisite:

Student shall have knowledge of Basic Electronics, Linear Integrated Circuits and Digital Electronics

Course Objectives:

1. To describe the concept, construction characteristics of power electronic devices.
2. To understand applications of thyristor.
3. To understand Chopper circuit.
4. To design and analyse timer, frequency counters and digital voltmeters.
5. To design signal conditioning circuits using sensors.
6. To design and analyse controllers for industry applications.

Course Outcomes:

At the end of this course, Students will be able to

1. Describe construction, working & analyse characteristics of thyristors.
2. Analyse AC and DC power control circuits using thyristors.
3. Describe Chopper Circuits
4. Design and implement timers, frequency counters, digital voltmeters and frequency synthesizers.
5. Deign signal conditioning circuits using sensors.
6. Design and analyse controllers for industrial applications.

Section I

Unit 1: Introduction to Modern Power Semiconductor Devices (07)

Power IGBT: Construction, working, Transfer Characteristics, Output Characteristics, and application. SCR - Construction, working, VI Characteristics, Concept of Turn on and Turn off methods. TRIAC - Construction, working, VI Characteristics, DIAC - Construction, working, VI Characteristics.

Unit 2: Power Electronics Applications (05)

Single phase half wave controlled rectifier, center tapped full wave controlled rectifier, fully controlled bridge rectifier, AC power control using DIAC & TRIAC and its applications

Unit 3: Chopper circuits (05)

DC choppers: Types, Control strategies of chopper, Single quadrant, two quadrant, four quadrant chopper (circuit diagram, operation with waveforms), Morgan chopper circuit diagram, operation with waveforms

Section II

Unit 4: Timer, Counters & Digital Voltmeter (06)

Design of Timer using XR 2240, Design of counter using IC 74C926 for the time & event counting. Design of 3 digit Multi-range DVM using discrete components.

Unit 5: Signal Conditioning Circuits (06)

Signal conditioning for sensors PT 100, 1.M 35, Thermocouples (J & K type), current loop Interface (4mA to 20mA), zero & span circuit, offset V to I & I to V converter, V to V converter.

Unit 6: Design of Controllers and PLC Applications. (05)

Design of analog ON/OFF controller and proportional controller for controlling process, PLC Fundamentals and applications, bottle filling plant & elevator control.

- **Internal Continuous Assessment:**

ICA consists of minimum six practical from following list of experiments and two case studies as described below.

- **List of Experiments:**

1. VI Characteristics of SCR.
2. VI characteristics of TRIAC & DIAC
3. Single phase half wave controlled rectifier.
4. Lamp dimmer using TRIAC & DIAC.
5. Check the effect of variation in duty cycle on the output of Step up chopper.
6. Check the effect of variation in duty cycle on the output of Step Down chopper.
7. PLL application using MATLAB SIMULINK.
8. Implementation of frequency division circuit using IC.
9. Application implementation using PLC.
10. Temperature controller using OPAMP.
11. V to V Converter,
12. Simulation of Display design.
13. Design and simulate 3 digit DVM

- **Case Studies:**

  Students are supposed explore the following case studies as part of ICA evaluation.

  1. **Designing High-Performance Analog Circuits for Audio Systems**

  - Brief: This case study discusses the design of high-fidelity audio circuits, including amplifiers, DACs (digital-to-analog converters), and audio signal processing. It focuses on reducing noise, distortion, and ensuring the integrity of audio signals in consumer-grade and professional audio equipment.
  - Resource: Audio Amplifier Design by Texas Instruments

  2. **Development of Unmanned Aerial Vehicles (UAVs) for Commercial Use**

  - Brief: The case study covers the design of unmanned aerial vehicles, including drone systems used for commercial applications like mapping, delivery, and surveillance. It includes flight control systems, power management, communication, and safety considerations.
  - Resource: UAV Design by DJI Innovations

Text Books:

1. Power Electronics, Circuits, Devices & Applicationsby M. H> RRashid, Pearson Education, 3rd edition
2. Power Electronics by P. C. Sen, TATA Mc Graw Hill, 2nd Edition.
3. Power Electronics by M. D. Singh & K. B. Khanchandani, TATA Mc Graw Hill, 2nd Edition.
4. Introduction to System Design Using Integrated Circuits by B. S. Sonde, New Age International Publishers, 2nd Edition

Reference Books:

1. Integrated Circuits by K. R. Botkar, Khanna Publishers, 10th Edition
2. Programmable Logic Controllers by Job Den Otter, Prentice Hall International Editions.
3. Programmable Logic Controllers by Jon W. Webb & Ronald Reis, PHI Publications, 5th editions.
4. Process Control Instrumentation Technology by Curtis D. Johnson, Pearson Education, 8th edition
5. Datasheets of Analog and Digital ICs used for design using Web resources.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
T. Y. B. Tech (Electronics & Telecommunication Engineering)

Semester-VI (as per NEP) w.e.f. 2025-26

ENTPCC- 11 : Optical Communication

Teaching Scheme:
Lectures – 3 Hours/week, 3 credits

Examination Scheme:
ESE – 70 Marks
ISE – 30 Marks
ICA– 25 Marks

This course introduces the basic concept of optical communication. It explains the basic working principle of optical fiber. It covers the study of basic optical devices as optical source, optical detector and optical joints. It also introduces aspects of practical design of optical communication system.

Course Prerequisite:

Student should have knowledge of basic communication system, light reflection, refraction process.

Course Objectives:

1. To make students to understand basic working principle of optical fiber.
2. To introduce to student basic losses in optical fiber & reasons behind the losses.
3. To make students to understand the basics of optical sources (LASER & LED).
4. To make students to understand the basics of optical detectors.
5. To study the concepts of optical networks.
6. To make students able to design blocks of optical communication system.

Course Outcomes:

After completion of syllabus students should be able to

1.Discuss various elements of optical fiber

2.Describe transmission characteristics of optical fibers & discuss concept of optical joints.

3.Illustrate different optical sources and evaluate the various parameters.

4.Illustrate different optical detectors and evaluate the various parameters.

5.Identify the different types of optical networks.

6.Design functional blocks in optical communication system.

Section I

Unit 1– Introduction (05)

Introduction, Historical development, general optical communication system, advantages, disadvantages, optical fiber waveguides, ray theory, mode theory, Types of optical fibers, single mode, multimode fiber, step index & graded index fibers, applications of optical fiber communication, problems based on number of modes, numerical aperture, acceptance and critical angle.

Unit 2– Optical Fiber losses and Joints (08)

Introduction, Attenuation, absorption- intrinsic & extrinsic, linear &nonlinear scattering losses, bending loss, dispersion- intermodal & intramodal, Fiber's alignment and joint loss, fiber splices, connectors, fiber couplers & its types, problems based on attenuation in optical fiber.

Unit 3– Optical Sources (08)

LASER: Requirements of optical source, basic concept of LASER, optical emission from semiconductors, double heterojunction (DH) structure, Semiconductor injection laser and structures, Injection laser characteristics.
LED: LED structures, LED characteristics.

Section II

Unit 4-Optical Detectors (08)

Introduction, requirements of optical detector, optical detection principles, performance parameters of detector derivation of formula and numericals -absorption, quantum efficiency, responsivity, cut off wavelength.

Semiconductor photo diodes with and without internal gain:- PN, PIN, Avalanche Photo diodes, Phototransistors.

Unit 5-Optical Networks (05)

Optical Networks: Introduction, networking terminology, optical network modes, SONET / SDH, Optical Ethernet, Fiber Distributed Data Interface (FDDI), data buses.

Unit 6-Fiber Optical Communication Systems (08)

Introduction, Transmitter Design, Receiver Design, Noise equivalent model of receiver, Link Design, Wavelength Division Multiplexing (WDM), DWDM, Optical Time Division Multiplexing (OTDM).

Internal Continuous Assessment (ICA):

ICA consists of minimum eight assignments based on above syllabus.

Text Books:

1. Optical Fiber Communications, John M. Senior, Pearson Education. 3rd Impression, 2007

2. Optical Fiber Communications, Gerd Keiser, 4th Ed., MGH, 2008

3. Optical Fiber Communications, D.C. Agarwal - S. Chand and company

Reference Books:

1. Optical Communications, David Gover – PHI

2. Fiber Optics communication, Hozold Kolimbiris - Pearson Education.

3. Fiber Optics Communication – 5th Edition, Palais-Pearson Education

Programme Elective Courses

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
T. Y. B. Tech (Electronics & Telecommunication Engineering)

Semester-VI (as per NEP) w.e.f. 2025-26

ENTPEC- 02 A : VLSI Design

Teaching Scheme:
Lectures – 3 Hours/week, 3 credits
Practical – 2 Hours/week, 1 credits

Examination Scheme:
ESE – 70 Marks
ISE – 30 Marks
ICA– 25 Marks
POE– 25 Marks

This course introduces how to design, simulate and test digital logic circuits using the hardware description language of Verilog HDL and CMOS logic. It also introduces the CPLD and FPGA architectures used to implement the digital logic circuits.

Course Prerequisite:

Students shall have knowledge of Digital Devices, combinational logic circuit design, and simulation.

Course Objectives:

1. To make students learn EDA Tools for Verilog HDL programming and CMOS Logic Design and simulation
2. To enable students to design Verilog HDL modules for combinational and sequential logic circuits.
3. To acquaint students with CPLD and FPGA architecture.
4. To introduce students to MOS Transistor Theory and CMOS Logic-based design of combinational logic circuits.

Course Outcomes:

At the end of the course, students will be able to

1. Explain the different syntax of Verilog HDL language.
2. Design combinational circuits using Verilog HDL.
3. Design sequential logic circuits using Verilog HDL.
4. Describe MOS transistor theory and behavior of E-MOSFET
5. Implement combinational logic circuit using E-MOSFETs.
6. Describe the architecture and internal components of CPLD and FPGA.

Section I

Unit 1- Introduction to Verilog HDL [07 Hrs]

Structure of Verilog module, Operators, Data Types, Styles of Description. Verilog Models for Gate Propagation Delay (Inertial Delay), Time Scales for Simulation, Verilog Models for Net Delay (Transport Delay), Module Paths and Delays, Path Delays and Simulation, Inertial Delay Effects and Pulse Rejection, Examples using Verilog.

Unit 2- Combinational logic using Behavioral Descriptions [07 Hrs]

Structure, Variable Assignment Statement, Sequential Statements, Loop Statements, Verilog Behavioral Description of Adder, Subtractor, Comparator, Multiplexer, Demultiplexer, Encoder, Decoder.

Unit 3 – Sequential logic using Behavioral Descriptions [07 Hrs]

Behavioral models of Flip-flops, counters and shift registers, Verilog HDL model using state machine for sequence detector

Section II

Unit 4 - MOS Transistor Theory [07 Hrs]

Physical structure of MOS transistor, accumulation, depletion & inversion modes, MOS device design equations, second order effects, Static and dynamic behavior of CMOS inverter, power and energy delay.

Unit 5 – Combinational Logic Design in CMOS [08 Hrs]

Static CMOS design- complementary CMOS, Implementation of Boolean Expressions using CMOS Logic, Ratioed logic and pass transistor logic; dynamic CMOS design- dynamic logic basic principle, speed and power dissipation, issues in dynamic design, cascading dynamic gates, comparison of static and dynamic designs in CMOS, Timing Issues in Digital Circuits.

Unit 6: Architecture of Commercial Devices [06 Hrs]

CPLD Architecture, Xilinx XC9500, Altera Max7000, FPGA architecture, Altera Flex 10k.

Internal Continuous Assessment:

ICA shall be based on a minimum of eight experiments based on the above syllabus using any EDA software tool for Verilog HDL modules and CMOS logic design.

Suggested List of experiments:

Design and Implementation of the following using Verilog HDL and write test bench for-

1. Design of half adder and full adder
2. Design of 4-bit adder using structural style modelling
3. Design of code converters
4. Design of comparators
5. Design of encoder and decoder
6. Design of multiplexer and demultiplexer
7. Design of flip flops
8. Design of asynchronous and synchronous counters
9. Design of sequence detector using state machine
10. Design of ADD and Shift multiplier using state machine
11. Design and Implementation of the Following using CMOS / Ratioed Logic / Dynamic CMOS Logic.

1. Logic Gates
2. Universal Logic Gates
3. Boolean Expression
4. Half adder and full adder
5. Half subtractor and full subtractor

Text Books:

1. Digital Systems Design using Verilog, Charles H. Roth, Lizy Kurian John, Byeong Kil Lee- Cengage Learning.
2. HDL Programming VHDL And Verilog, Nazeih M.Botros, Dreamtech Press
3. HDL with Digital Design: VHDL and Verilog, Nazeih Botros. Mercury Learning And Information LLC. ISBN: 978-1-938549-81-6
4. Modeling, Synthesis and Rapid Prototyping with the Verilog HDL, M.D. CILETTI ,Prentice- Hall.
5. Digital Integrated Circuits, Rabey, Chandrakasan, Nikolic, Pearson Education
6. CMOS VLSI design, Neil H. E. Weste, David Harris, Ayan Banerjee, Pearson Education

Reference Books :

1. Digital Design Principles and Practices, John F. Wakerly, Printice Hall, 3rd Edition.
2. Datasheets of CPLDs and FPGAs.
3. CMOS digital integrated circuits, Analysis and Design, Sung-Mo Kang, Yusuf Leblebici, TATA McGRAW Hill
4. Principles of CMOS VLSI Design, Neil Weste, Kamran Eshraghian, Addison Wesley/Pearson Education

5. Modern VLSI Design, Wayne Wolf, 2nd Edition, Prentice Hall,1998
6. Essentials of VLSI Circuits and Systems, Kamran Ehraghian, Dauglas A. Pucknell and Sholeh Eshraghiam, PHI, EEE, 2005 Edition

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
T. Y. B. Tech (Electronics & Telecommunication Engineering)

Semester-VI (as per NEP) w.e.f. 2025-26

ENTPEC- 02 B : Digital Image Processing

Teaching Scheme:
Lectures – 3 Hours/week, 3 credits
Practical – 2 Hours/week, 1 credits

Examination Scheme:
ESE – 70 Marks
ISE – 30 Marks
ICA– 25 Marks
POE– 25 Marks

This course covers fundamental notions in image and video processing, as well as covers most popular techniques used, such as edge detection, motion estimation, segmentation, and case studies.

Course Prerequisite:

Student shall have knowledge of Digital Signal Processing

Course Objectives:

1. To introduce basic image processing techniques.
2. To introduce Morphological image processing techniques.
3. To enhance understanding of Color Image Processing techniques.
4. To facilitate the understanding of different image compression techniques.
5. To explore different application areas of Digital Image Processing.

Course Outcomes:

After completion of syllabus students should be able to

1. Explain basic image processing techniques.
2. Demonstrate the ability to restore degraded images using appropriate models and filters
3. Examine different Morphological processing techniques.
4. Explain Color Image Processing techniques.
5. Describe image compression techniques
6. Examine applications of digital image processing.

Section I

Unit 1: Introduction to Image Processing (05 Hrs.)

Overview of Image Enhancement Techniques, Overview of Image Segmentation Techniques, Comparison.

Unit 2: Image Restoration (08 Hrs.)

Introduction to Image Restoration, Image Degradation model, noise models, Image Deblurring Technique- Blind Deconvolution, estimation of degradation function by modeling, restoration using Weiner filters and Inverse filters.

Unit 3: Morphological Image Processing (08 Hrs.)

Introduction to Morphological Image Processing, Fundamental Morphological Operations - Dilation, erosion, opening, closing, Advanced Morphological Operations **-** hit or miss transform, thinning and thickening, Morphological Algorithms for Image Processing **-** boundary extraction, Region Filling.

Section II

Unit 4: Color Image Processing (08Hrs.)

Introduction to Color Image Processing, Color Models and Representations, Color Image Acquisition and Representation, Color Image Enhancement, Color Image Segmentation

Unit 5: Image Compression Techniques (08 Hrs.)

Introduction to Image Compression, fundamentals of Image Compression, Lossless Image Compression Techniques - Run-Length Encoding (RLE), Huffman Coding, Arithmetic Coding, Lempel-Ziv-Welch (LZW) Compression, Lossy Image Compression Techniques- Transform-Based Compression, Predictive Coding for Lossy Compression, Image Compression Standards

Unit 6: Application of Image Processing (05 Hrs.)

Blood Vessel Detection, Cancer and tumor detection, Disaster detection (e.g., flood, wildfire, earthquake impact assessment), MRI and CT scans

---

- **Internal Continuous Assessment (ICA):**

  Minimum Eight Laboratory experiments must be conducted on above topics for ICA.

- **Text Books:**

1. Gonzales and Woods--Digital Image Processing, Pearson Education, India, Third Edition
2. Fundamentals of Digital Image Processing, A.K. Jain, PHI, 1989
3. Introduction to Image Processing & Analysis – John C. Russ, J. Christian Russ, CRC Press, 2010

- **Reference Books:**

1. Anil K. Jain, ―Fundamentals of Image Processing, Prentice Hall of India, First Edition, 1989.
2. John W. Woods, ―Multidimensional Signal, Image and Video Processing, Academic Press 2012
3. J.R. Ohm , ―Multimedia Communication Technology", Springer Publication.
4. Digital image processing with matlab & labview – Vipula singh

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
T. Y. B. Tech (Electronics & Telecommunication Engineering)

Semester-VI (as per NEP) w.e.f. 2025-26

ENTPEC- 03 A : Embedded System

Teaching Scheme:
Lectures – 3 Hours/week, 3 credits
Practical – 2 Hours/week, 1 credits

Examination Scheme:
ESE – 70 Marks
ISE – 30 Marks
ICA– 25 Marks

Course Objectives:

1. To make student realize different aspects and application areas of embedded systems.
2. To make student understand ARM core architecture.
3. To provide the knowledge of different hardware peripherals and programming of different peripherals of ARM7 based controller like LPC2148
4. To introduce to student concepts of Real time operating system.
5. To encourage students to provide solution for real world problems using embedded systems

Course Outcomes: At the end of this course, Students will be able to,

1. Discuss hardware and software architecture of embedded system.
2. Describe ARM7TDMI core architecture and Controller based on this architecture
3. Develop embedded C program for different applications for LPC2148 microcontroller.
4. Interface different peripherals with LPC2148 microcontroller.
5. Differentiate real time and general purpose Operating systems
6. Illustrate embedded systems real time applications.

Course Prerequisite: Student shall have knowledge digital circuits, basic C programming, and Microcontroller fundamentals.

SECTION I

Unit 1: Embedded System Introduction: **[05Hrs]**

Introduction to Embedded System, Design challenges-optimizing design metrics, Common Design Metrics, time to market, NRE and Unit Cost, Performance Design Metric, applications of embedded systems and recent trends in embedded systems.

Unit 2: System Architecture: [08Hrs]

Introduction to ARM7TDMI core architecture, bus architecture, memory management. ARM7 operating modes, register structure. Pipeline, ARM instruction set, thumb instruction set.

Unit 3: LPC2148 On Chip Peripherals: [08Hrs]

LPC2148 architecture block diagram, Study of on-chip peripherals I/O ports, PLL, timers/ counters, interrupts, on-chip ADC, DAC, RTC module, WDT, PWM. UART.

SECTION II

Unit 4: Interfacing and Programming: [08Hrs]

Introduction to Embedded C Programming, Basic embedded C programs for on-chip peripherals studied in system architecture like PLL, timers/counters, ADC, DAC. Interfacing of devices – LED, Switches (buttons), 7-segment display, LCD display, DC motor.

Unit 5: Real Time Operating System: [08Hrs]

RTOS versus traditional OS, Architecture of RTOS, task scheduler, Threads, Process, ISR, Semaphores, mailbox, message queues, pipes, events, timers, memory management, Introduction to μcos II.

Unit 6: Case Studies: [05Hrs]

Case studies like Digital Camera, Smart Card System based ATM and Mobile Internet Device.

Internal Continuous Assessment:

ICA consists of 8 to 10 practical's based upon above curriculum.

Suggested Practical's List:

1. Arithmetic and Logic operations using assembly language
2. Interfacing of Switch, LED / Buzzer / Relay
3. Interfacing of LCD Display.

4. Interfacing matrix Keypad and display key pressed on LCD / Seven Segment Display

5. Interfacing of Seven Segment Display

6. Use of Timer for generation of time delays

7. Use of Interrupts for any Application

8. Use of ADC of Microcontroller.

9. Interfacing of Stepper motor.

10. Interfacing of DC Motor.

11. UART Serial communication.

12. Creating two tasks, which will print some characters on the serial port, Start the scheduler and observe the behavior.

13. Implementing a semaphore for any given task switching using RTOS on microcontroller board.

14. Implementing a Mailbox for task communication.

Text books:

1. Embedded Systems: Architecture, Programming And Design by Rajkamal Tata McGraw-Hill Education

2. Frank Vahid - Embedded Systems - Wiley India

3. ARM System Developer's Guide, Designing and Optimizing System Software - Andrew N. Sloss , Dominic Symes, Chris Wright - Morgan Kaufmann Publisher.

4. Embedded systems software primer - David Simon – Pearson

5. MicroC / OS-II, Jean J Labrose - Indian Low Price Edition

Reference Books:

1. Dr. K.V.K.K. Prasad - Embedded / real time system – Dreamtech

2. Embedded real systems Programming – Iyer, Gupta, TMH

3. Embedded systems: a contemporary design tool, James K. Peckol- Wiley India

4. Datasheet of LPC 2148.

5. Application Handbook of Embedded System

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
T. Y. B. Tech (Electronics & Telecommunication Engineering)

Semester-VI (as per NEP) w.e.f. 2025-26

ENTPEC- 03 B : Pattern Recognition

Teaching Scheme:
Lectures – 3 Hours/week, 3 credits
Practical – 2 Hours/week, 1 credits

Examination Scheme:
ESE – 70 Marks
ISE – 30 Marks
ICA– 25 Marks

Course Objectives:

1. To study the Pattern Recognition system.
2. To study the Probability.
3. To study the Clustering required in Pattern Recognition.
4. To study the Neural Networks and object Recognition.

Course Outcomes:

At the end of this course, students will be able to

1. To explain the Pattern Recognition system
2. To use the Probability for problem solving.
3. To describe Clustering required in Pattern Recognition
4. To describe Neural Networks and object Recognition

Section-I

Unit 01: Introduction **(07)**

Machine perception; Pattern Recognition systems; Design cycle; Learning and Adaptation; Applications of Pattern Recognition; Types of Patterns and its recognition.

Unit 02: Probability **(07)**

Probability of Events; Random variables; Joint distributions and Densities; Moments of Random Variables; Estimation of parameters from samples; Minimum Risk Estimators.

Unit 03: Statistical decision techniques **(07)**

Decision Rules; Bayesian Decision Theory- Continuous features; Two Category Classification; Minimum Error - Rate Classification: Minimax Criterion, Neyman - Pearson Criterion; Bayes' Decision Theory- Discrete Features; Types of Machine Learning: Supervised Learning, Unsupervised Learning,

Section-II

Unit 04: Non Parametric Techniques (07)

Density Estimation; Parzen Window; Kn-Nearest Neighbour [KNN] Estimation; The Nearest Neighbour Rules: Convergence of the nearest neighbor, Error rate for Nearest Neighbour Rule, Error Bounds, The k Nearest Neighbour Rule.

Unit 05: Clustering (07)

Introduction; hierarchical clustering:- single linkage, complete linkage, Average linkage, Algorithms, Wards method,; Partitional clustering: - Forgy's, K means, lsodata algorithm.

Unit 06: Object Recognition (07)

Knowledge representation; statistical pattern recognition; Neural Networks: feed forward network; Syntactic pattern recognition; fuzzy Optimization technique in Recognition: genetic algorithm; simulated annealing.

Internal Continuous Assessment:

Minimum 8 Experiments based on above syllabus using Simulink/Matlab/Python.

Text Books:

1. "Pattern Recognition" Second Edition ELSEVIER Academic Press By –Sergios Theodoridis, Konstantinos Koutroumbas.
2. "Pattern Recognition And Machine Learning" Cambridge University By-Christopher M. Bishop.
3. "Image Processing, Analysis, And Machine Vision" Second Edition By- Milan Sonka, Vaclav Hlavac, Roger Boyle.

Reference Books:

1. "Pattern Classification" Second Edition by- Richard O. Duda, Peter E. Hart and David G. Stork.
2. "Statistical Pattern Recognition" Second Edition, John Willy & Sons Ltd by- Andrew R. Webb Qinetiq.
3. "Digital Image Processing" Katson books by- Sanjay Sharma
4. "Introduction to Probability Models" University of California, Ninth Edition by -Sheldon M. Ross.
5. "Introduction to Pattern Recognition", Lap-Lambert Academic Publishing, by- Kutubuddin Sayyad Liyakat Kazi, ISBN: 978-620-8-42094-9.

.

Skill Enhancement Course (SEC)

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
T. Y. B. Tech (Electronics & Telecommunication Engineering)

Semester-VI (as per NEP) w.e.f. 2025-26

ENTSEC- 02 : Hardware Mini Project

Teaching Scheme:
Practical – 4 Hours/week, 2 credits

Examination Scheme:
ICA– 25 Marks
POE – 50 Marks

This course is introduced to enable students to apply the knowledge and skills learned out of courses studied to solve/implement predefined practical problem. The Project work may be beyond the scope of curriculum of courses for learning additional skills, developing the ability to define, design, analysis and implementation of the problem and lead to its accomplishment with proper planning.

Course Prerequisite:

Student shall have knowledge of PCB designing, circuit designing, testing, soldering.

Course Objectives:

1. To produce PCB artwork using an appropriate EDA tool.
2. To practice good soldering, testing, fault detection and effective trouble-shooting.
3. To design and implement application based hardware project.
4. To present technical seminar and display the project.

Course Outcomes:

At the end of this course, Students will be able to,

1. Produce PCB artwork using an appropriate EDA tool.
2. Practice good soldering, testing, fault detection and effective trouble-shooting.
3. Design and implement application based hardware project.
4. Present technical seminar and display the project.

- **Guidelines for project implementation:**

1) Project group should be not more than 3 students per group.

2) Domains for projects may be based on a particular application from the following, but not limited to:

i) Instrumentation and Control Systems
ii) Electronic Communication Systems
iii) Biomedical Electronics
iv) Power Electronics

v) Audio, Video Systems
vi) Embedded Systems
vii) Mechatronics Systems
viii) Energy Conservation

3) Week 1 & 2: Formation of groups, searching of an application based hardware project
4) Week 3 & 4: Finalization of Mini project & Distribution of work.
5) Week 5 & 6: PCB artwork design using an appropriate EDA tool & Simulation.
6) Week 7 & 8: Procurement of electronic components for the project & PCB manufacturing.
7) Week 9, 10 & 11: Hardware assembly, testing, fabrication
8) Week 12: Demo, Group presentation & report submission

- **Internal Continuous Assessment (ICA):**

1. The seminar shall consist of the Literature Survey, Market survey, Basic project work and applications of Mini project.
2. Seminar Assessment shall be based on Innovative Idea, Presentation skill, depth of understanding, Applications, Future Scope and Individual Contribution.
3. A certified copy of seminar/ project report shall be required to be presented at the time of final submission.

- **Text Books:**

1. Thomas C Hayes, Paul Horowitz, ―The Art of Electronics, Newens Publication
2. Jim Williams (Editor) ― Analog Circuit Design: Art, Science and Personalities, EDN series for Design Engineers
3. M Ashraf Rizvi ― Effective Technical Communication, Tata McGraw Hill Education Pvt. Ltd.

- **Reference Books:**

1. Robert Boylested, ― Essentials of Circuit Analysis‖, PHI Publications
2. Meenakshi Raman, Sangeeta Sharma ― Technical Communication, Principles and Practice, Oxford University Press
3. A.E. Ward, Angus ― Electronic Product Design, Stanley thornes Publishers, UK.
4. C Muralikrishna, Sunita Mishra, ― Communication Skills for Engineers, Pearson

Multidisciplinary Minor (MDM)

A) Multidisciplinary Minor in "Controllers and Applications"

Semester	Course Code	Course Title
VI	ENTMDM-04A	Advanced Microcontrollers

B) Multidisciplinary Minor in "Internet of Things"

Semester	Course Code	Course Title
VI	ENTMDM-04B	Industrial IOT

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
T. Y. B. Tech (Electronics & Telecommunication Engineering)

Semester-VI (as per NEP) w.e.f. 2025-26

ENTMDM- 04 A : Advaned Microcontrollers

Teaching Scheme:
Lectures – 2 Hours/week, 2 credits
Practicals –2 Hours/week, 1 credit

Examination Scheme:
ESE – 70 Marks
ISE – 30 Marks
ICA– 25Maks

Course Prerequisite:

Student shall have knowledge of Digital Techniques, Microprocessors and Microcontrollers

Course Objectives:

1. To describe features and architecture of Advanced Microcontrollers

2 To get the knowledge of Assembly language/ embedded C programming, hardware interfacing and various applications of advanced microcontrollers.

3 To describe features and architecture of Arduino Uno with Installation.

4. To impart the knowledge of interfacing various sensors and peripherals with Arduino Uno and applications

Course Outcomes:

At the end of this course, students will be able to –

1. Understand the features and architecture of Advanced Microcontrollers ARM LPC2148

2. Study embedded Assembly language / C programming, hardware interfacing and various applications of advanced microcontrollers.

3. Understand the features and architecture of Ardunio Uno with installation.

4. Demonstrate and interfacing various sensors and peripherals with Arduino Uno.

SECTION – I

Unit 1: Advanced Microcontrollers System Architecture (08 Hrs)

ARM processor fundamentals , features , ARM Architecture - Introduction to ARM7TDMI core architecture, Register, CPSR, Pipeline , Exceptions and interrupts , Interrupt vector table , ARM extension family , ARM LPC 2148, ARM instruction set and thumb instruction set required for programming , memory management .

Unit 2: Programming, Hardware interfacing and Applications (07 Hrs)

Introduction to Embedded C Programming. Interfacing of devices – LED, Switches (buttons), 7-segment display, LCD display, DC motor / stepper motor, Interfacing of LM35 Temperature Sensor with LPC 2148, Case studies like Digital Camera.

SECTION – II

Unit 3: Architecture, Installation of Arduino and applications of ardunio. (07 Hrs)

Introduction to Arduino, features, Architecture of Ardunio UNO, Pin Diagram and Pin description of ardunio Uno, Arduino setup and installation with computer / laptop, Various Applications of Ardinio.

Unit 4: Interface various Sensors and peripherals using Arduino. (08 Hrs)

Interfacing of LED with Arduino. Interfacing of Bluetooth with Ardunio. Interface Ultrasonic Sensor, PIR Sensor, IR Sensor, Smoke & Gas Sensor, Capacitive touch Sensor , Temperature and humidity Sensor, LDR, Soil Moisture detection Sensor using Arduino.

Internal Continuous Assessment (ICA):

Minimum 08 Experiments on above curriculum.

Suggested List of Practical's:

1. Arithmetic and Logic operations
2. Interfacing of Switches, LEDs and Buzzer with ARM
3. Interfacing of LCD Display and display key pressed on LCD / Seven Segment Display with A RM
4. Interfacing of Stepper motor / DC motor with ARM
5. Interfacing of Matrix Keyboard/ Keypad with ARM
6. Interfacing of LED with Arduino
7. Interfacing LDR with Arduino.
8. Interface Temperature and humidity Sensor with Arduino
9. Interfaces Ultrasonic Sensor with Arduino
10. Interface PIR / IR sensor with Arduino
11. Interfacing of Bluetooth with Ardunio
12. Interfacing of Soil Moisture detection Sensor with Arduino.

Text Books:

1. Embedded Systems: Architecture, Programming and Design by Rajkamal Tata McGraw-Hill Education
2. ARM System Developer's Guide, Designing and Optimizing System Software - Andrew N. Sloss, Dominic Symes, Chris Wright - Morgan Kaufmann Publisher
3. DR.K.V.K.K. Prasad - Embedded / real time system – Dramatic, Asia LPE (Second Edition)
4. Frank Vahid - Embedded Systems - Wiley India
5. Embedded systems software primer - David Simon – Pearson
6. J. Fraden, Handbook of Modern Sensors: Physical, Designs, and Applications, AIP Press, Springer
7. Sensors and Actuators Engineering System Instrumentation by Clarence W deSilva

Reference Books:

1. Datasheet of LPC 2148
2. Embedded real time systems Programming – Iyer, Gupta, TMH
3. Embedded systems: a contemporary design tool, James K. Peckol- Wiley India
4. Handbook of Embedded System
4. Handbook of Ardunio.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
T. Y. B. Tech (Electronics & Telecommunication Engineering)

Semester-VI (as per NEP) w.e.f. 2025-26

ENTMDM- 04 B : Industrial IOT

Teaching Scheme:
Lectures – 2 Hours/week, 2 credits
Practicals –2 Hours/week, 1 credit

Examination Scheme:
ESE – 70 Marks
ISE – 30 Marks
ICA– 25Maks

Course Objective:

1. To provide students with good depth of knowledge of Designing Industrial IOT Systems for various application.
2. Knowledge for the design and analysis of Industry 4.0Systems for Electronics Engineering students.

Course Outcome:

At the end of this course, students will be able to:

1. Knowledge of theory and practice related to Industrial IoT Systems.
2. Ability to identify, formulate and solve engineering problems by using Industrial IoT.

Section-I

Unit 1: Introduction to Industrial IoT (IIoT) Systems: (07Hrs)

Definition of IIoT, Structure of IIoT, Difference between IoT and IIoT, Role of Internet of Things (IoT) & Industrial Internet of Things (IIoT) in Industry, Industry 4.0 revolutions, Support System for Industry 4.0, Smart Factories

Unit 02: Implementation systems for IIoT: (08 Hrs)

Sensors and Actuators for Industrial Processes, Sensor networks, Process automation and Data Acquisitions on IoT Platform, Wireless Sensor nodes with Bluetooth, WiFi, and LoRa Protocols and IoT Hub systems.

Section-II

Unit 03: IIoT Data Monitoring & Control: (07Hrs)

IoT Gate way, IoT Edge Systems and It's Programming, Cloud computing, Real Time Dashboard for Data Monitoring, Data Analytics and Predictive Maintenance with IIoT technology.

Unit 04: Industrial IoT- Application & Security Concern: (08Hrs)

IIoT in Manufacturing Industry, IIoT security, Types of Industrial need IoT Security, Security concern of IIoT, Secure Remote access for IIoT devices,

---

Internal Continuous Assessment:

Perform any 6 experiments on above mentioned syllabus using any software/simulation tool.

Text Books:

1. Industry 4.0: The Industrial Internet of Things, by Alasdair Gilchrist Publications: Apress
2. The Concept Industry 4.0 An Empirical Analysis of Technologies and Applications in Production Logistics, by Bartodziej, Christoph Jan Springer: Publication in the field of economic science.
3. IoT Security, by Kazi Kutubuddin Sayyad Liyakat, Lap Lambert Academic Publishing, ISSN: 978-620-8-42099-4**.**

Reference Books:

1. Embedded System: Architecture, Programming and Design by Rajkamal, TMH3.
2. Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems", by Dr. OvidiuVermesan, Dr. Peter Friess, River Publishers