

SIPNA COLLEGE OF ENGINEERING & TECHNOLOGY, AMRAVATI

An Autonomous Institute Affiliated to

Sant Gadge Baba Amravati University, Amravati, Maharashtra (India)

(Approved by AICTE, New Delhi and Recognized by DTE, Maharashtra)

(Accredited With 'A+' Grade by NAAC)



Bachelor of Technology (B. Tech.)

Third Year Syllabus: Semester V and VI




Department of Electronics and Telecommunication Engineering

(Semester Pattern)

Effective from Academic Year 2026-27

Prepared By: Boards of Studies-Electronics and Telecommunication Engineering

Approved By: Academic Council -Sipna COET, Amravati

			30/03/2026	1.00
Chairman Board of Studies	Dean Academics	Chairman Academic Council	Date of Release	Version



Program: B. Tech. (Electronics and Telecommunication Engineering)				Semester: V				
Course: Microprocessor & Microcontrollers				Code:		BTETPC14ET5T		
Teaching Scheme				Evaluation Scheme				
Lecture	Tutorial	Hours	Credit	TA	MSE-I	MSE-II	ESE	Total
3	-	3	3	10	15	15	60	100
Methods of Teacher Assessment (TA): Regular Class Assignment, Attendance, Viva etc...								
Course Objectives:								
<ol style="list-style-type: none"> 1. To understand the fundamentals of microprocessor Intel 8085. 2. To deal interfacing and assembly language programming of Intel 8085 with Intel 8255. 3. To study microcontroller 8051 and its architecture. 4. To perform assembly language programming with Intel 8051. 5. To interface and program ADC 0809 with microcontroller 8051 6. To equipped with measurement of physical quantities using microcontroller 8051. 								
After completion of the course, the students will be able to:								
CO	Course Outcomes							BT Levels
CO-1	Describe the internal architecture, addressing modes and functioning of 8085 microprocessors.							L 2
CO-2	Understand PPI 8255 with its interfacing and programming with 8085							L2
CO-3	Illustrate the architecture & Memory interfacing for 8051 microcontroller.							L3
CO-4	Implement assembly language programs using the 8051 instruction set.							L3
CO-5	Elaborate with timers, counters, and interrupts of 8051.							L 2
CO-6	Design and development of microcontroller-based system using ADC and LCD.							L5

Unit I: Introduction to Microprocessors (6 Hrs.)

Intel 8085 Pin Diagram & Architecture, addressing modes and overview of instruction set, Program control and Stack related instructions, Interrupt system.

Unit II: I/O Interfacing & Programming of Intel 8085 (6 Hrs.)

Address space partitioning schemes with its related instructions. Architecture, interfacing and programming of Intel 8085 with Intel 8255 PPI

Unit III: Introduction to Microcontrollers and 8051 Architecture (6 Hrs.)

Difference between Microprocessor and Microcontroller, Intel 8051 signal description and architecture, Register set, Memory organization and interfacing.

Unit IV: - 8051 Instruction Set and Programming (6 Hrs.)

Addressing modes and instruction types, Instruction set: Data transfer, Arithmetic, Logical, Branching, Assembly language programming examples.

Unit V: Timers, Counters, and Interrupts in 8051 (6 Hrs.)

Handwritten signature
Approved in 4th
Academic Council Meeting 1
Dated: 30/03/2024



Timer and Counter structure, Modes of operation, Serial communication registers and modes in 8051, Interrupt structure of Intel 8051.

Unit VI: Interfacing Applications

(6 Hrs.)

Architecture, Interfacing and programming of ADC 0808/09 with 8051. Measurement of physical quantities using microcontroller, LCD Interfacing.

Total: 36

Text Books:

1. **Ramesh S. Gaonkar**, *Microprocessor Architecture, Programming and Applications with 8085*, Penram International.
2. **Muhammad Ali Mazidi & Janice Gillispie Mazidi**, *The 8051 Microcontroller and Embedded Systems*, Pearson Education.
3. **Ajay Deshmukh**, *Microcontrollers: Theory and Applications*, Tata McGraw-Hill.

Reference Books:

1. **Kenneth J. Ayala**, *The 8051 Microcontroller: Architecture, Programming and Applications*, Penram International.
2. **Han-Way Huang**, *The 8051 Microcontroller and Embedded Systems Using Assembly and C*, Cengage Learning.
3. **Raj Kamal**, *Embedded Systems: Architecture, Programming and Design*, McGraw-Hill Education.
4. **Steve Furber**, *ARM System-on-Chip Architecture*, Addison-Wesley.

MOOC Links:

- 1) NPTEL – Microprocessors and Microcontrollers (IIT Kharagpur)
https://onlinecourses.nptel.ac.in/noc22_ee12/preview_NPTEL
- 2) NPTEL – Introduction to Microcontrollers & Microprocessors (IIT Kanpur) –
https://nptel.ac.in/courses/117104072_NPTEL
- 3) NPTEL – Microprocessors and Microcontrollers (IISc Bangalore) –
https://nptel.ac.in/courses/106108100_NPTEL
- 4) NPTEL – Microprocessors and Microcontrollers (IIT Kharagpur) –
<https://nptel.ac.in/courses/108105102>

AS Approved in..... 4th
Academic Council Meeting
Dated:-..... 30/03/2020



Program:	B. Tech. (Electronics and Telecommunication Engineering)			Semester:	V
Course:	Microprocessor & Microcontrollers Lab			Code:	BTETPC15ET5P
Teaching Scheme				Evaluation Scheme	
Practical	Tutorial	Hours	Credit	INT	EXT
02	00	02	01	30	20
					Total
					50

Course Objectives:


1. To understand the fundamentals of various arithmetic operations.
2. To perform assembly language programming using looping instructions.
3. To develop skills for sorting of numbers using assembly language programming.
4. To implement interfacing and assembly language programming of peripherals with Intel 8085.
5. To interface and program ADC 0809 with microcontroller 8051
6. To achieve an experience for measurement of physical quantities using microcontroller 8051.

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

CO	Course Outcomes	BT Levels
C01	Build the assembly language program for various arithmetic operations.	L3
C02	Execute assembly language program using looping instruction	L3
C03	Acquire skills for sorting of numbers using assembly language	L3
C04	Organising Interfacing of peripherals with assembly language programming	L4
C05	Integrating Interfacing and programming of microcontroller 8051 with ADC 0809	L4
C06	Design for measurement of physical quantities using microcontroller 8051	L5

Experiment List

- 1) Write and execute 8085 ALP for addition and subtraction of two 8 bit numbers from memory & store Result at next location of memory.
- 2) Write and execute 8085 ALP for multiplication of two 8 bit numbers from memory and store the result in memory.
- 3) Write and execute 8085 ALP for addition of series of 8 bit numbers from memory and store the result in memory.
- 4) Write and execute 8085 ALP for smallest/largest numbers from an array of memory.
- 5) Interfacing and programming of Intel 8085 with Intel 8255 PPI for I/O Mode
- 6) Interfacing and programming of Intel 8085 with Intel 8255 PPI for BSR Mode
- 7) Interfacing and Programming of Intel 8051 microcontroller with ADC 0808/09.
- 8) Measurement of physical quantities using microcontroller 8051.



Approved in.....*4th*.....
 Academic Council Meeting
 Dated:- *30/03/2020*.....



Program:	B. Tech. (Electronics and Telecommunication Engineering)	Semester:	V
Course:	Digital Signal Processing	Code:	BTETPC16ET5T
Teaching Scheme		Evaluation Scheme	
Lecture	Tutorial	Hours	Credit
03	-	03	03
		TA	MSE-I
		10	15
		MSE-II	ESE
		15	60
		Total	100

Methods of Teacher Assessment (TA): Class Tests, Assignments & Class Attendance

Course Objectives:

- Understand discrete-time signals, systems, convolution, and Z-transform with ROC.
- Apply DFT and FFT for frequency-domain analysis of discrete-time signals.
- Design and realize FIR and IIR digital filters using standard methods.
- Explore multirate DSP, filter banks, DSP processors, and applications.

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

CO	Course Outcomes	BT Levels
CO-1	Analyze the discrete-time signals and identify the type of system.	L4
CO-2	Analyze Z-Transform of various signals along with its ROC.	L4
CO-3	Evaluate the Fourier transform of discrete signal.	L3
CO-4	Design of FIR filters.	L5
CO-5	Design of IIR filters.	L5
CO-6	Understand the concepts of Multirate Digital Signal Processing, need of Filter banks and applications of DSP Processor.	L2

Unit I: Introduction to Discrete Time Signals [DTS] (6 Hrs.)

Discrete Time Signal, representations of DTS, Basic Signal Operations, Linear Convolution by using Analytical and Graphical Method.

Unit II: Z-Transform (6 Hrs.)

Definition and Properties of Z-Transform, Concept of Region of Convergence [ROC], Inverse Z-transform using long division method, PFE method and residue method

Unit III: Discrete and Fast Fourier Transform (6 Hrs.)

Definition and Properties of DFT, IDFT. Circular convolution of sequences using DFT and IDFT. Fast Fourier Transforms (FFT), Radix-2 decimation in time and decimation in frequency FFT. [Numerical based on DIT-FFT & DIF-FFT]

Unit IV: Finite Impulse Response (FIR) filters (6 Hrs.)

Design techniques for FIR filter by windowing method: Rectangular window and Hamming Window. Realization of basic structure FIR system: Direct form and Cascade.

Unit V: Infinite Impulse Response (IIR) filters (6 Hrs.)

IIR Filter Design by Mapping of S-plane to Z-plane: impulse invariance method, bilinear transformation method. Design of Butterworth and Chebyshev Filters. Realization of basic structure IIR system: Direct form-I, Direct Form-II, Cascade & Parallel.

Approved in.....
 Academic Council Meeting
 Dated: 30/08/2026 4



Unit VI: Multirate Digital Signal Processing

(6 Hrs.)

Sampling, Sampling rate conversion, multi-level filter bank. Overview and architecture of DSP processor TMS320C54XX. Applications of DSP (Only Block Diagram): Speech Signal, RADAR & SONAR.

Total: 36

Textbooks:

- 1) Nagoorkani, "Digital Signal Processing", Tata McGraw-Hill Education, Second Edition.
- 2) S.Salivahanan, A.Vallavaraj, "Digital Signal Processing", Tata McGraw-Hill Education, 2001.

Reference Books:

1. Oppenheim & Schaffer, "Discrete Time Processing", PHI.
2. Proakis & Manolakis D.G., "Digital Signal Processing", PHI.
3. Mitra S.K., "Digital Signal Processing", TMH.
4. Roman Kuc, "Digital Signal Processing", MGH.
5. Ifeacher E.C., Jervis B.W., "Digital Signal Processing", Addison Wesley.
6. P.P.Vaidyanathan, "DSP and Multirate Systems", PHI.

AD
Approved in.....*4th*
Academic Council Meeting
Dated:-...*30/03/2019*.....



Program:	B. Tech. (Electronics and Telecommunication Engineering)	Semester:	V
Course:	Digital Signal Processing Lab	Code:	BTETPC17ET5P
Teaching Scheme		Evaluation Scheme	
Practical	Tutorial	Hours	Credit
02	-	02	01
		INT	EXT
		30	20
			Total
			50

Course Objectives:

1. To familiarize students with MATLAB as a computational tool for digital signal processing.
2. To enable students to generate and manipulate standard discrete-time signals.
3. To develop skills for implementing convolution, correlation, and other signal operations using programming.
4. To help students understand and visualize system characteristics through pole-zero plots and related analyses.
5. To provide hands-on experience with DFT/FFT algorithms and their applications in spectral analysis.
6. To train students in designing and implementing digital FIR filters using window techniques.

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

CO	Course Outcomes	BT Levels
CO1	Generate standard discrete-time sequences and perform basic operations using MATLAB	L3
CO2	Implement linear convolution, circular convolution, and understand their differences through programming.	L4
CO3	Compute auto-correlation and cross-correlation of signals and interpret the results.	L4
CO4	Construct and analyze pole-zero plots to understand system behaviour.	L4
CO5	Compute DFT using FFT/IFFT and evaluate frequency-domain characteristics of signals.	L4
CO6	Design FIR filters such as low-pass filters using Hamming Window and evaluate their performance.	L5

Experiment List

1. Introduction to MATLAB and its features.
2. Generation and representation of Standard Discrete sequence.
3. Perform a Basic Operation on Signals (Add, Sub, Multiplication, Scaling).
4. Write a program to Perform Linear Convolution.
5. Write a program to Analysis of Region of Convergence (ROC) for Different Signals
6. Write a Program to design pole zero plot.
7. Write a program to Perform Circular Convolution using FFT/IFFT.
8. Write a program to Implementation of Radix-2 DIT-FFT Algorithm in MATLAB
9. Write a program to design Filter using Rectangular Window Method of size11
10. Write a program to design FIR low pass Filter.
11. Write a program to Perform Sampling Rate Conversion (Interpolation and Decimation)

Approved in.....
Academic Council Meeting
Dated:- 30/03/2026



Program:	B. Tech. (Electronics and Telecommunication Engineering)	Semester:	V
Course:	Power Electronics	Code:	BTETPC18ET5T
Teaching Scheme		Evaluation Scheme	
Lecture	Tutorial	Hours	Credit
3	0	3	3
TA	MSE-I	MSE-II	ESE
10	15	15	60
			Total
			100

Methods of Teacher Assessment (TA): Class Tests, Assignments & Class Attendance

Course Objectives:

1. To introduce power electronics devices; SCR, TRIAC, IGBT, MOSFET and to learn their characteristics.
2. To study Series & Parallel circuits of SCRs.
3. To study principle of phase control & various rectifiers.
4. To study forced commutated circuits and various inverters.
5. To study the basics principle of chopper & cycloconverter.
6. To study various applications of Power Electronics.

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

CO	Course Outcomes	BT Levels
CO-1	state fundamental knowledge of various devices of Thyristor family.	L1
CO-2	Classify series & parallel circuits of SCR.	L2
CO-3	Understand the concepts of principle of phase control & able to Design various controlled rectifier.	L2
CO-4	Analyze the performance of forced commutated circuits and various inverters.	L4
CO-5	Analyze the basics principle of chopper & cycloconverter.	L4
CO-6	Demonstrate various applications of Power Electronics.	L3

Unit I: (6 Hrs.)

SCR, DIAC, TRIAC-construction, characteristics, two transistor analogy of a SCR, dynamic turn ON/OFF mechanism, Introduction to GTO, Power MOSFET, IGBT - their construction & characteristics.

(6 Hrs.)

Unit II:

Series parallel operation of SCRs, static & dynamic equalizing circuits, equalization of current in parallel connected SCRs, string efficiency, de-rating factor, protection of SCRs against di/dt, dv/dt, radio frequency, interference.

(6 Hrs.)

Unit III:

Principle of phase control, half wave-controlled rectifier, half controlled bridge & fully controlled bridge rectifier for resistive and R-L load, derivation for output voltage and current, effect of free-wheeling diode, single phase dual converters.

(6 Hrs.)

Unit IV:

Classification of circuit for forced commutation, series inverter, improved series inverter, parallel inverter, principle of operation for three phase bridge inverter in 120 deg. and 180 deg. mode, single phase transistorized bridge inverter.

Syllabus - Semester V & VI : 1.0

AP
Approved in.....*gh*

Academic Council Meeting 7

Dated:-...*30/03/2028*.....



Unit V:

(6 Hrs.)

Basic principles of chopper, time ratio control and current limit control techniques, voltage commutated chopper circuits, Jones chopper, step-up chopper and AC chopper, Basic principle of cycloconverter, single phase to single phase cycloconverter.

Unit VI:

(6 Hrs.)

Speed control of DC series motors using chopper, speed control of DC shunt motor using phase-controlled rectifiers, Static circuit breakers, UPS, fan speed regulator.

Total: 36

Textbooks:

- 1) M. Ramamoorthy, *An Introduction to Thyristors and Their Applications*, 2nd Edition, Affiliated East-West Press Pvt. Ltd., New Delhi, 1991
- 2) M. H. Rashid - *Power Electronics Circuits, Devices and Application*, Pearson Edu. 4th Edition
- 3) K. B. Khanchandani & M. D. Singh, *Power Electronics*, 2nd Edition, McGraw-Hill Education (India), New Delhi, 2006.

Reference Books:

- 1) Joseph Vithayathil, "Power Electronics: Principles and Applications", McGraw-Hill
- 2) Ned Mohan, Tore M. Undeland, William P. Robbins, "Power Electronics: Converters, Applications, and Design", Wiley
- 3) K. Hari Babu – Power Electronics, Scitech Pub.
- 4) Devdatta Y. Shingare, A Textbook of Industrial & power electronics, Electrotech Pub. Satara.

MOOC Links:

1. https://onlinecourses.swayam2.ac.in/ntr25_ed137/preview
2. https://onlinecourses.swayam2.ac.in/ntr26_ed34/preview


Approved in..... 4th
Academic Council Meeting
Dated:-... 30/03/2020 8



Program:	B. Tech. (Electronics and Telecommunication Engineering)			Semester:	V	
Course:	Power Electronics Lab			Code:	BTETPC19ET5P	
Teaching Scheme				Evaluation Scheme		
Practical	Tutorial	Hours	Credit	INT	EXT	Total
02	0	02	01	30	20	50

Course Objectives:


1. To understand the characteristics of power electronic devices like SCR, TRIAC, DIAC, IGBT.
2. To verify the effect of firing angle in phase-controlled converters.
3. To understand the turn off mechanism of SCR.
4. To verify the working of Series & Parallel Inverter
5. To verify the working of Choppers.
6. To understand the fan speed regulator using SCR.

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

CO	Course Outcomes	BT Levels
C01	Analyze the characteristics of various power electronics devices.	L4
C02	Understand SCR firing circuits.	L2
C03	Realize SCR commutation techniques.	L2
C04	Illustrate the operation of Series & Parallel Inverter	L3
C05	Understand the operation of Choppers	L2
C06	Explain the operation of Fan Speed Regulator using SCR	L2

Experiment List

1. To verify the Characteristics of SCR.
2. To verify the Characteristics of DIAC.
3. To verify the Characteristics of TRIAC.
4. To verify the Characteristics of IGBT
5. To verify the effect of firing angle on output voltage in single phase half wave/ full wave rectifier
6. To verify the working of SCR Commutation
7. To verify working of Series Inverter
8. To verify working of Parallel Inverter
9. To verify the working of Step-Down Chopper Using SCR
10. To study fan speed regulator using SCR.


 Approved in.....
 Academic Council Meeting
 Dated:- 30/03/2020



Program:	B. Tech. (Electronics and Telecommunication Engineering)	Semester:	V
Course:	PE I: Fiber Optic Communication	Code:	BTETPE01ET5T
Teaching Scheme		Evaluation Scheme	
Lecture	Tutorial	Hours	Credit
03	01	4	4
TA	MSE-I	MSE-II	ESE
10	15	15	60
			Total
			100

Methods of Teacher Assessment (TA): Class Tests, Assignments & Class Attendance

Course Objectives:

- 1) To provide comprehensive knowledge of fiber optic fundamentals, optical laws, fiber types, numerical aperture, and propagation modes.
- 2) To enable students to understand and analyze attenuation mechanisms and dispersion effects in optical fiber transmission.
- 3) To familiarize students with working principles, characteristics, and efficiency of optical sources
- 4) To develop understanding of photodetector types, performance parameters, and noise characteristics in optical receivers.
- 5) To introduce passive and active optical components used in fiber optic networks for signal processing and management.
- 6) To provide knowledge of optical amplification techniques and wavelength division multiplexing for high-capacity systems.

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

CO	Course Outcomes	BT Levels
CO-1	Analyze fiber optic communication and calculate numerical aperture, acceptance angle, and mode volume for different fiber types	L3
CO-2	Classify fiber losses and analyze different types of dispersion in optical fibers.	L3
CO-3	Describe LED and laser diode structures and evaluate their efficiency	L5
CO-4	Analyze the operation of optical detectors and key performance parameters.	L4
CO-5	Understand functions of passive and active optical components used in fiber optic networks.	L2
CO-6	Comprehend optical amplifier principles (SOA, EDFA, Raman) and explain WDM/DWDM concepts.	L1

Unit I: Optical Fiber Communication System:

(6 Hrs.)

Advantages of Fiber Optic communication, Block Diagram of fiber optic communication. Basic optical laws and definitions, Numerical Aperture, Optical fiber modes and configurations, Step index fibers, Graded index fibers, Single mode fibers.

Unit II: Attenuation

(6 Hrs.)

Attenuation, absorption losses, scattering losses, bending losses, dispersion, intramodal - intermodal dispersion.

Unit III: Light Sources

(6 Hrs.)

Basic concepts: Absorption and emission of radiation, Population inversion, Optical feedback and laser oscillation, Threshold condition for laser oscillation, The semiconductor injection laser, Efficiency, Optical emission from semiconductors from p-n junction, Spontaneous emission, Direct and indirect bandgap semiconductors LED, double heterojunction LED, power and efficiency.



Unit IV: Photodetectors

(6 Hrs.)

Optical detection principle, absorption coefficient, quantum efficiency, responsivity, PN and PIN photo diode, noise in photodiode, APD and Multiplication factor.

Unit V: Optical Components

(6 Hrs.)

Passive Components: optical couplers, isolators, circulators, filters, gratings, and wavelength multiplexers. Active components: optical attenuators, tunable optical filters, dynamic gain equalizers, optical add/drop multiplexers, polarization controllers, and dispersion compensators

Unit VI: Optical Amplifiers and Basics of Wavelength Division Multiplexing

(6 Hrs.)

Semiconductor Optical Amplifier: Basic configuration of SOA, Erbium doped fiber amplifier: Configuration and operating principle of EDFA, Fiber Raman amplifier: configuration of FRA. Wavelength-division Multiplexing: Introduction and concept of WDM and Dense WDM

Total: 36

Textbooks:



- 1) Senior J.M.: "Optical Fiber Communication and Application", Prentice Hall of India Pvt. Ltd., New Delhi.
- 2) G. Keiser: "Optical Fiber Communication", Mc-Graw Hill International Book Co., New York.
- 3) R. P. Khare: "Fiber Optics and Optoelectronics", Oxford University Press

Reference Books:

- 1) 1. Gowar: "Optical Communication System", Prentice Hall
- 2) 2. J. H. Franz and V. K. Jain: "Optical Communications, Components and System", Narosa Publication
- 3) 3. Ghatak & Thyagarajan: "Optical Electronics", Cambridge foundation.
- 4) 4. Djafar K. Mynbaev, Lowell I. Scheiner: "Fiber Optic Communication Technology", LPE, Pearson Education, 2001.

MOOC Links:

- 1) NPTEL - Fiber Optic Communication Systems and Techniques-
<https://nptel.ac.in/courses/108104113>
- 2) Swayam - Fiber Optics- https://onlinecourses.nptel.ac.in/noc20_ph07/preview

  4th
Approved in.....
Academic Council Meeting
Dated: 30/03/2026.....



Program:	B. Tech. (Electronics and Telecommunication Engineering)	Semester:	V
Course:	Control System	Code:	BTETPE02ET5T
Teaching Scheme		Evaluation Scheme	
Lecture	Tutorial	Hours	Credit
3	1	4	4
		TA	MSE-I
		10	15
		MSE-II	ESE
		15	60
			Total
			100

Methods of Teacher Assessment (TA): Class-Test, Assignment, Quiz.

Course Objectives:

- 1) Introduce the fundamentals of control systems and basic system modeling.
- 2) Develop the ability to derive and simplify block diagrams and signal-flow graphs.
- 3) Analyze time-domain behavior and evaluate system performance.
- 4) Assess system stability using Routh's stability criteria and root-locus methods.
- 5) Evaluate frequency-domain characteristics using Bode and Polar plots.
- 6) Understand industrial control technologies such as PID, PLCs, SCADA, IoT, and AI-based control systems.

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

CO	Course Outcomes	BT Levels
CO-1	Explain different control systems, create basic mathematical models, and convert mechanical systems into electrical analogies.	L2
CO-2	Determine transfer functions from block diagrams and signal flow graph. Simplify block diagrams, find system gain using signal-flow graphs and analyse MIMO systems	L4
CO-3	Analyze system time response and evaluate transient and steady-state errors.	L4
CO-4	Evaluate system stability and draw root locus plots to observe the impact of poles and zeros.	L5
CO-5	Analyze frequency response using Bode plot to determine system stability and understand the basics of Polar and Nyquist plots.	L4
CO-6	Describe the basics of PID, PLCs, and SCADA systems used in industrial control.	L2

Unit I: Basics of Control system

(6 Hrs.)

Types of control systems Classification of control system, Mathematical modelling of Physical Systems, Electrical Analogous Systems, Force -voltage analogy, force- Current analogy.

Unit II: Control system Representation

(6 Hrs.)

Block diagram reduction technique, rules for block diagram reduction. Analysis of multiple input multiple output systems, properties of signal flow graphs, Mason's gain formula, basic control actions.

Unit III: Time Response Analysis

(6 Hrs.)

Standard test signals, Time response of first order and second order system, impulse response function, Transient domain specifications, Steady state analysis: steady state error and error constants, dynamic error coefficients

Unit IV: Stability of Control System

(6 Hrs.)

Concept of stability, necessary conditions for stability, Routh stability criterion. Root locus Techniques: Introduction, Construction of root locus, construction rules, Stability analysis of systems using root locus,

Academic Council Meeti
Dated:- 30/03/2026



Effect of addition of open loop zeros & poles.

Unit V: Frequency- Domain analysis:

(6 Hrs.)

Introduction, correlation between time and frequency response, Bode plot: general procedure for construction, Gain margin and phase margin, Stability analysis of systems using Bode plots. Introduction to Polar plots, Nyquist stability criterion.

Unit VI: Industrial Control Systems & Emerging Trends:

(6 Hrs.)

Introduction to PID Controller's, Adaptive control system, Industrial control systems overview (PLCs, SCADA,), Introduction to IoT in control system and AI based Control System.

Total: 36

Textbooks:

- 1) Nagrath I. J. and M. Gopal, "Control Systems Engineering", 5th Ed. New Age International.
- 2) K. Ogata: Modern Control Engineering, Fourth Edition (PHI) Microelectronic Circuits – Adel S. Sedra, Kenneth C. Smith (Oxford University Press)
- 3) John W. Webb and Ronald A. Reis, "Programmable Logic Control: Principles and Applications", Pearson; 4th edition .

Reference Books:

1. Richard C. Dorf and Robert H. Bishop, "Modern Control Systems", 11th Ed., Pearson Education.
2. M. Gopal, "Control System – Principles and Design", Tata McGraw Hill, 4th Edition, 2012.
3. Norman S. Nise, "Control System Engineering", 5th Edition, Wiley.
4. Bhattacharya: Control System Engineering, 2nd Edition (Pearson Education).
5. Benjamin C. Kuo , Automatic Control System "JOHN WILEY & SONS, INC. 9th Edition
6. NIIT, Programmable Logic Control: Principles and Applications, Prentice Hall India Learning Private Limited

MOOC Links:

1. NPTEL - Control Systems By Prof. C. S. Shankar Ram | IIT Madras https://onlinecourses.nptel.ac.in/noc25_de14/preview
2. udemy - <https://www.udemy.com/course/control-system-engineering-from-basic-to-advanced-concepts/?couponCode=UDEAFFHP22025>

Approved in... *GH*
Academic Council Meeting
Dated: *30/03/2016*



Program:	B. Tech. (Electronics and Telecommunication Engineering)	Semester:	V
Course:	AI with Python	Code:	BTETPE03ET5T
Teaching Scheme		Evaluation Scheme	
Lecture	Tutorial	Hours	Credit
03	01	04	04
		TA	MSE-I
		10	15
		MSE-II	ESE
		15	60
			Total
			100

Methods of Teacher Assessment (TA): Class-Test, Assignment, Quiz

Course Objectives:

1. Understand the fundamental concepts, history, and significance of Artificial Intelligence in modern technology.
2. To provide understanding of supervised learning techniques for prediction and classification.
3. To introduce unsupervised learning techniques for pattern discovery in data.
4. To introduce the concepts of deep learning and neural network architectures.
5. Use essential Python libraries such as NumPy, Pandas, Matplotlib, and basic ML frameworks.
6. Explore real-world AI applications and understand ethical and social issues related to AI.

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

CO	Course Outcomes	BT Levels
CO-1	Explain the fundamental concepts and types of AI.	L2
CO-2	Apply supervised learning methods such as regression and classification	L3
CO-3	Analyze data using clustering and identify hidden patterns.	L4
CO-4	Explain the basic working of neural networks and key Deep Learning models.	L2
CO-5	Implement basic Python programs and use libraries for data analysis and simple AI tasks.	L3
CO-6	Identify applications of AI in various domains and analyze ethical and social implications.	L4

Unit I: Fundamentals of Artificial Intelligence

(6 Hrs.)

Definition and concept of Artificial Intelligence, History and evolution of AI, Types of AI: Narrow AI, General AI, and Super AI, AI vs Human Intelligence.

Unit 2: Supervised Machine Learning Techniques

(6 Hrs.)

Introduction to Supervised Learning, Types of Supervised Learning Regression and Classification, Simple Linear Regression, KNN, Decision Tree, Basic applications of Supervised Learning

Unit 3: Unsupervised Machine Learning Techniques

(6 Hrs.)

Introduction to Unsupervised Learning, Types of Unsupervised Learning Clustering, K-Means Clustering, Hierarchical Clustering, Basic applications of Unsupervised Learning

Unit 4: Introduction to Deep Learning

(6 Hrs.)

Concept of Deep Learning, Fundamentals of Neural Networks, Architecture of Artificial Neural Networks, Deep Learning vs Machine Learning, Overview of Convolutional Neural Networks (CNN).

Unit 5: Python Programming for AI

(6 Hrs.)

Introduction to Python programming, Python data types and Identify applications of AI in various domains and analyze ethical and social implications. Functions and modules in Python, Python libraries for AI and data analysis: NumPy, Pandas, Matplotlib. Introduction to Machine Learning libraries (Scikit-



learn, TensorFlow)

Unit 6: AI Applications and Ethical Issues

(6 Hrs.)

Applications of AI in healthcare, education, industry, and robotics, Introduction to Natural Language Processing (NLP), Basics of Computer Vision, Social impact of AI, Ethical issues and challenges in AI, Future trends in Artificial Intelligence.



Total: 36

Text Books:

1. Stuart Russell and Peter Norvig, *Artificial Intelligence: A Modern Approach*, Pearson.
2. Ian Goodfellow, Yoshua Bengio, and Aaron Courville, *Deep Learning*, MIT Press.

Reference Books:

1. Tom Mitchell, *Machine Learning*, McGraw-Hill.
2. Ethem Alpaydin, *Introduction to Machine Learning*, MIT Press.
3. Christopher Bishop, *Pattern Recognition and Machine Learning*, Springer.
4. Simon Haykin, *Neural Networks and Learning Machines*, Pearson.
5. Sumeet Kumar, *Artificial Intelligence in Wireless Communications*, CRC Press.
6. S. Haykin, *Cognitive Radio: Brain-Empowered Wireless Communications*, IEEE Press.
7. Official documentation for Python, NumPy, Pandas, Scikit-learn, TensorFlow, PyTorch, LangChain, HuggingFace, Ollama
8. V A Gulhane, N T Gadare, S V Rode, *Generative Intelligence in Python*, IIP Publishers.
9. Python official documentation www.python.org

  gth
Approved in.....
Academic Council Meeting
Dated:---30/03/2026.....



Program: B. Tech. (Electronics and Telecommunication Engineering)		Semester: V	
Course: Comm. Engg. Project/ Field project		Code: BTETFP01ET5P	
Teaching Scheme		Evaluation Scheme	
Practical	Tutorial	Hours	Credit
02	-	02	01
		INT	Total
		50	50

Course Outcomes: To enable students to design and develop a real-world software or hardware-based solution by applying engineering principles, teamwork, and project management skills.

CO	Course Outcomes	BT Levels
CO-1	Identify a real-world problem and define appropriate project objectives.	L1
CO-2	Apply core Electronics & Telecommunication concepts to design an effective system solution.	L3
CO-3	Conduct surveys and case studies to collect relevant data using appropriate tools and methodologies.	L3
CO-4	Analyze the collected data using analytical and critical thinking skills to understand problem patterns and causes.	L4
CO-5	Propose feasible and innovative solutions to address the identified community problems.	L6
CO-6	Effectively present and communicate project findings and solutions to the community	L3

General Guidelines:

- 1) A group of 10 to 15 students shall select a project domain from the provided list. The selection is not restricted to the listed domains; students may propose an alternative domain with prior approval from the Chairman of the Board of Studies (BoS).
- 2) Students will prepare a case study and will deliver it in nearby community.
- 3) Model/Mobile app/Web app could also be prepared.

Domain List

- | | |
|---|---|
| 1. Healthcare & Biomedical Applications | 12. Social Welfare & E-Governance |
| 2. Agriculture & Smart Farming | 13. Tourism & Hospitality Management |
| 3. Education & E-Learning Systems | 14. Logistics & Supply Chain Management |
| 4. Banking & Financial Applications | 15. Sports & Fitness Applications |
| 5. Retail & E-Commerce Systems | 16. Library & Information Management |
| 6. Transportation & Traffic Management | 17. Automobile & Vehicle Management |
| 7. Smart City Applications | 18. Real Estate & Property Management |
| 8. Energy & Power Management | 19. Media & Content Management |
| 9. Manufacturing & Production Systems | 20. Human Resource & Office Automation |
| 10. Environment & Pollution Monitoring | |
| 11. Security & Surveillance Systems | |


 Approved in.....^{4th}.....
 Academic Council Meeting



Program:	B. Tech. (Electronics and Telecommunication Engineering)	Semester:	VI
Course:	Embedded System	Code:	BTETPC20ET6T
Teaching Scheme		Evaluation Scheme	
Lecture	Tutorial	Hours	Credit
3	-	3	3
TA	MSE-I	MSE-II	ESE
10	15	15	60
Total			
100			

Methods of Teacher Assessment (TA): Regular Class Assignment, Attendance, Viva etc...

Course Objectives:

1. To learn the building blocks and characteristics of embedded systems.
2. To examine architecture and inbuilt peripherals of AVR Microcontroller.
3. To execute the programs of AVR Microcontroller in C
4. To organising interfacing and programming with AVR Microcontroller in C
5. To look over different applications with programming in AVR C
6. To get familiar with ARM 7 Architecture

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

CO	Course Outcomes	BT Levels
CO-1	Recognize and summarize the quality attributes of Embedded System	L2
CO-2	Articulate the architecture and inbuilt peripherals of AVR Microcontroller	L2
CO-3	Prepare the programs of AVR Microcontroller in C	L3
CO-4	Analyse interfacing and programming with AVR Microcontroller in C	L3
CO-5	Appraise different applications like DC, Stepper motors through programming	L4
CO-6	Distinguish between RISC and CISC through ARM 7 Architecture	L4

Unit I: Introduction and Building blocks of Embedded systems (6 Hrs.)

Embedded systems vs. General computing systems, Classification of Embedded systems, Major application areas of Embedded systems, Core of the Embedded system, Sensors and Actuators, Characteristics of Embedded systems, Quality attributes of Embedded System.

Unit II: Introduction to AVR Microcontroller (6 Hrs.)

AVR microcontroller, History, Features and AVR family and its inbuilt Peripherals, Architecture of AT Mega 32: signal description, registers of AVR, Data Memory, data formats.

Unit III: AVR programming in C (6 Hrs.)

Data types & time delay, I/O programming, logical operation, data convergence program, data serialization.

Unit IV: - Interfacing and programming Peripherals of AVR Microcontroller in C (6 Hrs.)

Memory, Timer Structure, Watch dog timer, UART, Interrupt Structure, Digital to Analog convertors.

[Signature]
Approved in.....
[Signature]
Academic Council Meeting
Dated:- 30/03/2026



Unit V: Applications and Programming with AVR C

(6 Hrs.)

Keyboard, Sensors, relay, opto-isolator and stepper motor, PWM programming and DC motor

Unit VI: Introduction to ARM

(6 Hrs.)

Difference between CISC and RISC, Study of ARM Philips NXP LPC 2148 Microcontroller with details of 32-bit ARM7 Architecture

Total: 36

Text Books:

- 1) **Shibu K. V.**, *Introduction to Embedded System*, McGraw Hill Education.
- 2) **S.V. Iyer & Pankaj Gupta**, *Embedded Real-time Systems Programming*, McGraw Hill Education
- 3) **Muhammad Ali Mazidi, Sarmad Naimi and Sephers Naimi**, *AVR Microcontroller and Embedded systems using assembly and C*, Pearson Education, Inc. publishing as Prentice Hall 2013.

Reference Books:

1. **Raj Kamal**, *Embedded Systems: Architecture, Programming and Design*, McGraw-Hill Education.
2. **Steve Furber**, *ARM System-on-Chip Architecture*, Addison-Wesley.

MOOC Links:

- 1) NPTEL – Embedded System Design with ARM (IIT Kharagpur)
<https://nptel.ac.in/courses/106105193>
- 2) NPTEL – Embedded Systems (IIT Delhi)
<https://nptel.ac.in/courses/108102045>

Handwritten signature
Approved in.....
Academic Council Meeting
Dated:..... 30/03/2026



Program:	B. Tech. (Electronics and Telecommunication Engineering)			Semester:	VI	
Course:	Embedded System Lab			Code:	BTETPC21ET6P	
Teaching Scheme				Evaluation Scheme		
Practical	Tutorial	Hours	Credit	INT	EXT	Total
02	-	02	01	30	20	50

Course Objectives:


1. To understand the fundamentals of embedded systems and microcontroller architecture.
2. To learn the methods of interfacing input and output devices with a microcontroller.
3. To develop embedded C programs for data handling, conversion, and port operations.
4. To implement serial and parallel communication techniques using microcontroller ports.
5. To apply logical operations and control structures for real-time decision-making in embedded applications.
6. To gain hands-on experience in hardware interfacing such as sensors, LEDs, and seven-segment displays.

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

CO	Course Outcomes	BT Levels
C01	Identify and explain the components of an embedded system.	L1
C02	Write embedded C programs to perform I/O port operations on microcontrollers.	L2
C03	Acquire skills in number system conversions and data formatting (Hex, Decimal, BCD, ASCII).	L3
C04	Understand and implement serial communication using bit-level data transmission.	L4
C05	Interface sensors and actuators to develop simple real-time embedded applications.	L5
C06	Design and test programs that display numeric information using seven-segment displays or LEDs.	L5

Experiment List

- 1) To study Embedded Systems and its different components.
- 2) Write an AVR C program for outputting 8 bit data on any of the port.
- 3) Write and execute a program to toggle the LEDs of any port with some delay.
- 4) Write a program to convert packed BCD number and store ASCII number in the memory of microcontroller.
- 5) Write a program to send a byte data serially through pin of the output with first bit as LSB using microcontroller.
- 6) Write & execute an AVR C program for generation of triangular wave using DAC 0808.
- 7) Write & execute interacing and programming of DC motor with AVR C for clockwise and anticlockwise rotation
- 8) Write & execute interacing and programming of Stepper motor with AVR C for clockwise and anticlockwise rotation with concept of step angle
- 9) Study of ARM7 Architecure



Approved in.....^{4th}.....
 Academic Council Meeting
 Dated: 30/03/2026.....



Program:	B. Tech. (Electronics and Telecommunication Engineering)	Semester:	VI
Course:	UHF & Microwaves	Code:	BTETPC22ET6T
Teaching Scheme		Evaluation Scheme	
Lecture	Tutorial	Hours	Credit
3	-	3	3
		TA	MSE-I
		10	15
		MSE-II	ESE
		15	60
			Total
			100

Methods of Teacher Assessment (TA): Class Tests, Assignments, Viva -Voce

Course Objectives:

1. To understand the limitations of conventional devices and study microwave tubes like Klystron, Magnetron and TWT.
2. To Learn the working and applications of semiconductor microwave devices such as Gunn, IMPATT, TRAPATT diodes and MASERS.
3. To study waveguides and microstrip lines for microwave signal transmission.
4. To understand microwave resonators and their characteristics.
5. To analyse passive microwave devices using scattering parameters.
6. To perform key microwave measurements of frequency, power, VSWR, attenuation and impedance.

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

CO	Course Outcomes	BT Level
CO-1	Explain why conventional devices fail at microwave frequencies and describe the operation of Klystron, Magnetron and TWT.	L2
CO-2	Describe the structure, working, and applications of semiconductor microwave devices like Gunn and IMPATT diodes.	L2
CO-3	Analyze propagation of waves through rectangular and circular waveguides and determine the characteristics of microstrip lines.	L4
CO-4	Compute resonant frequencies and quality factors for different types of microwave resonators.	L3
CO-5	Use scattering matrix concepts to study and design basic passive microwave components.	L5
CO-6	Conduct and interpret microwave measurements such as power, frequency, VSWR, attenuation and impedance accurately.	L3

Unit I: Microwave Tubes

(6 Hrs.)

Limitation of Conventional devices at high frequency, Construction & working principle of Two cavity, Reflex klystron, Cylindrical Cavity Magnetron & TWT with supportive expressions.

Unit II: Semiconductor Microwave Devices

(6 Hrs.)

Construction & working of Gunn Diodes, IMPATT diodes, TRAPATT diodes & Parametric amplifiers and MASERS.

Unit III: Waveguide and Microstrip line

(6 Hrs.)

Waveguides: Principle of waveguide, Phase velocity & Group velocity, TE & TM Modes of propagation through rectangular wave guide & circular waveguide, Microstrip line: Introduction, characteristic impedance & losses in parallel microstrip line.

MO
Approved in.....*4th*.....



Unit IV: Microwave Resonator

(6 Hrs.)

Introduction, RLC circuits & resonant frequency, Transmission line resonators, Cavity resonators: rectangular and circular cavities and quality factor of resonators.

Unit V: Passive Microwave Devices

(6 Hrs.)

Scattering matrix formulation for E-plane Tee, H-plane Tee, Magic Tee, Directional Coupler, Principle of Faraday's rotation, Isolator, Gyrator & Circulator.

Unit VI: Microwave Measurements

(6 Hrs.)

Frequency Measurements, Power Measurements, Attenuation Measurements, VSWR Measurements & Impedance Measurements.

Total : 36

Textbooks:


1. Liao, Samuel Y., "Microwave Devices & Circuits", Tata Mc-Graw Hill Co. Ltd., New Delhi. 2
2. David M Pozar, "Microwave Engineering" Wiely 3 rd Edition.
3. Collin, Robert E., "Foundations for Microwave Engineering", Mc- Graw Hill, New York.

Reference Books:

1. Kennedy G., "Electronics Communication Systems", Tata Mc-Graw Hill Book Co., NewDelhi.
2. K.C. Gupta, "Microwave Engineering", New Age.
3. Reich, Scolnik, Ordnung, Krangs, "Microwave Principles", PHI.
4. M.L. Sisodiya and G.S. Raghuvanshi, "Microwave Circuits and Passive devices", John Wiley & Sons Ltd.
5. Mathew M. Radmanesh, "RF and Microwave Electronics – Illustrated", Prentice Hall.

MOOC Links:

1. <https://nptel.ac.in/courses/108101112>
2. <https://nptel.ac.in/courses/108103141>

 Approved in... 4th
Academic Council Meeting
Dated:- 30/03/2020



Program:	B. Tech. (Electronics and Telecommunication Engineering)	Semester:	VI
Course:	UHF & Microwave Lab	Code:	BTETPC23ET6P
Teaching Scheme		Evaluation Scheme	
Practical	Tutorial	Hours	Credit
2	-	2	1
		INT	EXT
		30	20
		Total	
		50	

Course Objectives:

1. To provide fundamental knowledge of passive microwave components and introduce students to scattering parameters used in microwave network analysis.
2. To develop practical understanding of VSWR measurements and load matching techniques using microwave bench equipment such as slide-screw tuners.
3. To familiarize students with the operation, characteristics, and tuning behavior of microwave vacuum tube devices, specifically the Reflex Klystron.
4. To enable students to understand propagation characteristics in waveguides, with emphasis on guide wavelength, free-space wavelength, and their inter-relationships.
5. To train students in impedance determination of unknown uniform load using smith chart.
6. To develop the ability to interpret and analyze V-I characteristics of microwave semiconductor devices such as the Gunn diode.

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

CO	Course Outcomes	BT Levels
CO1	Explain Passive microwave components and the scattering matrix evaluation.	L2
CO2	Demonstrate the concept of VSWR and Unknown load matching using slide screw tuner.	L3
CO3	Elaborate the characteristics of Reflex Klystron, relationship between repeller voltage and frequency of oscillation of reflex klystron.	L2
CO4	Distinguish between guide wavelength and free space wavelength along with the relationship between them.	L4
CO5	Determine impedance for unknown load by using graphical calculator, i.e smith chart.	L3
CO6	Analyze the plot of V-I Characteristics of Gun diode.	L4

Experiment List

- 1) To Study Series Tee, Shunt Tee and Magic Tee.
- 2) To study Directional Coupler, Isolator and Circulator.
- 3) To Determine VSWR for Horn Antenna.
- 4) To Matched Unknown Load with the system using slide screw tuner.
- 5) To Study characteristics of Reflex Klystron Tube.
- 6) To Determine guide wavelength and frequency.
- 7) To Demonstrate the relationship between the free space wavelength (λ_0) and guide wavelength (λ_g).
- 8) To Determine impedance of uniform load using smith chart.
- 9) To Study Characteristics of Gunn Diode.
- 10) To verify relationship between frequency of oscillation & repeller voltage of Reflex klystron.



Program:	B. Tech. (Electronics and Telecommunication Engineering)	Semester:	VI
Course:	Satellite Communication	Code:	BTETPE04ET6T
Teaching Scheme		Evaluation Scheme	
Lecture	Tutorial	Hours	Credit
3	1	4	4
		TA	MSE-I
		10	15
		MSE-II	ESE
		15	60
			Total
			100

Methods of Teacher Assessment (TA): Class Tests, Assignments & Class Attendance

Course Objectives:

1. To understand the frequency bands used in satellite communication
2. To know the basics of orbital mechanism, the types of satellite orbits and orbital aspects of Satellite communication.
3. To understand the various typical phenomenon in satellite communication.
4. To understand different satellite channel parameters.
5. To understand the working of different satellite subsystems
6. To understand the various services of satellite.

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

CO	Course Outcomes	BT Levels
CO-1	Visualize the architecture of satellite systems as a means of high speed, high range communication system.	L1
CO-2	Describe various aspects related to satellite systems such as orbital equations	L2
CO-3	Analyze typical phenomena in satellite communication	L4
CO-4	Categorize different losses and link analysis in satellite communication	L3
CO-5	Illustrate role of satellite sub systems	L2
CO-6	Understand VSAT and GPS	L3

Unit I: Unit Name: - Introduction to Satellite Communication: (6 Hrs.)

Principles and architecture of satellite Communication, Brief history of Satellite systems, advantages, disadvantages, applications and frequency bands used for satellite communication, satellite types - LEO, MEO, GEO, HEO

Unit II: Orbital Mechanics: (6 Hrs.)

Orbital equations, Kepler's laws, Apogee and Perigee for an elliptical orbit, evaluation of velocity, orbital period, angular velocity, look angle determination of a satellite, concepts of Solar day and Sidereal day. Geo stationary and non-Geo- stationary orbits.


Unit III: Typical Phenomena in Satellite Communication: (6 Hrs.)

Solar Eclipse on satellite, its effects, remedies for Eclipse, Sun Transit Outage phenomena, its effects and remedies, Doppler frequency shift phenomena and expression for Doppler shift, space launch vehicles

Unit IV: Satellite Channels: (6 Hrs.)

Electromagnetic field propagation, Atmospheric losses, Receiver noise, Carrier to Noise ratio, Satellite system link model: Uplink, Downlink, Cross link, Transponder, Satellite system parameters, Satellite link analysis, Frequency reuse and depolarization.

Unit V: Satellite sub-systems: (6 Hrs.)


 Approved in..... 4th
 Academic Council Meeting
 Dated:-...30/03/2016.....



Study of Architecture and Roles of various sub-systems of a satellite system such as Telemetry, tracking, command and monitoring (TTC & M), Attitude and orbit control system (AOCS), Communication sub-system, power sub-systems etc. Satellite link budget.

Unit VI: Very Small Aperture Satellite (VSAT) Satellite Navigation and Global Positioning System (GPS): (6 Hrs.)

Overview of VSAT system, Network architecture, Access control protocols, Signal format, Modulation coding and interference issues, VSAT antennas, Transmitter and Receiver, Link analysis for VSAT network.

Radio and Satellite navigation, Position, Location in GPS, GPS receivers and codes, GPS navigation message and signal levels, Timing accuracy, GPS receiver operation, Differential GPS

Total: 36

Textbooks:

1. Timothy Pratt Charles W. Bostian, Jeremy E. Allnutt: Satellite Communications: Wiley India. 2nd Edition, 2002
2. Tri T. Ha: Digital Satellite Communications: Tata McGraw Hill, 2009

Reference Books:

Dennis Roddy: Satellite Communication: 4th Edition, McGraw Hill, 2009

MOOCS Link

1. <https://nptel.ac.in/courses/101105077>.
2. <https://www.udemy.com/course/satcom-fundamentals-your-first-step-into-satellite-comms/>
3. <https://www.coursera.org/search?query=satellite%20communication>

AS
Approved in.....*21/3*.....
Academic Council Meeting
Dated:---*30/03/2020*.....



Program: B. Tech. (Electronics and Telecommunication Engineering)				Semester: VI				
Course: Computer Architecture				Code: BTETPE05ET6T				
Teaching Scheme				Evaluation Scheme				
Lecture	Tutorial	Hours	Credit	TA	MSE-I	MSE-II	ESE	Total
3	1	4	3	10	15	15	60	100
Methods of Teacher Assessment (TA): Regular Class Assignment, Attendance, Viva etc...								
Course Objectives:								
1. To Learn how computers work								
2. To understand different types of instruction formats and concepts of arithmetic operations								
3. To learn the concepts of microinstruction, its sequencing and execution.								
4. To study different types of memories and understand memory organization								
5. To acquire how I/O devices are organised and accessed.								
6. To recognize the concept of parallel processing and multi-processor architecture								
After completion of the course, the students will be able to:								
CO	Course Outcomes							BT Levels
CO-1	Familiarize with the basic concepts and structure of computers							L2
CO-2	Recognise instruction formats and implementation of various operations							L2
CO-3	Illustrate the concepts of microinstruction, its sequencing and execution.							L2
CO-4	Identify different types of memories and understand memory organization							L3
CO-5	Examine how I/O devices are organised and accessed							L4
CO-6	Evaluate the concept of parallel processing and multi-processor architecture							L5

Unit I: Basic Structure of Computers (6 Hrs.)

Hardware & software Functional units, Basic operational concepts, Bus structures, addressing methods and Machine program sequencing: Memory locations, Addresses, Instruction and Instruction sequencing, Addressing modes, Basic I/O operations.

Unit II: Processing Unit (6 Hrs.)

Processor organization, information representation, number formats, Instruction sets and its implementation. Arithmetic operation, Floating point arithmetic, IEEE 754 floating point formats.

Unit III: Control Unit (6 Hrs.)

Micro operation, control of processor Hardwired implementation, micro program control: Concepts, microinstructions sequencing and execution, application of microprogramming.

Unit IV: Memory Unit (6 Hrs.)

Concept of virtual memory, Memory hierarchies, Main memory allocation, Replacement policies, segments and pages, file organization, High speed memory, inter-board memories, Cache memories.

Unit V: I/O Organization (6 Hrs.)

Accessing I/O devices, Interrupts, Enabling and disabling interrupts, handling multiple devices, DMA, I/O Hardware, Standard I/O interfaces.

Unit VI: Parallel Processing (6 Hrs.)



Basic concepts, types of parallel processors. Pipeline processor: Pipeline types, design, structures, Multiprocessors: Types, performance, parallel programming, Multiprocessor Architecture, interconnect network

Total : 36

Text Books:

- 1) **Hayes J.P.**, "Computer Architecture and Organization, PHI, Second edition
- 2) **A.S.Tanenbum**, *Structured Computer Organization*, PHI, Third edition
- 3) **M.M.Mano**, *Computer System Architecture*, Pearson Education, Inc. publishing as Prentice Hall 2013.

Reference Books:

- 1) **V.Carl Hammacher**, *Computer Organisation*, McGraw-Hill Education, Fifth edition
- 2) **C.W.Gear**, *Computer Organization and Programming*, McGraw Hill, N.V. Edition.
- 3) Barry B. Brey, *The Intel Microprocessors: Architecture, Programming, and Interfacing*, Eighth Edition, Pearson Education

MOOC Links:

- 1) NPTEL – Introduction to Computer Architecture (IIT Delhi)
<https://nptel.ac.in/courses/106102062>
- 2) NPTEL – Computer Architecture and Organization (IIT Kharagpur)
- 3) <https://nptel.ac.in/courses/106105163>

Approved in..... 4th
Academic Council Meeting
Dated:-...30/03/2020.....



Program: B. Tech. (Electronics and Telecommunication Engineering)				Semester: VI				
Course: Digital Image Processing				Code: BTETPE06ET6T				
Teaching Scheme				Evaluation Scheme				
Lecture	Tutorial	Hours	Credit	TA	MSE-I	MSE-II	ESE	Total
3	1	4	4	10	15	15	60	100

Methods of Teacher Assessment (TA): Class Tests, Assignments & Class Attendance

Course Objectives:

After taking this course student will be capable to learn and apply:

1. Fundamentals of digital image processing
2. Various Transform of digital Images and its applications.
3. Image enhancement techniques in spatial and frequency domain.
4. knowledge of image segmentation and morphological image processing.
5. Image restoration and compression techniques used in digital image processing.

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

CO	Course Outcomes	BT Levels
CO-1	Comprehend fundamentals of digital image processing.	L2
CO-2	Understand the various transforms of Digital images.	L2
CO-3	Understand & apply knowledge of spatial domain and frequency domain filtering to digital images.	L2
CO-4	Demonstrate the basic concepts of Segmentation of digital images.	L3
CO-5	Analysis of various morphological techniques in digital images.	L4
CO-6	Understand image degradation model and its restoration; analyze various image compression techniques based on redundancy features.	L4

Unit I: Digital Image Fundamentals

(6 Hrs.)

Origin of Digital Image processing, Elements of Visual Perception, Image Sampling & Quantization, Basic relationship between pixels.

Unit II: Image Transform

(6 Hrs.)

Need for Transform, Fourier Transform, 2D Discrete Fourier Transform, Properties of 2D DFT, Discrete Cosine Transform, Haar Transform.

Unit III: Image Enhancement

(6 Hrs.)

Image Enhancement in Spatial Domain, Point operation, Histogram Manipulation, Linear Grey Level Transformation, Image Enhancement in Frequency Domain filters- High Pass & Low Pass.

Unit IV: Image Segmentation

(6 Hrs.)

Importance and applications of Digital Image Segmentation, Detection of Discontinuities, Thresholding: Local & Global, Region based Segmentation.

Unit V: Morphological Image Processing

(6 Hrs.)

Erosion & Dilation, Opening & Closing, Hit or Miss transformation, Basic Morphological Algorithms: Boundary Extraction, Hole filling, Thinning.



Unit VI: Image Restoration and compression techniques

(6 Hrs.)

Model of image degradation / restoration process, Noise models, Noise restoration filters, Image compression: fundamentals of image compression, Huffman coding, Run length coding, JPEG.

Total: 36

Textbooks:

1. Gonzalez and Woods, "Digital Image Processing", 3rd edition, Pearson
2. S. Jayaraman, S. Esakkirajan, T. Veerakumar, "Digital Image Processing", 2nd edition, McGraw Hill publication

Reference Books:

1. Anil Kumar Jain, Fundamentals of Digital Image Processing, Prentice Hall of India. 2nd edition 2004
2. Arthur R. Weeks, "Fundamentals of Electronic Image Processing", Wiley-Blackwell
3. William Pratt, "Digital Image Processing: PIKS Inside, Fourth Edition", A Wiley-Interscience Publication.

MOOC Links:

- 1) <https://nptel.ac.in/courses/117105135>
- 2) https://onlinecourses.nptel.ac.in/noc22_ee116/preview

MS
Approved in..... *4th*
Academic Council Meeting
Dated:-..... *30/03/2024*.....



Program: B. Tech. (Electronics and Telecommunication Engineering)				Semester:		VI		
Course: Antenna and Wave Propagation				Code:		BTETPE07ET6T		
Teaching Scheme				Evaluation Scheme				
Lecture	Tutorial	Hours	Credit	TA	MSE-I	MSE-II	ESE	Total
3	1	4	4	10	15	15	60	100
Methods of Teacher Assessment (TA): Class Tests, Assignments, Viva -Voce								
Course Objectives: The student will learn and Understand								
1. Basic Terminology and concept of Antennas.								
2. Concept of radiation mechanism of wired antennas and antenna array.								
3. Principle of aperture antennas.								
4. Concept of Broadband & Micro strip antennas.								
5. Antenna Measurements.								
6. Mechanism and models for radio-wave propagation								
After completion of the course, the students will be able to:								
CO	Course Outcomes							BT Level
CO-1	Describe the basic concepts and applications of Antenna systems.							L2
CO-2	Determine the radiation pattern and directivity of antenna arrays.							L3
CO-3	Describe the concept of Huygens Principle & aperture antenna.							L2
CO-4	Understand the properties of broadband antennas and micro strip antennas.							L2
CO-5	Describe the basic principles of Antenna Measurements.							L2
CO-6	Understand different ways of propagation of radio waves.							L2

Unit I: Antenna Fundamental

(6 Hrs.)

Transmission lines & equivalent Circuits, Concept of radiation, Radiation pattern, near and far fields, reciprocity, directivity and gain, effective aperture, polarization, input impedance, efficiency, Friis transmission equation.

Unit II: Wire Antenna and Antenna Arrays

(6 Hrs.)

Radiation from Wires and Loops- Infinitesimal dipole, finite-length dipole, small circular loop, Uniform Linear arrays of Isotropic sources, Principle of Pattern Multiplication, Two-element array, Broadside arrays, End fire arrays, binomial array.

Unit III: Aperture Antennas:

(6 Hrs.)

Huygens' Principle, radiation from rectangular and circular apertures, design considerations, Slot antenna, Waveguide horn antenna.

Unit IV: Broadband & Micro strip Antennas

(6 Hrs.)

Broadband Antennas: Broadband concept, Log-periodic and Yagi-Uda antennas, frequency independent antennas. Micro strip Antennas: Basic characteristics of micro strip antennas, feeding methods, Introduction of rectangular and circular patch antennas.

Unit V: Antenna Measurements

(6 Hrs.)

Antenna measurement range, Radiation pattern measurement, Gain and Directivity, Polarization.



Unit VI: Wave Propagation

(6 Hrs.)

Modes of Propagation: Ground, Sky & Space wave propagations, Structure of atmosphere, fading, Ionospheric Absorption, critical frequency, maximum usable frequency, virtual height, skip distance, Multi-hop propagation and Super refraction.

Total: 36 Hrs

Textbooks:

- 1) C. A. Balanis, "Antenna Theory and Design", 3rd Ed., John Wiley & Sons, 2005.
- 2) Harish A. R., Antenna and wave propagation, Oxford University Press.
- 3) Tri T. Ha, "Digital Satellite Communications", Tata McGraw-Hill, 2009
- 4) J.D.Kraus, "Antennas, McGraw-Hill, 1988
- 5) R.S.Elliot, "Antenna Theory and Design", IEEE Press, John Wiley, 2005
- 6) K.D.Prasad, "Antennas and Radiating Systems", Satyaprakasa

Reference Books:

- 1) R.E. Collin, Antennas and Radio Wave Propagation, McGraw Hill, 1985.
- 2) R.C. Johnson and H. Jasik, Antenna Engineering Handbook, McGraw hill, 1984.
- 3) I.J. Bahl and P. Bhartia, Micro Strip Antennas, Artech House, 1980.
- 4) R.K. Shevgaonkar, Electromagnetic Waves, Tata McGraw Hill, 2005.
- 5) R.E. Crompton, Adaptive Antennas, John Wiley.

MOOC Links:

1. <https://nptel.ac.in/courses/108105114>

 Approved in 4th
Academic Council Meeting
Dated: 30/03/2016



Program:	B. Tech. (Electronics and Telecommunication Engineering)	Semester:	VI
Course:	Advanced Digital Signal Processing	Code:	BTETPE08ET6T
Teaching Scheme		Evaluation Scheme	
Lecture	Tutorial	Hours	Credit
03	01	04	04
		TA	MSE-I
		10	15
		MSE-II	ESE
		15	60
			Total
			100

Methods of Teacher Assessment (TA): Regular Class Assignment, Attendance, Viva etc...

Course Objectives:

1. Introduce the fundamental concepts of discrete-time signals, systems, and transforms used in digital signal processing.
2. Develop understanding of filter design techniques for IIR and FIR systems using classical and modern approaches.
3. Explain sampling rate conversion and multi-rate DSP techniques essential for advanced signal processing applications.
4. Familiarize students with adaptive signal processing concepts and algorithms such as LMS and RLS.
5. Provide basic knowledge of two-dimensional signal processing tools like 2D DFT, DCT, and STFT.
6. Expose students to architecture and features of general and special-purpose DSP processors and their applications.

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

CO	Course Outcomes	BT Levels
CO-1	Analyze discrete-time signals and systems using convolution, correlation, and various transforms including FFT.	L3
CO-2	Design and implement digital filters using appropriate design techniques	L5
CO-3	Apply multirate DSP concepts such as decimation, interpolation, and polyphase structures for sampling rate conversion.	L2
CO-4	Explain and implement adaptive filtering algorithms such as LMS and RLS for real-time signal processing applications.	L3
CO-5	Use two-dimensional transforms like 2D DFT, DCT, and STFT for analyzing and processing multidimensional signals.	L3
CO-6	Understand DSP processor architecture and demonstrate basic programming concepts for applications in signal processing.	L3

Unit I: Overview of discrete time signal and systems

(6 Hrs.)

Convolution, correlation, Time bandwidth relationship, Different transforms and their properties, use of DFT in linear filtering, filtering of long data sequences, Algorithm for convolution and DIT-FFT and DIF-FFT algorithm.

Unit II: Filter Design

(6 Hrs.)

Analog filter design, Discrete time IIR filter from analog filter, IIR filter design by Impulse Invariance, Bilinear transformation, Approximation of derivatives, HPF, BPF, BRF filter design using frequency translation, Structures of FIR, Linear phase, FIR filter, Filter design using windowing techniques and Frequency sampling techniques. Implementation of Filter using filter structure.



Unit III: Introduction to Multi-rate Digital Signal Processing

(6 Hrs.)

Sample rate reduction, decimation by integer factors sampling rate increase, interpolation by integer factor, Design of practical sampling rate converters, Filter Specification filter requirement for individual stages, Determining the number of stages and decimation factors, Sampling rate conversion using poly-phase filter structure, poly-phase implementation of interpreters.

Unit IV: Adaptive Signal Processing

(6 Hrs.)

Adaptive filters, Concepts -Adaptive filter as a Noise Canceller, Other configurations of the adaptive filter, Main components of the adaptive filter, Basic Wiener filter theory, The basic LMS adaptive algorithm, Practical limitations of the basic LMS algorithm, Recursive Least Square Algorithm, Limitations, Factorization Algorithm.

Unit V: Introduction to two dimensional signal and Systems

(6 Hrs.)

2D, Discrete Fourier Transforms, Properties and applications, Discrete Hilbert Transform and Discrete Cosine Transform, Properties and Applications, Short term Fourier Transform, Gabor Transform, Properties and Applications.

Unit VI: General and special purpose DSP Processors

(6 Hrs.)

Computer Architecture for signal processing, Harvard Architecture, Pipelining, Hardware Multiply and Accumulate, Special Instructions, Replication, On-chip Memory Cache, Extended Parallelism, SIMD, Architecture and programming of TMS320 C67XX, Application of DSP to biomedical Signal Processing.

Total : 36

Textbooks:

- 1) "Digital Signal Processing" Emmanuel C Ifeakor, Barrie W Jrevis, Pearson Education
- 2) "Digital Signal Processing – A Computer Based Approach" , Sanjit K. Mitra, Tata McGraw Hill, Third Edition, 2007 .

Reference Books:

- 1) "Electronic Filter Design", Hand Book A .B Williams and FT Taylor, McGraw Hill
- 2) "Digital Signal Processing": Principles, Algorithms & Applications", John G. Proakis & Dimitris G.Manolakis, Fourth edition, Pearson education / Prentice Hall, 2007

AMP
Approved in.....*4th*
Academic Council Meeting
Dated:-.....*30/03/2020*.....



Program:	B.Tech. (Electronics and Telecommunication Engineering)	Semester:	VI
Course:	5G & 6G Mobile Communication	Code:	BTETPE09ET6T
Teaching Scheme		Evaluation Scheme	
Lecture	Tutorial	Hours	Credit
3	-	3	3
TA	MSE-I	MSE-II	ESE
10	15	15	60
			Total
			100

Methods of Teacher Assessment (TA): Class Tests, Assignments & Class Attendance

Course Objectives:

1. To equip students with a solid understanding of 5G network architecture its key technological components, including Machine-Type Communication (MTC), Device-to-Device (D2D) communication, and massive MIMO.
2. To develop students' ability to assess cognitive radio techniques, spectrum optimization mechanisms, and major security issues in 5G, while exploring technological trends progressing toward 6G.

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

CO	Course Outcomes	BT Levels
CO-1	Describe the evolution from LTE to 5G and identify the key drivers, roadmap elements, pillars, and architectural features of 5G systems.	L1
CO-2	Identify key features and requirements of MTC and assess the evolution, standardization, and challenges of Device-to-Device (D2D) communication in 4G and 5G networks.	L2
CO-3	Describe cognitive radio principles, spectrum optimization techniques, and challenges in 5G systems, including dynamic spectrum access, carrier aggregation, and energy-efficient cognitive terminals.	L2
CO-4	Elaborate the principles, capacity, and performance of MIMO and massive MIMO systems.	L3
CO-5	Explore security threats, vulnerabilities, and challenges across user equipment of access networks, core networks, and external IP networks.	L3
CO-6	Identify the key challenges, and assess the future prospects of 6G communication networks.	L4

Unit I: Drivers for 5G:

(6 Hrs.)

Introduction, Historical Trend of Wireless Communications. Evolution of LTE Technology to Beyond 4G, 5G Roadmap, Pillars of 5G, 5G Architecture.

Unit II: Machine-type & D2D communications:

(6 Hrs.)

Introduction, Use cases and categorization of MTC, MTC requirements, and Fundamental techniques for MTC, Data and control for short packets, non-orthogonal access protocols.

Syllabus - Semester V & VI : 1.0

Approved in.....
Academic Council Meeting 33
Dated: 30/03/2026



Unit III: Cognitive Radio for 5G Wireless Networks: (6 Hrs.)

Introduction, Overview of Cognitive Radio Technology in 5G Wireless, Cognitive Radio and Carrier Aggregation. Key Requirements and Challenges for 5G Cognitive Terminals.

Unit IV: MIMO SYSTEM: Introduction: (6 Hrs.)

MIMO in LTE, Single user MIMO, Multi-user MIMO, Capacity of massive MIMO, Resource allocation and transceiver algorithms for massive MIMO.

Unit V: Security for 5G Communications : (6 Hrs.)

Introduction, Overview of a Potential 5G Communications System Architecture, Security Issues and Challenges in 5G Communications Systems, User Equipment, Access Networks, Mobile Operator's Core Network.

Unit VI: Overview of 6G : challenges and features, development of cellular communication, capacity and data rates for 6G, introduction to 6G standards security issues: Introduction to 6G Security, 6G Network- Based Challenges, Security Standardization (6 Hrs.)

Total : 36

Textbooks:

1. 5G Mobile and Wireless Communications Technology :AFIF OSSEIRAN,JOSEF . MONSERRAT,PATRICKMARSCH ,Cambridge University Press.
2. Fundamentals of 5G Mobile Networks : Jonathan Rodriguez,John Wiley & Sons, Ltd.
3. 6G Communication Network - Architecture, Security and Applications:Ajay Kumar Vyas, Narendra Khatri, and Sunil Kumar Jha,crc Press.

Reference Books:

1. 5G Wireless Technologies :Azizi Othman
2. 5G NETWORKS BACKGROUND, ISSUES AND SECURITY,Snova New York
3. 5G NR: The Next Generation Wireless Access Technology-Erik Dahlman,Stefan Parkvall, Johan Sköld-Academic Press
4. 6G Wireless Communications and Mobile Networking: Xianzhong Xie ,Bo Rong,Michel Kadoch,Bentham Books.
5. Wireless Communications Principles and Practice-2nd EditionTheodore S. Rappaport, New York University

MOOC Links:

- 1) NPTL : Enabling Technologies for 6G Communications Networks - https://onlinecourses.nptel.ac.in/noc26_ee72/preview
- 2) NPTL : Evolution of Air Interface towards 5G - https://onlinecourses.nptel.ac.in/noc26_ee57/preview
- 3) Coursera : 5G Mobile Networks Specialization (Design 5G Mobile Networks) -



<https://www.coursera.org/specializations/5g-mobile-networks-technology-architecture-and-protocols>

- 4) Coursera : 6G for a Connected Future Specialization -
<https://www.coursera.org/specializations/6g-for-a-connected-future>
- 5) Coursera : 5G for Everyone - <https://www.coursera.org/learn/5g-training-qualcomm>

MO
Approved in.....*4th*
Academic Council Meeting
Dated:-...*30/03/2020*.....



Program:	B.Tech. (Electronics and Telecommunication Engineering)	Semester:	VI					
Course:	Modern Indian Languages	Code:	BTALAE02SH6P					
Teaching Scheme				Evaluation Scheme				
Lecture	Tutorial	Hours	Credit	TA	MSE-I	MSE-II	ESE	Total
1	0	1	1	50	-	-	-	50
Methods of Teacher Assessment (TA): Class test, Assignment, Case studies, Group Discussions.								
Course Objectives:								
● मराठी साहित्याची अभिरुची वाढवून व्यक्तिमत्व विकास करणे.								
● व्यावहारिक मराठी भाषेद्वारा अभिव्यक्ती कौशल्य विकसित करणे.								
After completion of the course, the students will be able to:								
CO	Course Outcomes							BT Levels
CO-1	समृद्ध मराठी साहित्याचे वाचन करून सर्वांगीण व्यक्तिमत्व विकास साधतील.							L3
CO-2	व्यावहारिक मराठी द्वारा त्याचे अभिव्यक्ती कौशल्य विकसित होईल.							L3

Unit I: मराठी साहित्य परंपरा ओळख, प्रकार वैशिष्ट्ये, मूल्यविचार, समृद्ध जीवन अनुभवाची ओळख.

(6 Hrs.)

Unit II: व्यावहारिक मराठी कौशल्य विकास- मुलाखत, अहवाल लेखन, रेज्यूमी (resume) इत्यादी.

(6 Hrs.)

Total : 12 Hrs

संदर्भ:

१. मराठी भाषेची समृद्धता व सृजनशीलता- डॉ. अतुल जोशी
२. व्यक्तिमत्व विकास आणि भाषा लेखक : गणेश मोकाशी प्रकाशन : स्नेहवर्धन प्रकाशन, पुणे
३. व्यक्तिमत्व विकास आणि भाषा लेखक : तुषार चांदवडकर प्रकाशन : अथर्व प्रकाशन, जळगाव

APJ
Approved in.....*4th*
Academic Council Meeting
Dated:---*30/03/2024*.....




Program:	B. Tech. (Electronics and Telecommunication Engineering)			Semester:	VI	
Course:	Drone Technology			Code:	BTETVS05ET6P	
Teaching Scheme				Evaluation Scheme		
Lecture	Practical	Hours	Credit	INT	EXT	Total
1	2	3	2	50	-	50
Methods of Teacher Assessment (TA): Assignment, Quiz, Attendance						
Course Objectives:						
1.To introduce the fundamental concepts, classifications, and applications of drone technology.						
2.To familiarize students with drone components, assembly procedures, and basic operational practices.						
After completion of the course, the students will be able to:						
CO	Course Outcomes					BT Levels
CO-1	Explain the fundamentals of drone technology, classifications, and applications.					L2
CO-2	Identify drone components and demonstrate basic drone assembly, configuration, and safe operation.					L3

Unit I: Fundamentals of Drone Technology and Types of Drones	(6 Hrs.)
Introduction to drone technology, definition of drone, evolution of drones, basic principles of flight, category, classification of drones and applications such as aerial photography, agriculture, surveillance, mapping, disaster management and logistics.	
Unit II: Drone Components, Assembly, and Basic Operation	(6 Hrs.)
Study of drone components including frame, motors, propellers, electronic speed controllers, flight controller, power distribution system, batteries, GPS module, sensors, transmitter and receiver, selection of components, drone assembly process, mechanical and electrical integration, basic flight controller configuration, calibration procedures, pre-flight checks, basic flight modes, drone operation, maintenance and troubleshooting.	
Total : 12	

List of Experiments

- 1.Study of drone technology, UAV terminology, and applications.
- 2.Identification and study of different types of drones.
- 3.Identification and functional study of major drone components.
- 4.Study of drone frame, motors, and propellers.
- 5.Study of Electronic Speed Controller (ESC) and brushless DC motor operation.
- 6.Study of Li-Po battery characteristics and safety precautions.
- 7.Study of flight controller and onboard sensors.
- 8.Assembly of drone frame and mounting of motors and propellers.
- 9.Electrical wiring, integration, and calibration of drone components.
10. Basic drone flight operation: take-off, hovering, and landing.


 Approved in.....
 Academic Council Meeting
 Dated:.....30/03/2026.....