

Zeal Education Society's

ZEAL COLLEGE OF ENGINEERING & RESEARCH, PUNE – 41

(An Autonomous Institute Affiliated to Savitribai Phule Pune University)

NBA Accredited, NAAC Accredited with A+ Grade, ISO 21001:2018



ELECTRONICS AND COMPUTER ENGINEERING DEPARTMENT

Curriculum Structure and Syllabus of

T.Y. B. Tech. – Electronics and Computer Engineering

(With effect from - Academic Year 2026-2027)

(2024 Pattern)

VISION OF THE INSTITUTE

- To Be A Premier Institute In Technical Education By Imparting Academic Excellence, Research, Social And Entrepreneurial Attitude.

MISSION OF THE INSTITUTE

- To Achieve Academic Excellence Through Innovative Teaching And Learning Process.
- To Imbibe The Research Culture For Addressing Industry And Societal Needs.
- To Inculcate Social Attitude Through Community Engagement Initiatives.
- To Provide Conducive Environment For Building The Entrepreneurial Skills.



DEPARTMENT OF ELECTRONICS AND COMPUTER ENGINEERING

VISION:

To emerge as a leading department in Electronics and Computer Engineering by imparting academic excellence, fostering innovation and research, and nurturing socially responsible and entrepreneurial professionals for sustainable technological growth.

MISSION:

- M1:** To facilitate quality education in Electronics and Computer Engineering through innovative pedagogy and hands-on learning.
- M2:** To foster research and development addressing real-world industrial and societal challenges.
- M3:** To instill ethical values and social responsibility through active community engagement.
- M4:** To create a conducive ecosystem for developing entrepreneurial skills and leadership Qualities using Industry-Academia Collaboration.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs):

- PEO1:** Graduates will establish themselves as professionals by applying core concepts of electronics and computer engineering to solve real-world problems.
- PEO2:** Graduates will adapt to emerging technologies through lifelong learning and pursue higher education, certifications, or entrepreneurship.
- PEO3:** Graduates will demonstrate ethical values, communication skills, and leadership qualities while working in multidisciplinary teams.

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PROGRAM OUTCOMES (POs):

PO1: Engineering Knowledge

Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop the solution of complex engineering problems.

PO2: Problem Analysis

Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)

PO3: Design/Development of Solutions

Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)

PO4: Conduct Investigations of Complex Problems

Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8)

PO5: Engineering Tool Usage

Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6).

PO6: The Engineer and The World

Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).

PO7: Ethics

Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9).

PO8: Individual and Collaborative Team Work

Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

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PO9: Communication

Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences.

PO10: Project Management and Finance

Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

PO11: Life-Long Learning

Recognize the need for, and have the preparation and ability for:

- i) Independent and life-long learning;
- ii) Adaptability to new and emerging technologies; and
- iii) Critical thinking in the broadest context of technological change. (WK8)

PROGRAM SPECIFIC OUTCOMES (PSOs):

PSO1: Apply principles of electronics, signal processing, and embedded systems to develop hardware/software-based solutions.

PSO2: Design and implement computer engineering solutions involving databases, networking, and algorithms for real-time and data-centric applications.

PSO3: Integrate domain knowledge with modern tools and technologies to solve interdisciplinary engineering problems in IoT, automation, and intelligent systems.

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LIST OF ABBREVIATIONS	
Abbreviation	Description
BSC	Basic Science Course
ESC	Engineering Science Course
PCC	Programme Core Course
PEC	Programme Elective Course
MDM	Multidisciplinary Minor
OE	Open Elective - Other than a particular program
VSEC	Vocational and Skill Enhancement Course
AEC	Ability Enhancement Course
ENTR	Entrepreneurship
EC	Economics
MC	Management Courses
IKS	Indian Knowledge System
VEC	Value Education Courses
RM	Research Methodology
CEP	Community Engagement Project
FP	Field Project
PROJ	Project
INT	Internship
OJT	On Job Training
CC	Co-curricular Courses
HSSM	Humanities Social Science and Management
ELC	Experiential Learning Course
B. Tech	Bachelor of Technology
L	Lecture
P	Practical
T	Tutorial
H	Hours
CR	Credits
IE	Internal Evaluation
MTE	Mid Term Evaluation
ETE	End Term Evaluation
TW	Term Work
OR	Oral
PR	Project

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Third Year B. Tech. – Electronics and Computer Engineering:

Semester - V

Course Code	Course Type	Course Name	Teaching Scheme (hrs/Week)							Evaluation Scheme					
			L	P	T	H	CR			CIE	ETE	TW	PR	OR	Total
							TH	PR	Total						
ECPC508	PCC	Advance Java Programming	3	-	-	3	3	-	3	40	60	-	-	-	100
ECPC508P	PCC	Advance Java Programming Lab	-	2	-	2	-	1	1	-	-	-	-	50	50
ECPC509	PCC	Digital Signal Processing	3	-	-	3	3	-	3	40	60	-	-	-	100
ECPC510	PCC	Microcontroller and Applications	4	-	-	4	4	-	4	40	60	-	-	-	100
ECVS503	VSEC	Microcontroller and Signal Processing Lab	-	4	-	4	-	2	2	-	-	-	50	-	50
ECPE501	PEC	Program Elective Course - I *	3		-	3	3	-	3	40	60	-	-		100
ALOE503	OE	Open Elective - III #	2	-	-	2	2	-	2	-	-	50	-	50	100
ECMD503	MDM	Project Management System – II	-	2	-	2	-	1	1	-	-	25	-	-	25
ECAE506	AEC	Mini Project and Seminar	-	2	-	2	-	1	1	-	-	25	-	25	50
ECIN504	ELC - INT	Internship – IV	4 Weeks				-	2	2			25			25
Total			15	10	0	25	15	7	22	160	240	125	50	125	700


BoS Chairman
Dr. Mahesh Navale




Director
Dr. Ajit Kate

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* - Select any one course from the given Program Elective Courses		
Course Code	Course Type	Program Elective-I
<u>ECPE501A</u>	PEC	Cryptography and Network Security
<u>ECPE501B</u>		Software Engineering & Testing
<u>ECPE501C</u>		Mobile Communication

* - Select any one course from the given Open Elective Courses		
Course Code	Course Type	Open Elective - III
<u>ALOE503A</u>	OEC	Data Analytics
<u>ALOE503B</u>		Green Building
<u>ALOE503C</u>		Electric Mobility
<u>ALOE503D</u>		Introduction to Stock Market
<u>ALOE503E</u>		Patent Law for Engineers and Scientist

DEPARTMENT OF ELECTRONICS AND COMPUTER ENGINEERING

Third Year B. Tech. – Electronics and Computer Engineering :

Semester - VI

Course Code	Course Type	Course Name	Teaching Scheme (hrs/Week)							Evaluation Scheme					
			L	P	T	H	CR			CIE	ETE	TW	PR	OR	Total
							TH	PR	Total						
ECPC611	PCC	Web Technology	3	-	-	3	3	-	3	40	60	-	-	-	100
ECPC611P	PCC	Web Technology Lab	-	2	-	2	-	1	1	-	-	-	-	50	50
ECPC612	PCC	Power Electronics and EV Technology	4	-	-	4	4	-	4	40	60	-	-	-	100
ECPC612P	PCC	Power Electronics and EV Technology Lab	-	2	-	2	-	1	1	-	-	-	-	50	50
ECPE602	PEC	Program Elective Course - II *	3		-	3	3		3	40	60	-	-	-	100
ECPE603	PEC	Program Elective Course - III *	3		-	3	3		3	40	60	-	-	-	100
ECMD604	MDM	Artificial Intelligence and Machine Learning	3	-	-	3	3	-	3	40	60	-	-	-	100
ECMD604P	MDM	Artificial Intelligence and Machine Learning Lab	-	2	-	2	-	1	1	-	-	-	-	50	50
ECVS604	VSEC	Quality Management System - III	-	2	-	2	-	1	1	-	-	25	-	-	25
ECIN403	ELC - INT	Internship - V	4 Weeks					2	2			25			25
Total			16	8	-	24	16	6	22	200	300	50	-	150	700


BoS Chairman
Dr. Mahesh Navale




Director
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* - Select any one course from the given Program Elective Courses		
Course Code	Course Type	Program Elective-II
ECPE602A	PEC	Electronic System Design
ECPE602B		Wireless Sensor Networks
ECPE602C		Data Science and Visualization

* - Select any one course from the given Program Elective Courses		
Course Code	Course Type	Program Elective-III
ECPE603A	PEC	Cloud Computing
ECPE603B		Internet of Things (IoT)
ECPE603C		Augmented and Virtual Reality

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Semester - V

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Program: B. Tech. (Electronics and Computer Engineering)							Semester: V		
Course: Advanced Java Programming							Code: ECPC508		
Teaching Scheme (Hrs/week)				Evaluation Scheme (Marks)					
Lecture	Practical	Tutorial	Credit	CIE	ETE	TW	OR	PR	Total
03	-	-	03	40	60		-		100
Prerequisites:									
Basic Programming Concepts / C, C++									
Course Objectives:									
1. To understand the fundamental building blocks and syntax of Java programming. 2. To design and develop basic OOPS concepts in Java. 3. To design and develop packages, string handling, collections and networking based programs in Java. 4. To design GUI and event-driven applications using AWT/Swing. 5. To design enterprise based applications by encapsulating an application's business logic using JDBC									
Course Outcomes: After completion of this course, students will be able to -									
CO1	Apply core Java syntax and programming constructs to write basic Java programs.								
CO2	Apply object-oriented principles, exception handling and packages to build robust Java applications								
CO3	Utilize fundamental classes, string handling, collections and networking APIs in Java.								
CO4	Apply relevant AWT/Swing components and event handling techniques in GUI applications								
CO5	Design and develop GUI applications using Abstract Windowing Toolkit (AWT), Swing and Layout Managers								
CO6	Develop database-driven and client/server applications using JDBC and Java networking classes.								
Course Contents:									
Unit	Description							Duration (Hrs.)	
1.	Introduction to Core Java : Introduction to Java: History, Features and Buzzwords, JDK/JRE/JVM, Bytecode and Platform Independence, Structure of a Java Program, Compilation and Execution process. Data Types, Variables and Scope, Type Casting. Operators: Arithmetic, Relational, Logical, Bitwise, Assignment and Ternary Operators. Control Statements: if-else, nested if, switch-case. Looping Statements: for, while, do-while, for-each, break and continue. Arrays: Single and Multidimensional Arrays, Array of Objects. Introduction to Classes and Objects, Constructors and Constructor Overloading, this keyword. Static keyword.							07	

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2.	Object Oriented Programming and Exception Handling : Encapsulation, Inheritance, Polymorphism and Abstraction. Inheritance: Types of Inheritance, super keyword, Method Overriding, Dynamic Method Dispatch. Access Modifiers: public, private, protected, default, CLASSPATH. Interfaces and Abstract Classes: Declaration, Implementation. Exception Handling: try, catch, finally, throw, throws, Built-in and User-defined (Custom) Exceptions.	07
3.	Packages, Interfaces and Fundamental Classes: String Handling: String, StringBuffer, StringBuilder classes, Creating and Formatting Strings, String Methods and Immutability. Fundamental Classes: Object class, Math class, Wrapper classes (Integer, Character, etc.), Autoboxing and Unboxing. Nested Classes: Static Nested, Inner, Anonymous and Local Classes. Threads: Thread Life Cycle, creating threads using thread class and runnable interface, synchronization. Collections Framework hierarchy: List, Set, and Map interfaces, Networking: Socket Programming, , URL class and Connection	07
4.	Event Handling using AWT & Swing Components: Event Handling: Events, Event Sources, Event Classes, Event Listeners, Delegation Event Model. Handling Mouse Events (MouseListener, MouseMotionListener) and Keyboard Events (KeyListener). Adapter Classes and Inner Classes for Event Handling. Action Events: ActionListener, ItemListener, WindowListener. The AWT Class Hierarchy, Component and Container classes, Overview of User Interface Design Principles. Introduction to Swing over AWT components.	06
5.	GUI Programming: Designing Graphical User Interfaces in Java: Components and Containers, Basics of Components (Labels, Buttons, TextFields, TextAreas, Checkboxes, Radio Buttons, Combo Boxes, Lists, Tabbed Panes and Scroll Panes). Using Containers: Frame, Panel, Dialog. Layout Managers: FlowLayout, BorderLayout, GridLayout, CardLayout, GridBagLayout (overview). AWT/Swing Components: Menu Bar and Menus to window. Java Utilities (java.util Package): Scanner, Random, Date and Calendar classes.	06
6.	Database Programming using JDBC: The Concept of JDBC, JDBC Driver Types and Architecture, JDBC Packages, A Brief Overview of the JDBC Process. Establishing a Database Connection, Basic JDBC Program Structure. Statement, ResultSet, PreparedStatement and CallableStatement, Executing SQL Commands (INSERT, UPDATE, DELETE) and Executing Queries (SELECT). Transaction Management (overview): Commit and Rollback.	06



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TOTAL	39
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Text Books:

1. Herbert Schildt, "Java: The Complete Reference", Tata McGraw Hill, 7th Edition
2. E. Balaguruswamy, "Programming with JAVA: A Primer", McGraw Hill Education, India, 5th Edition.
3. Jim Keogh, "Complete Reference J2EE", Tata McGraw Hill.

Reference Books:

1. "Java 6 Programming", Black Book, Dreamtech Press
2. "Java Server Programming, Java EE6 (J2EE 1.6)", Black Book, Dreamtech Press

E-Resources:

1. NPTEL Course "Programming in Java" Link of the Course:
<https://nptel.ac.in/courses/106/105/106105191/>
2. Udemy course "Advanced Java Programming" Link of the Course:
<https://www.udemy.com/course/advanced-java-programming>

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DEPARTMENT OF ELECTRONICS AND COMPUTER ENGINEERING

Program: B. Tech. (Electronics and Computer Engineering)							Semester: V		
Course: Advanced Java Programming Lab							Code: ECPC508P		
Teaching Scheme (Hrs/week)				Evaluation Scheme (Marks)					
Lecture	Practical	Tutorial	Credit	CIE	ETE	TW	OR	PR	Total
-	02	-	-	-	-	-	50	-	50
Prerequisites:									
Basic Programming Concepts / C, C++									
Course Objectives:									
1. To learn Java programming and GUI development. 2. To apply JDBC, RMI, Servlets, and JSP concepts. 3. To develop database and web-based applications									
Course Outcomes: After completion of this course, students will be able to -									
CO1	Develop Java programs using GUI and event handling.								
CO2	Implement JDBC, RMI, Servlets, and JSP applications.								
CO3	Develop database-driven and web-based application								

List of Experiments:	
GROUP A: (Any Four)	
1. Write a program to add, subtract, multiply and divide two numbers entered by the user. 2. Write a program to demonstrate constructor overloading, this keyword and the static keyword by creating a class. 3. Write a program to demonstrate multilevel inheritance, method overloading and method overriding using a class hierarchy. 4. Write a program to demonstrate exception handling using built-in exceptions and a user-defined exception. 5. Write a program to demonstrate the use of String, StringBuffer and StringBuilder classes to check whether a given string is a palindrome and count the vowels/consonants in it. 6. Write a program to create two threads using the Thread class and the Runnable interface, where one thread prints even numbers and the other prints odd numbers from 1 to 20.	
GROUP B : (Any Four)	
7. Write a program to demonstrate the status of keys on a Frame using KeyListener — keyPressed, keyReleased and keyTyped events. 8. Write a program to create a Frame using AWT and implement mouseClicked(), mouseEntered() and mouseExited() events. The frame's background colour should change when the mouse enters it. 9. Develop a GUI application using AWT/Swing which accepts the marks for all subjects of a student and displays the result in a separate window using ActionListener and WindowListener 10. Develop the Notepad application using Menu Bar, Menu and Menu Item and handle their action events	

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| 11. Create GUI based Simple Calculator application.
12. Write a program to insert and retrieve data from a database using JDBC (Statement/PreparedStatement and ResultSet). |
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GROUP C : Mini Project

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|--|
| a. A group of 04 students can develop a small application in Java.
b. Group formation should be done within the same batch. |
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Reference Books:

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| 1. "Java 6 Programming", Black Book, Dreamtech Press
2. "Java Server Programming, Java EE6 (J2EE 1.6)", Black Book, Dreamtech Press |
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DEPARTMENT OF ELECTRONICS AND COMPUTER ENGINEERING

Program: B. Tech. (Electronics and Computer Engineering)							Semester: V		
Course: Digital Signal Processing							Code: ECPC509		
Teaching Scheme (Hrs/week)				Evaluation Scheme (Marks)					
Lecture	Practical	Tutorial	Credit	CIE	ETE	TW	OR	PR	Total
03	-	-	03	40	60	-	-	-	100
Prerequisites:									
- Fourier Series - Fourier Transform									
Course Objectives:									
- To understand the students with Signals ,classification of signals and different operations on signals - To introduce students to DFT, FFT, DCT transforms for analysis of DT signals. - To design and implementation of IIR digital filters. - To design and implementation of FIR digital filters.									
Course Outcomes: After completion of this course, students will be able to -									
CO1	Describe the characteristics of discrete-time (digital) signals and DSP systems.								
CO2	Illustrate the representation of discrete-time signals and discrete-time systems.								
CO3	Apply the Fourier transform for signal processing								
CO4	Analyze the design and implementation of IIR filters								
CO5	Analyze the design and implementation of FIR filters								
CO6	Build and Evaluate DSP techniques for speech/ biomedical/ image signal Process								
Course Contents:									
Unit	Description								Duration (Hrs.)
1.	Introduction to Signals & Systems Signals: Introduction, Graphical, Functional, Tabular and Sequence representation of Continuous and Discrete time signals. Basics of Elementary signals: Unit step, Unit ramp, Unit parabolic, Impulse, Sinusoidal, Real exponential, Complex exponential, Rectangular pulse, Triangular, Sinc and Gaussian function. Operations on signals: time shifting, time reversal, time scaling, amplitude scaling, signal addition, subtraction, signal multiplication. Communication, control system and Signal processing examples. Classification of signals: Deterministic, Random, periodic, Non periodic, Energy , Power, Causal , Non Causal, Even and odd signal.								07
2.	Introduction to discrete time signals and systems Introduction to digital signal processing, review of discrete-time signals and systems, analysis of discrete-time linear time invariant systems, frequency domain representation of discrete time signals and systems, analysis of linear time-invariant systems in the z-domain, pole-zero stability.								07

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3.	Discrete Fourier Transform Introduction, Discrete Fourier Series, properties of DFS, Discrete Fourier Transform, Inverse DFT, properties of DFT, Linear and Circular convolution, convolution using DFT. Fast Fourier Transform Introduction, Fast Fourier Transform, Radix-2 Decimation in time and Decimation in frequency FFT, Inverse FFT (Radix-2).	07
4.	IIR Filters Introduction to digital filters, Analog filter approximations – Butterworth and Chebyshev, Design of IIR Digital filters from analog filters by Impulse invariant and bilinear transformation methods, Frequency transformations, Basic structures of IIR Filters - Direct form-I, Direct form-II, Cascade form and Parallel form realizations.	06
5.	FIR Filters Introduction, Characteristics of FIR filters with linear phase, Frequency response of linear phase FIR filters: Symmetric impulse response and Antisymmetric impulse response, Design of FIR filters using Fourier series and windowing methods (Rectangular, Triangular, Hanning, Hamming, Blackman), Comparison of IIR and FIR filters, Basic structures of FIR Filters– Direct form, Cascade form, Linear phase realizations.	06
6.	Introduction to 1D & 2D Signal Processing Dimensionality of signals, Introduction of 1D signals Speech: Basics of speech signal and its features, LTI representation of speech signal, Estimation of fundamental frequency, identification of voiced and unvoiced speech and noise removal Biomedical Signal: Basics of ECG and its features, Applications of signal processing	06
TOTAL		39

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Text Books:

1. John G.Proakis, Dimitris G.Manolakis, *Digital Signal Processing, Principles, Algorithms and Applications*, 5th Edition, Pearson Education PHI, 2021.
2. A. V. Oppenheim and R. W. Schaffer, *Discrete – Time Signal Processing*, 3rd Edition, PHI, 2010.

Reference Books:

1. S.K.Mitra, *Digital Signal Processing – A practical approach*, 2nd Edition, Pearson Education, New Delhi, 2004.
2. M.H.Hayes, *Digital signal processing: Schaum's Outlines*, 2nd Edition, Tata Mc-Graw Hill, 2009.
3. Robert J. Schilling, Sandra L.Harris, *Fundamentals of Digital Signal Processing using Matlab*, 2nd Edition, Thomson, 2010.
4. Oppenheim, Schafer, “Discrete-time Signal Processing”, Pearson Education, 1st Edition.
5. K.A. Navas, R. Jayadevan, “Lab Primer through MATLAB”, PHI, Eastern Economy Edition.

E-Resources:

1. MOOC / NPTEL Courses: 1. NPTEL Course on “Digital Signal Processing” Link of the Course: <https://nptel.ac.in/courses/117/102/117102060/>
2. NPTEL Course on “Digital Signal Processing” Link of the Course: <https://nptel.ac.in/courses/108/105/108105055/>

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Program: B. Tech. (Electronics and Computer Engineering)							Semester: V		
Course: Microcontroller and Application							Code: ECPC510		
Teaching Scheme (Hrs/week)				Evaluation Scheme (Marks)					
Lecture	Practical	Tutorial	Credit	CIE	ETE	TW	OR	PR	Total
04	-	-	04	40	60	-	-	-	100
Prerequisites:									
- Digital Electronics - C Programming									
Course Objectives:									
- To understand the students with architecture, organization, and operation of 8051 and LPC 2148 microcontrollers. - To develop assembly language and Embedded C programs for solving engineering problems using microcontrollers. - To interface peripheral devices, sensors, displays, and communication modules with microcontroller systems.									
Course Outcomes: After completion of this course, students will be able to -									
CO1	Explain the architecture, memory organization, instruction set, and programming concepts of the 8051 microcontroller.								
CO2	Develop assembly language/embedded C programs and interface I/O peripherals using the 8051microcontroller.								
CO3	Describe the architecture of LPC 2148.								
CO4	Apply concepts of Embedded C programs for using GPIO, timers, interrupts, and PWM peripherals of the LPC2148.								
CO5	Implement LPC2148 peripheral and communication interfaces								
CO6	Build and evaluate various embedded solutions using LPC 2148 platforms for automation and monitoring.								
Course Contents:									
Unit	Description								Duration (Hrs.)
1.	8051 Architecture and Programming Fundamentals : Introduction to Embedded Systems, Microcontroller vs Microprocessor Evolution of Microcontrollers, MCS-51 Family Overview, 8051 Architecture and Pin Configuration, CPU Organization and Registers Memory Organization (ROM, RAM, SFR), I/O Ports Architecture Addressing Modes, Instruction Set, Assembly Language Programming Basics								08
2.	8051 Peripherals and Interfacing : Timers and Counters, Interrupt Structure and Programming, Serial Communication (UART), LCD Interfacing, Matrix Keypad Interfacing								08

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	Seven Segment Display Interfacing, ADC and DAC Interfacing, Stepper Motor Control, Sensor Interfacing Applications	
3.	Introduction to ARM Architecture and LPC2148 : Introduction to embedded systems and ARM processors. Overview of ARM architecture and RISC concepts. ARM7TDMI architecture, register organization, operating modes, CPSR and SPSR registers. Introduction to LPC2148 microcontroller: features, block diagram, pin configuration, memory organization, clock system, PLL and power control. Introduction to Embedded C programming for LPC2148	09
4.	GPIO, Timers, Interrupts and PWM : GPIO programming in LPC2148: pin function selection, GPIO registers, digital input and output operations. Interfacing of LED, switch, seven-segment display and LCD. Timers and counters: timer registers, match and capture operations, delay generation. Introduction to interrupts, external interrupts and Vectored Interrupt Controller (VIC). PWM generation and duty-cycle control with applications.	09
5.	Serial Communication and Analog Interfacing : UART communication: architecture, registers, baud-rate generation, transmission and reception. SPI communication and master-slave operation. I ² C communication and interfacing of sensors. ADC: architecture, registers and analog sensor interfacing. DAC and waveform generation.	09
6.	Peripheral Interfacing and Embedded Applications : Interfacing of matrix keypad and LCD, sensors and actuators with LPC2148. Interfacing and control of DC motor, stepper motor and relay. Sensor-based embedded system applications. Design of embedded applications such as temperature monitoring, data acquisition, motor control and serial communication-based systems.	09
TOTAL		52

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Text Books:
1. Mazidi, M. A., Mazidi, J. G., & McKinlay, R. D., The 8051 Microcontroller and Embedded Systems: Using Assembly and C, 2nd Edition, Pearson Education, 2011. 2. Ayala, K. J., The 8051 Microcontroller: Architecture, Programming and Applications, 3rd Edition, Cengage Learning, 2007. 3. ARM7TDMI Microcontroller with LPC2148: Programming and Interfacing Dr. S. K. Shah.
Reference Books:
1. Raj Kamal, <i>Microcontrollers: Architecture, Programming, Interfacing and System Design</i>, Pearson. 2. Andrew N. Sloss, Dominic Symes and Chris Wright, <i>ARM System Developer's Guide: Designing and Optimizing System Software</i>, Morgan Kaufmann.
E-Resources:
1. https://microcontrollerslab.com/category/8051-microcontroller/ 2. https://www.nxp.com/docs/en/user-guide/UM10139.pdf

BACK TO STRUCTURE

DEPARTMENT OF ELECTRONICS AND COMPUTER ENGINEERING

Program: B. Tech. (Electronics and Computer Engineering)							Semester: V		
Course: Microcontroller and Signal Processing Lab							Code: ECVS503P		
Teaching Scheme (Hrs/week)				Evaluation Scheme (Marks)					
Lecture	Practical	Tutorial	Credit	CIE	ETE	TW	OR	PR	Total
-	04	-	02	-	-	-	-	50	50
Prerequisites:									
• Digital Electronics • C Programming • Fourier Series and Transform									
Course Objectives:									
1. To develop practical understanding of signals and digital signal processing techniques through signal generation, DFT/FFT, convolution, and digital filter implementation. 2. To develop programming and interfacing skills using the 8051 microcontroller, including timers, interrupts, serial communication, ADC/DAC and peripheral interfacing. 3. To develop practical skills in ARM7/LPC2148-based embedded systems involving GPIO, timers, interrupts, PWM, serial communication, analog interfacing and embedded applications.									
Course Outcomes: After completion of this course, students will be able to -									
CO1	Generate, analyze and process continuous and discrete-time signals using DFT, FFT, convolution and digital filtering techniques.								
CO2	Develop and execute 8051-based programs for timers, interrupts, serial communication and interfacing of various peripherals.								
CO3	Develop LPC2148-based embedded applications using GPIO, timers, interrupts, PWM, serial communication, ADC/DAC and peripheral interfacing.								

List of Experiments:

Module 1 : Digital Signal Processing (Any 08)

- Generate and analyze elementary signals such as unit step, unit impulse, ramp, parabolic, sinusoidal, exponential, rectangular, triangular and sinc signals.
- Generate and perform basic operations on continuous and discrete-time signals such as time shifting, time reversal, time scaling, amplitude scaling, addition, subtraction and multiplication.
- Analyze discrete-time systems for linearity, time invariance, causality and stability. Obtain and analyze the impulse response of an LTI system.
- Compute Z-transform and inverse Z-transform of discrete-time sequences. Plot pole-zero locations and determine the stability of a discrete-time LTI system.
- Implement linear and circular convolution of discrete-time sequences and verify the relationship between linear and circular convolution using zero padding
- Compute DFT and IDFT of discrete-time sequences and verify important properties of DFT. Analyze the frequency-domain representation of signals.
- Implement Radix-2 Decimation-in-Time (DIT) and/or Decimation-in-Frequency (DIF) Fast Fourier Transform and its inverse. Compare the computational requirements of DFT and FFT.
- Design Butterworth and Chebyshev IIR digital filters using impulse-invariant and bilinear

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transformation methods. Plot and analyze their frequency responses.

9. Design FIR digital filters using Rectangular, Triangular, Hanning, Hamming and Blackman windows. Analyze and compare their frequency responses and linear-phase characteristics.
10. Perform speech signal analysis for fundamental-frequency estimation and voiced/unvoiced identification. Perform noise removal and basic feature analysis of an ECG signal.

Module 2 : Microcontroller and Applications

GROUP A: (Any Four)

1. Write and execute Assembly Language Programs for arithmetic operations using 8051.
2. Write a program in embedded C for interfacing LEDs with 8051.
3. Write a program in embedded C for interfacing Seven Segment Display with 8051.
4. Write a program in embedded C for interfacing LCD with 8051.
5. Write a program in embedded C for Stepper Motor interfacing and speed/direction control using 8051.

GROUP B: (Any Four)

1. Develop an Embedded C program for LPC2148 GPIO to interface LED and switch
2. Develop an Embedded C program for LPC2148 to interface seven-segment display and LCD
3. Implement LPC2148 timers and counters for delay generation using match and capture operations
4. Generate PWM using LPC2148 and control the duty cycle for an appropriate application
5. Implement UART communication using LPC2148 for serial data transmission and reception.
6. Interface ADC/DAC and analog sensors with LPC2148 and demonstrate analog signal acquisition/waveform generation.
7. Implement SPI/I²C communication and interface a suitable sensor with LPC2148.
8. Interface and control DC motor using LPC2148
9. Interface and control Stepper motor using LPC2148
10. Interface and control Relay using LPC2148.
11. Develop a sensor-based embedded application such as temperature monitoring/data acquisition/motor control using LPC2148



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Reference Books:

3. Raj Kamal, *Microcontrollers: Architecture, Programming, Interfacing and System Design*, Pearson.
4. Andrew N. Sloss, Dominic Symes and Chris Wright, *ARM System Developer's Guide: Designing and Optimizing System Software*, Morgan Kaufmann.

E-Resources:

3. <https://microcontrollerslab.com/category/8051-microcontroller/>
4. <https://www.nxp.com/docs/en/user-guide/UM10139.pdf>

BACK TO STRUCTURE

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Program: B. Tech. (Electronics and Computer Engineering)							Semester: V		
Course: Cryptography and Network Security							Code: ECPE501A		
Teaching Scheme (Hrs/week)				Evaluation Scheme (Marks)					
Lecture	Practical	Tutorial	Credit	CIE	ETE	TW	OR	PR	Total
03	-	-	03	40	60	-	-	-	100
Prerequisites:									
- Fundamentals of Computer Networks and Systems - Discrete Mathematics - Programming Fundamentals (C/Python)									
Course Objectives:									
- To understand the fundamentals of information security and cryptography. - To analyze authentication, digital signatures, and key management. - To design secure communication systems using modern security practices.									
Course Outcomes: After completion of this course, students will be able to -									
CO1	Explain principles of cryptography and information security.								
CO2	Apply encryption algorithms for secure communication.								
CO3	Analyze authentication and digital signature mechanisms.								
CO4	Analyze network security protocols.								
CO5	Analyze cyber-attacks and suggest countermeasures.								
CO6	Evaluate modern security solutions considering various aspects of network								
Course Contents:									
Unit	Description								Duration (Hrs.)
1.	Introduction to Information Security and Cryptography Information Security Concepts, CIA Triad, Security Services and Mechanisms, Types of Attacks, Cryptography Fundamentals, Cryptanalysis, Security Standards								06
2.	Classical and Symmetric Key Cryptography Data Encryption Standards (DES), Double DES and Triple DES, Modes of Operation (ECB, CBC, CFB, OFB, CTR), Stream Ciphers								07
3.	Public Key Cryptography Introduction to Public Key cryptosystem, Advanced Encryption Standard (AES), RSA Algorithm, Diffie-Hellman Key Exchange Algorithm, ElGamal Encryption Algorithm, Elliptic Curve Cryptography (ECC)								07

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4.	Authentication and Network Security Protocols Message Authentication, Digital Signatures, Key Management, Hash Functions, Cryptographic Hash Function, Secure Hash Algorithm (SHA), Digital Signature Standard(DSS)	07
5.	Network Security and Cyber Threats Firewalls, IDS/IPS, Malware and Ransomware, DoS/DDoS Attacks, Phishing and Spoofing, Web Security: SQL Injection and XSS, Secure Email, Wireless Security (WPA2/WPA3)	06
6.	System Security and Cloud Security Operating System Security: Access Control, Authentication and Authorization Database Security: Security Requirements, SQL Injection Prevention and Database Auditing Cloud Security: Security Challenges, Data Protection and Identity & Access Management (IAM)	06
TOTAL		39

Text Books:

4. William Stallings, *Cryptography and Network Security: Principles and Practice*, 8th Edition, Pearson.
5. Behrouz A. Forouzan, *Cryptography and Network Security*, McGraw-Hill.
6. Atul Kahate, *Cryptography and Network Security*, McGraw-Hill.

Reference Books:

5. Bruce Schneier, *Applied Cryptography*, Wiley.
6. Charlie Kaufman, Radia Perlman & Mike Speciner, *Network Security: Private Communication in a Public World*, Pearson.
7. Wenbo Mao, *Modern Cryptography: Theory and Practice*, Pearson.
8. Douglas Stinson, "Cryptography Theory and Practice", 2 nd Edition, Chapman & Hall/CRC.

E-Resources:

5. <https://nptel.ac.in/courses/106105031>
6. <https://nptel.ac.in/courses/106105162>

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DEPARTMENT OF ELECTRONICS AND COMPUTER ENGINEERING

Program: B. Tech. (Electronics and Computer Engineering)							Semester: V		
Course: Software Engineering & Testing							Code: ECPC501B		
Teaching Scheme (Hrs/week)				Evaluation Scheme (Marks)					
Lecture	Practical	Tutorial	Credit	CIE	ETE	TW	OR	PR	Total
03	-	-	03	40	60	-	-	-	100
Prerequisites:									
• Programming and Problem Solving									
Course Objectives:									
1. To learn and understand the principles of Software Engineering. 2. To be acquainted with methods of capturing, specifying, visualizing and analyzing software requirements. 3. To apply design and testing principles to software project development. 4. To understand project management through life cycle of the project.									
Course Outcomes: After completion of this course, students will be able to -									
CO1	Interpret software requirements and suitable software design.								
CO2	Apply software solutions considering ethical, social, legal, and economic aspects.								
CO3	Analyze modern software engineering models, tools, and technologies to develop innovative software solutions.								
CO4	Analyze user interfaces and component-level software architecture.								
CO5	Analyze software risks and software configuration								
CO6	Apply software testing, verification, and validation techniques to ensure software quality.								
Course Contents:									
Unit	Description								Duration (Hrs.)
1.	Introduction to Software Engineering and Software Process Model: Software Engineering Fundamentals: Introduction to software engineering, Software Engineering Layered Technology. Software Process: A Generic Process Model, defining a Framework Activity(SDLC), Prescriptive Process Models: The Waterfall Model, Incremental Process Models, RAD Model, Evolutionary Process Models: Prototype Models Spiral Model, Unified Process : Phases of Unified Process. Agile Model, Agile Tools: JIRA								07
2.	Software Requirements Engineering and Analysis: Requirements Engineering: Inception, Elicitation, Elaboration, Negotiation, Specification, Validation, Requirement Management.								07

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	Eliciting Requirements: Collaborative Requirements Gathering, Quality Function deployment, Usage Scenarios, Elicitation Work Products. Developing Use Cases, Building the Requirements Model, Elements of the Requirements Model, Negotiating Requirements, Validating Requirements.	
3.	Estimation and Scheduling: Estimation for Software Projects: The Project Planning Process, Defining Software Scope and Checking Feasibility, Resources management: Reusable Software Resources, Environmental Resources, Software Project Estimation, Decomposition Techniques: Problem Decomposition, Process Decomposition, Estimation : Software Sizing, Problem-Based Estimation, LOC-Based Estimation, FP-Based Estimation, Object Point (OP)-based estimation, Process- Based Estimation, Project Scheduling: Project Scheduling, Defining a Task for the Software Project, Scheduling.	07
4.	Design Engineering : Introduction to Design Engineering, The Design Process, Software Design Quality Guidelines and Attributes, Design Concepts : Abstraction, Architecture, Patterns, Modularity, Information Hiding, Functional Independence, Refinement, Refactoring, , Design Classes, Design Model: Data Design Elements, Architectural Design Elements, Interface Design Elements, Component-Level Design Elements, Deployment-Level Design Elements. Architectural Design: Software Architecture, Why is Architecture Important, Architectural Styles and its classifications	06
5.	Risk and Configuration Management: Risk Management: Software Risks, Risk Strategy: Reactive & Proactive, Risk Identification, Risk Projection, Risk Refinement, The RMMM : Plan. Software Configuration Management: Software Configuration Management, The SCM Repository: Roles and Features. SCM Process.	06
6.	Software Testing: Introduction to software testing, Principal of Testing, Testing Life Cycle:	06

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	Phases of Testing, Types of Testing: Unit, Integration, Regression, Smoke. Verification & Validation: Alpha and Beta Testing , Defect Management, Defect Life Cycle, Bug Reporting, Test Management and Automation.	
TOTAL		39

(It is mandatory to each student to complete Scrum Certification)

<https://www.scrumstudy.com/certification/scrum-fundamentals-certified>

Text Books:

1. Roger Pressman - “Software Engineering: A Practitioner’s Approach” , McGraw Hill, ISBN 0-07-337597-7.
2. Ian Sommerville – “Software Engineering” , Addison and Wesley, ISBN 0-13-703515-2.

Reference Books:

1. Carlo Ghezzi – “Fundamentals of Software Engineering”, PHI, ISBN-10: 0133056996
2. Rajib Mall – “Fundamentals of Software Engineering ”, PHI, ISBN-13: 978-8120348981
3. Pankaj Jalote – “An Integrated Approach to Software Engineering, Springer, ISBN13: 9788173192715.

E-Resources:

1. NPTEL Course “Software Engineering” https://onlinecourses.nptel.ac.in/noc19_cs69/preview
2. NPTEL Course on “Software Engineering” https://swayam.gov.in/nd2_cec20_cs07/preview

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Program: B. Tech. (Electronics and Computer Engineering)							Semester: V		
Course: Mobile Communication							Code: ECPE501C		
Teaching Scheme (Hrs/week)				Evaluation Scheme (Marks)					
Lecture	Practical	Tutorial	Credit	CIE	ETE	TW	OR	PR	Total
03	-	-	03	40	60	-	-	-	100
Prerequisites:									
- Analog Communication (AM, FM, PM) - Digital Communication (PCM, DPCM, Delta Modulation) - Quantization and Line Coding									
Course Objectives:									
- To understand the fundamentals of wireless and mobile communication systems. - To study cellular architecture, frequency reuse, and handoff techniques. - To learn radio wave propagation and multiple access techniques. - To understand modern cellular technologies from 2G to 5G. - To explore wireless networks, IoT, and emerging mobile communication technologies									
Course Outcomes: After completion of this course, students will be able to -									
CO1	Explain the fundamentals of mobile communication and cellular systems.								
CO2	Analyze radio wave propagation and wireless channel characteristics.								
CO3	Apply multiple access and mobility management techniques in cellular networks.								
CO4	Analyze the architecture and working of 2G, 3G, 4G and 5G mobile communication systems.								
CO5	Explain the concepts of Wireless LANs (WLANs), Personal Area Networks (PANs), and IoT communication technologies.								
CO6	Evaluate emerging mobile communication technologies and future wireless networks								
Course Contents:									
Unit	Description								Duration (Hrs.)
1.	Introduction to Mobile Communication Evolution of wireless communication, limitations of wired communication, mobile radio systems, wireless communication spectrum, cellular concept, frequency reuse, co-channel interference, cell splitting, sectoring, trunking, grade of service, capacity improvement techniques								07
2.	Radio Wave Propagation Free space propagation, reflection, diffraction, scattering, multipath propagation, fading (large-scale and small-scale), Doppler effect, delay spread, path loss models, shadowing, diversity techniques, wireless channel characteristics.								07
3.	Multiple Access Techniques and Mobility Management FDMA, TDMA, CDMA, OFDMA, SDMA, comparison of multiple access techniques, handoff strategies, location management, roaming, paging, mobile IP, power control in cellular systems.								07

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4.	Cellular Network Technologies (2G to 5G) Architecture and features of GSM, GPRS, EDGE, CDMA, UMTS (3G), LTE (4G), VoLTE, 5G NR architecture, network slicing, massive MIMO, beamforming, millimeter wave communication, comparison of cellular generations.	07
5.	Wireless Networks and IoT Communication Wireless LAN (IEEE 802.11), Bluetooth, ZigBee, NFC, Wi-Fi, LoRaWAN, NB-IoT, RFID, Wireless Sensor Networks, IoT communication architecture, smart city applications, industrial IoT.	06
6.	Emerging Trends in Mobile Communication Vehicular Communication (V2X), Device-to-Device (D2D) Communication, Cognitive Radio, Software Defined Radio (SDR), Satellite Mobile Communication, 6G overview, AI in wireless communication, security challenges in mobile communication.	05
TOTAL		39
Text Books:		
1. Theodore S. Rappaport, Wireless Communications: Principles and Practice, 2nd Edition, Pearson. 2. Jochen Schiller, Mobile Communications, 3rd Edition, Pearson. 3. William C. Y. Lee, Mobile Cellular Telecommunications, McGraw-Hill. 4. Andreas F. Molisch, Wireless Communications, Wiley.		
Reference Books:		
1. Vijay K. Garg, Wireless Communications and Networking, Morgan Kaufmann. 2. Mischa Schwartz, Mobile Wireless Communications, Cambridge University Press. 3. Erik Dahlman, Stefan Parkvall, Johan Skold, 5G NR: The Next Generation Wireless Access Technology, Academic Press.		
E-Resources:		
1. NPTEL – Wireless Communication by Prof. Aditya Jagannatham (IIT Kanpur). 2. NPTEL – Cellular Mobile Communication (IIT Kharagpur). 3. NPTEL – Introduction to 5G Wireless Communication. 4. IEEE Communications Society Digital Library. 5. 3GPP Technical Specifications (for LTE and 5G NR).		

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B. Tech. (Electronics and Computer Engineering)							Semester: V		
Course: Open Elective – III (Data Analytics)							Code: ALOE503A		
Teaching Scheme (Hrs/week)				Evaluation Scheme (Marks)					
Lecture	Practical	Tutorial	Credit	CIE	ETE	TW	OR	PR	Total
02	-	-	02	-	-	50	50	-	100
Prerequisites:									
Basic knowledge of Mathematics and Statistics, Fundamentals of Computer Science									
Course Objectives:									
1. To introduce the types and applications of data analytics across domains. 2. To apply descriptive statistics and visualization techniques to summarize data. 3. To apply inferential statistics and hypothesis testing for decision-making. 4. To analyze relationships in data using correlation, regression, and ANOVA. 5. To build predictive models using classification and clustering techniques. 6. To familiarize students with prescriptive analytics and Big Data concepts.									
Course Outcomes: After completion of this course, students will be able to -									
CO1	Explain the types of data analytics and their applications across domains.								
CO2	Apply descriptive statistics and visualization techniques to summarize data.								
CO3	Analyze data using inferential statistics and hypothesis testing methods.								
CO4	Apply correlation, regression, and ANOVA techniques for data-driven decisions.								
CO5	Design predictive models using classification and clustering approaches.								
CO6	Evaluate prescriptive analytics approaches and Big Data platforms for applications.								
Course Contents:									
Unit	Description								Duration (Hrs.)
1.	Introduction to Data Analytics: Types of analytics — descriptive, diagnostic, predictive, and prescriptive; Analytics vs. reporting; Key applications across domains: business, healthcare, finance, and marketing; Overview of analytics tools landscape: Excel, Python, R, and Power BI (comparative overview); KPIs and metrics for decision-making.								04
2.	Descriptive Analytics: Frequency distributions, outliers; Measures of central tendency and dispersion; Interquartile range; Skewness and kurtosis; Normal distribution and z-scores; Data visualization principles: bar chart, histogram, box plot, scatter plot, and heat map.								05
3.	Inferential Statistics: Population vs. sample, random sampling; Sampling distribution, standard error; Hypothesis testing: null and alternate hypothesis, z-test, t-test; One-tailed and								05

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	two-tailed tests; Confidence intervals and level of confidence; Type I and Type II errors.	
4.	Correlation, Regression & ANOVA: Correlation and scatter plots; Simple linear regression, least squares method; Multiple regression; Coefficient of determination (R^2); One-way and two-way ANOVA; Chi-square test of independence.	04
5.	Predictive Analytics: Introduction to predictive modeling; Classification techniques: logistic regression, decision trees; Clustering: k-means; Model evaluation: accuracy, confusion matrix; Time series analysis basics: moving averages, trend analysis.	04
6.	Prescriptive & Big Data Analytics: Prescriptive analytics: optimization and simulation for decision-making; Introduction to Big Data: the 5 V's, sources of big data; Overview of the Big Data ecosystem: Hadoop, Spark (conceptual only); Applications: business analytics, web analytics, and social media analytics.	04
TOTAL		26

Term Work:

Sr. No.	Title	Proposed Tutorial Activities
1	Introduction to Data Analytics	Identify descriptive, diagnostic, predictive, and prescriptive analytics using real-world case studies. Compare Excel, Python, R, and Power BI for analytics tasks.
2	Descriptive Statistics – I	Calculate mean, median, mode, range, variance, and standard deviation using a given dataset in Excel/Python.
3	Descriptive Statistics – II	Detect outliers using IQR and visualize distributions using histograms and box plots.
4	Data Visualization	Create bar charts, scatter plots, heat maps, and box plots. Interpret insights from visualizations.
5	Sampling & Probability	Perform random sampling, calculate standard error, and differentiate between population and sample using datasets.
6	Hypothesis Testing	Perform z-test and t-test for given scenarios and interpret Type I and Type II errors.
7	Correlation & Regression	Calculate correlation coefficients, build simple linear regression models, and interpret R^2 values.

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8	ANOVA & Chi-Square	Perform one-way ANOVA and Chi-square tests using statistical software and interpret results.
9	Predictive Analytics	Build basic classification models (Logistic Regression/Decision Tree) and perform K-Means clustering using Python.
10	Model Evaluation	Evaluate predictive models using confusion matrix and accuracy metrics.
11	Time Series Analytics	Apply moving averages and identify trends in time-series datasets.
12	Big Data & Prescriptive Analytics	Explore Hadoop and Spark concepts through case studies and discuss optimization-based decision-making.

Text Books:

1. Anil Maheshwari, "Data Analytics", McGraw Hill Education
2. Robert S. Witte and John S. Witte, "Statistics", Wiley Publications
3. U. Dinesh Kumar, "Business Analytics: The Science of Data-Driven Decision Making", Wiley India

Reference Books:

1. Seema Acharya and Subhashini Chellappan, "Big Data and Analytics", Wiley India
2. Allen B. Downey, "Think Stats: Exploratory Data Analysis in Python", Green Tea Press

E-Resources:

1. NPTEL Course on "Introduction to Data Analytics" (IIT Madras Track)
Link: nptel.ac.in
2. NPTEL Course on "Data Analytics with Python" (IIT Roorkee Track)
Link: <https://nptel.ac.in/courses/106107220>
3. NPTEL Course on "Business Intelligence & Analytics" (IIT Madras Track)
Link: https://onlinecourses.nptel.ac.in/noc25_cs09/preview
4. NPTEL Course on "Business Analytics for Management Decision" (IIT Kharagpur Track)
Link: <https://nptel.ac.in/courses/110105089>
5. Coursera: "Google Data Analytics Professional Certificate" Link: coursera.org
6. edX: "Data Science: Statistics and Machine Learning" by Harvard University
Link: edx.org

EBooks

1. Allen B. Downey – Think Stats: Exploratory Data Analysis in Python (Open Access)
Link: greenteapress.com



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2. EMC Education Services – Data Science and Big Data Analytics (Open Academic Archive)
Link: archive.org

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B. Tech. (Electronics and Computer Engineering)							Semester: V		
Course: Open Elective – III (Green Building)							Code: ALOE503B		
Teaching Scheme (Hrs/week)				Evaluation Scheme (Marks)					
Lecture	Practical	Tutorial	Credit	CIE	ETE	TW	OR	PR	Total
02	-	-	02	-	-	50	50	-	100
Prerequisites:									
Basic environmental engineering, building materials & construction, engineering chemistry/ environmental science, basic knowledge of energy and sustainability concepts									
Course Objectives:									
1. To equip students with the principles of sustainable building design, resource-efficient construction, and green building practices.									
2. To provide students with knowledge of energy-efficient technologies, water and waste management, sustainable materials, and green building rating systems.									
Course Outcomes: After completion of this course, students will be able to -									
CO1	Explain the concepts, principles, benefits, and environmental impacts associated with green buildings and sustainable development.								
CO2	Assess building orientation, climate-responsive planning, landscaping, green roofs, and green walls for improving environmental performance.								
CO3	Evaluate building energy consumption and recommend energy-efficient strategies, HVAC optimization, renewable energy systems, and conservation measures.								
CO4	Design suitable water conservation, rainwater harvesting, greywater recycling, waste management, and sustainable drainage solutions for buildings.								
CO5	Select appropriate sustainable building materials and assess indoor environmental quality based on thermal comfort, indoor air quality, lighting, and acoustics.								
CO6	Compare major green building rating systems such as IGBC, GRIHA, and LEED and apply their principles to assess building sustainability.								
Course Contents:									
Unit	Description								Duration (Hrs.)
1.	Introduction to Green Buildings: Definition, concept, and need of green buildings, Sustainable development principles, Environmental impacts of conventional buildings, Benefits of green buildings.								05
2.	Sustainable Planning & Architecture: Sustainable planning, Orientation and climate-responsive design, Landscape planning, Green roofs and walls.								05
3.	Energy Efficiency in Buildings: Energy consumption in buildings, Energy-efficient building design, HVAC								04

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	optimization, Renewable energy systems (solar, wind), Energy audit and conservation techniques.	
4.	Water & Waste Management: Water conservation techniques, Rainwater harvesting systems, Greywater recycling, Waste management in buildings, Sustainable drainage systems.	04
5.	Sustainable Materials & Indoor Environmental Quality: Eco-friendly building materials, Low embodied energy materials, Recycled and locally available materials, Indoor air quality (IAQ), Thermal comfort, lighting, and acoustics.	04
6.	Green Building Rating Systems & Regulations: Overview of rating systems: Indian Green Building Council (IGBC) Green Rating for Integrated Habitat Assessment (GRIHA) Leadership in Energy and Environmental Design (LEED)	04
TOTAL		26
Teamwork : (Any 10)		
1. Study any IGBC/GRIHA certified building and identify the sustainable features adopted. 2. Study how sustainable development principles have been implemented in any residential, commercial, or institutional building. 3. Study a construction project and identify its environmental impacts. Suggest green alternatives to reduce these impacts. 4. Analyze building designed using passive architectural principles. 5. Study the site planning of a green campus, township, or commercial complex. 6. Study an existing building incorporating green roofs or vertical gardens. 7. Study an energy-efficient building and identify passive design strategies adopted. 8. Study a building utilizing renewable energy systems and evaluate their benefits. 9. Analyze an energy audit report (or published case study) and summarize the recommended energy-saving measures. 10. Study water conservation measures implemented in any green building. 11. Study a residential or institutional building with rainwater harvesting and grey water reuse systems. 12. Study the waste management practices of a smart city, residential township, or institutional campus. 13. Study a building that has extensively used sustainable building materials. 14. Perform a literature review on the life cycle assessment of one construction material. 15. Study an office, hospital, educational building, or green building focusing on indoor environmental quality improvements. 16. Compare two certified buildings, each evaluated under different rating systems (e.g., IGBC vs LEED or GRIHA vs IGBC).		

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17. Study the certification journey of an IGBC or GRIHA certified building

Text Books:

1. K.S. Jagadeesh, "Alternative Building Materials and Technologies", New Age International.
2. C.J. Kibert, "Sustainable Construction: Green Building Design and Delivery", Wiley.
3. Charles J. Kibert, "Green Buildings: Principles and Practices", Island Press.

Environmental Legislations & Standards:

Indian Regulations

1. Environment (Protection) Act, 1986
2. Energy Conservation Act, 2001
3. National Building Code (NBC) of India
4. Eco-Niwas Samhita (Energy Conservation Building Code – Residential)

Standards & Guidelines

1. Energy Conservation Building Code (ECBC)
2. GRIHA & IGBC rating guidelines
3. LEED certification standards
4. Bureau of Energy Efficiency (BEE) norms

Reference Books:

1. O.H. Koenigsberger, "Manual of Tropical Housing and Building", Orient BlackSwan
2. G.Z. Brown and Mark DeKay, "Sun, Wind & Light", Wiley
3. Laurie Baker, "Building with Earth", Centre for Science and Environment
4. Indian Green Building Council, "IGBC Manuals and Guidelines", CII – Indian Green Building Council

E-Resources:

1. Indian Green Building Council - <https://igbc.in>
2. Green Rating for Integrated Habitat Assessment - <https://grihaindia.org>
3. U.S. Green Building Council - <https://usgbc.org>
4. NPTEL Green Building courses - <https://nptel.ac.in>
5. Ministry of Environment, Forest and Climate Change - <https://moef.gov.in>

BACK TO STRUCTURE

**DEPARTMENT OF ELECTRONICS AND COMPUTER ENGINEERING**

B. Tech. (Electronics and Computer Engineering)							Semester: V		
Course: Open Elective – III (Electrical Mobility)							Code: ALOE503C		
Teaching Scheme (Hrs/week)				Evaluation Scheme (Marks)					
Lecture	Practical	Tutorial	Credit	CIE	ETE	TW	OR	PR	Total
02	-	-	02	-	-	50	50	-	100
Prerequisites:									
Basic Electrical and Electronics Engineering.									
Course Objectives:									
1. To apply fundamental principles of electric mobility to interpret EV architectures, components and applications. 2. To utilize energy storage and battery management concepts to evaluate battery performance, charging, and safety. 3. To implement basic concepts of EV powertrains, electric drives, regenerative braking, and charging infrastructure. 4. To integrate smart charging, vehicle-to-grid, IoT, and emerging technologies for sustainable electric mobility.									
Course Outcomes: After completion of this course, students will be able to -									
CO1	Explain the concepts, architecture, and applications of Electric and Hybrid Electric Vehicles.								
CO2	Identify the suitable energy storage systems used in electric vehicles.								
CO3	Illustrate battery charging methods, battery management systems, and SoC estimation techniques.								
CO4	Interpret hybrid powertrain configurations, operating modes, and regenerative braking.								
CO5	Demonstrate the use of electric drives, charging levels, charging standards, and EV charging equipment.								
CO6	Describe EV charging technologies and grid integration concepts such as G2V, V2G, V2H, V2B, and V2V.								
Course Contents:									
Unit	Description								Duration (Hrs.)
1.	Introduction to Electric Mobility: Need for electric mobility, evolution of EVs, advantages and challenges, environmental and economic aspects, EV vs conventional vehicles, types of EVs: BEV, HEV, PHEV and fuel-cell vehicles, basic EV architecture and major components.								04

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2.	Energy Storage Systems: Energy storage requirements, battery terminology and specifications, Li-ion batteries and their types, basic battery characteristics, battery alternatives: solid-state, Aluminium-air, fuel cell and supercapacitor, battery–supercapacitor hybrid system, selection of energy storage system.	04
3.	Battery Charging and Management: EV charging basics, AC and DC charging, charging methods and levels, charging time and factors affecting charging, Battery Management System (BMS), functions of BMS, State of Charge (SoC), State of Health (SoH), State of Power (SoP), cell balancing, battery thermal management and safety.	05
4.	EV Powertrain and Electric Drives: EV powertrain architecture, energy flow in EVs, vehicle performance and basic tractive effort, electric motors used in EVs: BLDC and PMSM, motor selection, basic drive control, regenerative braking and its benefits.	04
5.	EV Charging Infrastructure: EV charging infrastructure, charging levels, AC/DC chargers, EVSE, charging connectors and standards: CCS, CHAdeMO, SAE J1772, Bharat AC/DC, basic charging station components, installation and safety considerations.	04
6.	Smart and Emerging Electric Mobility: Grid-to-Vehicle (G2V), Vehicle-to-Grid (V2G), Vehicle-to-Home (V2H), Vehicle-to-Building (V2B), Vehicle-to-Vehicle (V2V), smart charging, wireless charging, battery swapping, energy management, IoT and digital technologies in EVs, future trends and challenges.	05
TOTAL		26

Teamwork :

1. Study the architecture of an Electric Vehicle (EV) and identify the functions of major components such as battery, BMS, motor, inverter, charger, controller and sensors.
2. Compare 3–5 EVs available in India based on battery capacity, motor power, driving range, charging time, efficiency, cost and other key specifications.
3. Study and compare different energy storage technologies such as Li-ion batteries, solid-state batteries, fuel cells and supercapacitors based on energy density, charging time, life, cost, safety and applications.
4. Visit an EV charging station and study the charger type, AC/DC charging, charging level, connector/standard, power rating, and charging time and safety provisions.
5. Prepare a basic layout of an EV charging station showing charging points, power supply, protection system, parking area, cable routing, safety provisions and user facilities.
6. Study smart EV charging and Vehicle-to-Grid (V2G) concepts, including G2V, V2G, V2H and V2B, and identify their applications in smart grids and buildings.
7. Collect and analyze EV performance or charging data using Excel/Python/MATLAB and study parameters such as battery capacity, range, charging time and energy consumption.
8. Design a conceptual IoT-based EV monitoring system showing sensors, communication

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network, cloud platform and user interface for monitoring SoC, temperature, charging status and energy consumption.

9. Study regenerative braking in EVs and prepare an energy-flow diagram. Analyze energy recovery under different braking conditions using numerical calculations or simulation.
10. Study an emerging EV technology such as battery swapping, wireless charging, solid-state batteries, autonomous EVs, solar charging or second-life batteries and evaluate its technical, economic and environmental benefits.

Text Books:

1. James Larminie and John Lowry, "Electric Vehicle", John Wiley & Sons, 2012.
2. Ronald K. Jurgen, "Electric and Hybrid-Electric Vehicles", SAE International.
3. K. T. Chau, "Energy Systems for Electric and Hybrid Vehicles", The Institution of Engineering and Technology.
4. D. A. J. Rand, R. Woods, and R. M. Dell, "Batteries for Electric Vehicles", Research Studies Press Ltd., New York, John Wiley & Sons.
5. "Electric & Hybrid Vehicles – Design Fundamentals", CRC Press.

Reference Books:

1. Mehrdad Ehsani, Yimin Gao, and Ali Emadi, "Modern Electrical Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design", CRC Press, 2009.
2. Junwei Lu and Jahangir Hossain et al. (Eds.), "Vehicle-to-Grid: Linking Electric Vehicles to the Smart Grid", IET Digital Library.
3. Tom Denton, "Automobile Electrical and Electronic Systems", SAE International Publications.
4. C. Mi, M. A. Masrur, and D. W. Gao, "Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives", John Wiley & Sons, 2011.
5. Mark Warner, "The Electric Vehicle Conversion Handbook", HP Books, 2011.

E-Resources:

1. <https://www.theiet.org/resources/books/transport/vehicle2grid.cfm>
2. <https://www.sae.org/publications/books/content/pt-143.set/>
3. <http://nptel.ac.in/courses/108103009/>

BACK TO STRUCTURE

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B. Tech. (Electronics and Computer Engineering)							Semester: V		
Course: Open Elective – III (Introduction to Stock Market)							Code: ALOE503D		
Teaching Scheme (Hrs/week)				Evaluation Scheme (Marks)					
Lecture	Practical	Tutorial	Credit	CIE	ETE	TW	OR	PR	Total
02	-	-	02	-	-	50	50	-	100
Prerequisites:									
• Basic knowledge of economics and financial systems. • Familiarity with percentage calculations and simple mathematics. • Interest in investing and financial markets.									
Course Objectives:									
1. To understand the structure and functioning of financial and stock markets along with investor psychology. 2. To apply candlestick patterns and indicators for identifying market trends. 3. To understand the fundamentals of option trading and option pricing concepts. 4. To develop short-term and long-term investment strategies using fundamental and technical analysis.									
Course Outcomes: After completion of this course, students will be able to -									
CO1	Explain the functioning of financial markets using fundamental analysis								
CO2	Analyze stock price movements using candlestick patterns for trading decisions.								
CO3	Analyze stock price movements using technical indicators for trading decisions.								
CO4	Describe the concepts of derivatives and option trading.								
CO5	Apply the strategies for option trading.								
CO6	Apply investment strategies based on market analysis.								
Course Contents:									
Unit	Description								Duration (Hrs.)
1.	Fundamental Analysis and Investor Psychology: Introduction to Financial Markets, Primary and Secondary Markets, Market Participants, Stock Exchanges, SEBI and Regulatory Framework, Investment vs Trading, Understanding Business Models, Reading Financial Statements (Balance Sheet, Profit & Loss Account, Cash Flow Statement), Fundamental Ratios (EPS, PE Ratio, PB Ratio, ROE, ROCE, Debt-Equity Ratio), Sector Analysis, Economic Indicators, Investor Psychology, Market Emotions (Fear & Greed), Behavioral Biases, Risk Management Principles.								06
2.	Technical Analysis using Candlestick Charts: Introduction to Technical Analysis, Dow Theory, Support and Resistance, Trend Analysis, Price Action Concepts Candlestick Anatomy: Single Candlestick Patterns (Doji, Hammer, Shooting Star, Marubozu, Spinning Top), Double Candlestick Patterns (Bullish & Bearish								04

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	Engulfing, Harami, Piercing Pattern, Dark Cloud Cover), Triple Candlestick Patterns (Morning Star, Evening Star, Three White Soldiers, Three Black Crows), Gap Analysis, Trend Reversal and Continuation Patterns.	
3.	Technical Analysis using Indicators: Technical Indicators : Moving Averages (SMA, EMA), MACD, RSI, Stochastic Oscillator, Bollinger Bands, VWAP, ADX, ATR, Volume Analysis, Fibonacci Retracement, Pivot Points, Trend Confirmation, Indicator-Based Trading Strategies, Combining Multiple Indicators, Entry and Exit Rules, Backtesting Concepts.	04
4.	Introduction to Derivatives and FNO: Introduction to Derivatives, Futures and Options, Types of Options (Call and Put), Option Terminology (Strike Price, Expiry, Premium, Lot Size, Open Interest), Intrinsic and Time Value, ITM, ATM, OTM Options, Option Chain Analysis, Greeks (Delta, Gamma, Theta, Vega, Rho - Basic Concepts), Option Pricing Factors, Option Expiry and Settlement Process.	04
5.	Introduction to Option Trading Strategies: Option Buying vs Option Selling, Risk and Reward Analysis, Long Call, Long Put, Covered Call, Cash Secured Put, Bull Call Spread, Bear Put Spread, Bull Put Spread, Bear Call Spread, Iron Condor (Basic Concept), Straddle and Strangle (Introduction), Position Sizing, Stop Loss Techniques, Capital Management, Risk Management in Options Trading.	04
6.	Short-Term and Long-Term Trading & Investment Strategies: Swing Trading, Positional Trading, Intraday Trading (Overview), Momentum Trading, Breakout Trading, Trend Following Strategies, Portfolio Building, Value Investing, Growth Investing, Dividend Investing, SIP in Equity, Asset Allocation, Diversification, Trading Plan Development, Trading Journal, Performance Evaluation, Common Mistakes Made by Traders and Investors, Ethics in Financial Markets.	04
Total		26

Term Work:

Perform Any 10:

Sr No	Title	Proposed Activities
1	Stock Market Basics & Trading Platform	Introduction to NSE & BSE, SEBI, Demat & Trading Accounts, Market Participants, Creating a Paper Trading Account.
2	Fundamental Analysis – I	Reading Financial Statements, EPS, PE Ratio, Book Value, Market Capitalization, Sector Analysis
3	Fundamental Analysis –	Company Comparison, Economic Indicators, Market

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	II & Investor Psychology	Cycles, Fear & Greed, Trading Discipline
4	Candlestick Analysis – I	Candlestick Anatomy, Doji, Hammer, Shooting Star, Marubozu, Trend Identification
5	Candlestick Analysis – II	Bullish/Bearish Engulfing, Morning Star, Evening Star, Support & Resistance using Charts
6	Technical Indicators – I	SMA, EMA, Volume Analysis, Trend Identification using TradingView
7	Technical Indicators – II	RSI, MACD, Bollinger Bands, VWAP, Indicator-based Entry & Exit
8	Option Trading Fundamentals	Call & Put Options, Strike Price, Premium, Expiry, Option Chain Analysis
9	Option Buying Strategies	Long Call, Long Put, Break-even Calculation, Risk & Reward Analysis
10	Option Selling Strategies	Covered Call, Cash Secured Put, Bull Call Spread, Bear Put Spread
11	Short-term Trading Strategies	Intraday (Concept), Swing Trading, Breakout Trading, Risk Management
12	Long-term Investment Strategies	Value Investing, Growth Investing, Dividend Investing, Portfolio Diversification

Students should spend most of the session on:

- Live chart analysis using TradingView or similar platforms.
- Analyzing real companies using NSE/BSE financial data.
- Paper trading (no real money involved).
- Maintaining a trading journal.
- Presenting and reviewing trading decisions.

Reference Books:

1. John J. Murphy, "Technical Analysis of the Financial Markets", Pearson.
2. Benjamin Graham, "The Intelligent Investor", Harper Business.
3. Martin J. Pring, "Technical Analysis Explained", McGraw-Hill.
4. Sheldon Natenberg, "Option Volatility and Pricing", McGraw-Hill.
5. Aswath Damodaran, "Investment Valuation", Wiley.
6. Alexander Elder, "Trading for a Living", Wiley.

E-Resources:

1. National Stock Exchange (NSE) Learning Portal – <https://www.nseindia.com> learn tab
2. Bombay Stock Exchange (BSE) Investor Education – <https://www.bseindia.com>
3. SEBI Investor Education – <https://investor.sebi.gov.in>
4. NISM (National Institute of Securities Markets) – <https://www.nism.ac.in>
5. Zerodha Varsity – <https://zerodha.com/varsity>



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6. Investopedia – https://www.investopedia.com

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B. Tech. (Electronics and Computer Engineering)							Semester: V		
Course: Open Elective – III (Patent Law for Engineers and Scientists)							Code: ALOE503E		
Teaching Scheme (Hrs/week)				Evaluation Scheme (Marks)					
Lecture	Practical	Tutorial	Credit	CIE	ETE	TW	OR	PR	Total
02	-	-	02	-	-	50	50	-	100
Prerequisites:									
Basic understanding of engineering/scientific concepts and technological innovation, Basic skills in technical reading, documentation, and report writing.									
Course Objectives:									
1. To understand the importance of Intellectual Property Rights (IPR) and patents. 2. To identify patentable and non-patentable inventions based on patentability criteria. 3. To conduct prior-art and patent searches using public patent databases. 4. To draft a basic patent specification, including claims and abstract. 5. To understand and apply the complete patent filing, examination, and granting process in India. 6. To analyze engineering case studies involving patents, innovation, and commercialization.									
Course Outcomes: After completion of this course, students will be able to -									
CO1	Apply the provisions of the Indian Patent Law to engineering inventions.								
CO2	Perform prior-art and patent searches using standard patent databases.								
CO3	Analyze the patentability, filing, examination, and grant process under the Indian Patent Act.								
CO4	Evaluate patent infringement, licensing, technology transfer, and commercialization issues.								
CO5	Draft a patent specification, including claims and abstract, in compliance with patent law.								
CO6	Develop a patent application for an innovative engineering solution following legal and procedural requirements.								
Course Contents:									
Unit	Description								Duration (Hrs.)
1.	Introduction to Intellectual Property Rights and Patents: Introduction to Intellectual Property Rights (IPR), significance of IPR in engineering, innovation and entrepreneurship, types of IPR, concept and objectives of patents, patentability criteria (novelty, inventive step and industrial applicability), patentable and non-patentable inventions under the Indian Patent Act, 1970, patents versus research publications and products, role of patents in technology commercialization and startup ecosystem. Case Study: Patentability analysis of a simple engineering innovation.								05
2.	Indian Patent Law and Prior-Art Search: Overview of the Indian Patent Act, 1970 and its amendments, objectives and scope of patent law, rights and duties of inventors, overview of WIPO, Patent Cooperation Treaty (PCT) and international patent systems, prior-art search techniques, patent classification systems, patent search using Google Patents,								04

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	InPASS, Espacenet, and WIPO PATENTSCOPE novelty assessment and patent landscape analysis. Case Study: Prior-art search and novelty analysis of an engineering invention.	
3.	Patent Drafting: Structure and components of a patent specification including title, field of invention, background, prior art, problem statement, objectives, summary of invention, brief description of drawings, detailed description, claims, abstract, and drawings. Principles of claim drafting, dependent and independent claims, patent drafting guidelines, common drafting errors, and patent documentation for engineering innovations. Case Study: Drafting of a patent specification for a smart engineering product.	05
4.	Patent Filing, Examination and Grant: Patent filing procedure in India, provisional and complete specification, online filing process, statutory forms, publication of patent application, request for examination, First Examination Report (FER), response to objections, hearing process, patent grant, renewal, restoration, opposition, and maintenance of patents under the Indian Patent Act. Case Study: Patent filing and grant timeline of an Indian engineering patent.	04
5.	Patent Commercialization and Legal Issues: Patent ownership, licensing, assignment, technology transfer, patent valuation, startup and university patents, patent infringement, remedies and dispute resolution, freedom-to-operate (FTO), patent analytics, commercialization strategies, and ethical issues in patent protection. Case Study: Commercialization of a patented engineering innovation.	04
6.	Emerging Technologies and Patent Case Studies: Patents in Artificial Intelligence, Machine Learning, Internet of Things (IoT), Robotics, Semiconductor Technology, Biotechnology, Software, Green Technologies, and Industry 4.0, AI-generated inventions, recent developments in patent law, international patent trends, patent portfolio management, and innovation-driven entrepreneurship. Case Study: Analysis of landmark patent disputes such as Apple vs Samsung or an Indian engineering innovation, along with preparation of a basic patent draft for an engineering solution.	04
Total		26
Term Work:		
Students shall complete the following practical, activity-oriented assignments based on a selected engineering innovation/project:		
1. Identify suitable IP protection for an engineering innovation and assess basic patentability criteria. 2. Conduct patent searches using Google Patents, IP India, WIPO PATENTSCOPE and Espacenet and analyze the novelty of the selected innovation. 3. Identify a copyrightable work such as software, technical content or digital work and prepare/undertake the copyright registration process.		

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4. Develop a product/start-up brand, conduct trademark search, identify the appropriate class and prepare a basic trademark application.
5. Identify protectable visual features of an engineering product, conduct design search and prepare a basic design registration application.
6. Prepare a basic patent specification including title, background, objectives, description, drawings, abstract and claims for an engineering innovation.
7. Prepare a mock provisional/complete patent application and study the filing, publication, examination, FER, response and grant process in India.
8. Study the PCT route and prepare a mock PCT application based on the selected engineering invention.
9. Analyze patents in a selected emerging technology area and identify major patent holders, technology trends and basic FTO considerations.
10. Develop an IP portfolio for the selected innovation covering patent, copyright, trademark/design and propose a basic commercialization strategy.

Text Books:

1. P. Narayanan, "Patent Law", Eastern Law House.
2. Prabuddha Ganguli, "Intellectual Property Rights: Unleashing the Knowledge Economy", McGraw-Hill.
3. N. S. Gopalakrishnan and T. G. Agitha, "Principles of Intellectual Property", Eastern Book Company.
4. Government of India, "The Patents Act, 1970 (as amended) and The Patents Rules, 2003 (as amended)", Government of India.

Reference Books:

1. David Pressman, "Patent It Yourself", NOLO Publications.
2. WIPO, "WIPO Intellectual Property Handbook: Policy, Law and Use", World Intellectual Property Organization.
3. Indian Patent Office, "Manual of Patent Office Practice and Procedure", Office of the Controller General of Patents, Designs & Trade Marks (CGPDTM), Government of India.
4. Alexander I. Poltorak and Paul J. Lerner, "Essentials of Intellectual Property", John Wiley & Sons.

E-Resources:

1. **Patent Law for Engineers and Scientists** – NPTEL (IIT Madras): <https://nptel.ac.in/courses/110106081>
7. **Intellectual Property** – NPTEL (IIT Madras): <https://nptel.ac.in/courses/109106137>

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Program: B. Tech(Electronics and Computer Engineering)							Semester: V		
Course: Project Management System – II							Code: ECMD503		
Teaching Scheme (Hrs/week)				Evaluation Scheme (Marks)					
Lecture	Practical	Tutorial	Credit	CIE	ETE	TW	OR	PR	Total
-	02	-	01	-	-	25	-	-	25
Prerequisites:									
Project Management System - I									
Course Objectives:									
1. To curate all project tasks to meet the needs of the company, consumers, and stakeholders. 2. To schedule and divide different tasks and work among team members. 3. To set the quality standard in a project. 4. To use various PMS Software’s as per specific domain.									
Course Outcomes: After completion of this course, students will be able to -									
CO1	Explain various lifecycle models used in project management.								
CO2	Perform feasibility analysis and apply CPM & PERT Techniques.								
CO3	Understand project audit methodologies and scrum scheduling using Delphi Technique.								
CO4	Learn various project management software’s like JIRA, MSP, Teamwork.com, Trello etc.								
Course Contents:									
Unit	Description								Duration (Hrs.)
1.	Project Life cycle Management: Traditional project activity planning, agile project planning, coordination through integration management, project feasibility analysis, estimating project budget, project risk management, CPM, PERT, resource loading, resource leveling								08
2.	Project execution: Planning-monitoring-controlling cycle, earned value analysis, agile tool for tracking project, methods of project controlling, project audit, essentials of audit, evaluation, project closure, benefit realization, change management.								08
3.	Industry trends and software’s in project management: Enterprise project management, project success factor, standish factor of success, talent triangle, project governance, Change management, PMI’S code of conduct, software for project management, simulations software for project management.								10
TOTAL								26	

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Text Books:
1. Gary Richard Son, Brad Jackson, "Project Management Theory & Practice" CRC Press.
2. John M. Nicholas, Herman Steyn, "Project Management for business engineering and technology", Elsevier.
3. Arun Kanda, "Project Management: A Lifecycle Approach", PHI.
Reference Books:
1. "A Guide to the Project Management Body of Knowledge (PMBOK Guide)", Project Management Institute.
2. B. B. Goel, "Project Management: Principles and Techniques", Deep & Deep Publications Pvt. Ltd.
E-Resources:
1. Dr. Nimisha Singh, "Introduction to Project Management: Principles & Practices", NPTEL Course - https://onlinecourses.swayam2.ac.in/imb25_mg167/preview
2. Prof. Raghu Nandan Sengupta, "Project Management", NPTEL Course - https://onlinecourses.nptel.ac.in/noc25_mg78/preview
3. Project management for beginners by Ramesh Kumar https://youtu.be/gnkjcRDQkw0?list=PLLy_2iUCG87CBuNhvti0h6W54ZmqrSDMJ

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Program: B. Tech. (Electronics and Computer Engineering)							Semester: V		
Course: Mini Project and Seminar							Code: ECAE506		
Teaching Scheme (Hrs/week)				Evaluation Scheme (Marks)					
Lecture	Practical	Tutorial	Credit	CIE	ETE	TW	OR	PR	Total
-	02	-	01	-	-	25	25	-	50
Prerequisites:									
• Basic Knowledge of Computer Organization and Operating Systems • Programming Fundamentals using C/C++/Python • Fundamentals of Database Management Systems • Basic Knowledge of Analog and Digital Electronics									
Course Objectives:									
1. To understand the Product Development Process. 2. To plan for various activities of the project and distribute the work amongst team members. 3. To inculcate electronic hardware/software implementation skills by learning design and development of software based applications. 4. To understand the importance of document design by compiling Technical Report on the Mini Project work carried out.									
Course Outcomes: After completion of this course, students will be able to -									
CO1	Describe the process of planning and executing a mini project as a team.								
CO2	Implement electronic hardware/software by design and development process								
CO3	Prepare a technical report based on the Mini project.								
CO4	Deliver technical seminar based on the Mini Project work carried out.								
1.	Execution of Mini Project • Project group shall consist of minimum 2 and maximum 4 students per group. • Mini Project can be hardware based and or software based • Project designs ideas can be necessarily adapted from recent issues/innovative ideas • Bare board test report shall be generated in case of hardware based Mini Project • Bug Testing report should be generated in case of software based Mini Project • Assembly of components and enclosure design is mandatory in case of hardware based Mini Project								
2.	Project Selection (Domains for projects may be from the following, but not limited to) 1. Hardware Based : i) Electronic Communication System ii) Microcontroller Based Projects. (Only 8051 and LPC2148 is recommended. Arduino Projects not Allowed) iii) Analog Electronics iv) Digital Electronics v) Instrumentation and Control								

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	2. Software Based : i) C/C++ Based Projects ii) Python Based Projects. iii) Java Based (Preferred) iv) Database Management Based Projects
3.	Suggested Plan of Implementation i) Week 1 : Formation of Groups ii) Week 2 : Submission of Topics for Approval. iii) Week 3 : Finalization of Topic. iv) Week 4 & 5 : Development of Architectural Model or Algorithm for Software Based Topics and Circuit Diagram Design and Simulation for Hardware Based Topics. v) Week 6 : Testing of Hardware Assembly / Modular Programs vi) Week 7 : Seminar Presentation. vii) Week 8 & 9 : Testing of Final Product. viii) Week 10 : Preparation and Checking Draft Copy of Report. ix) Week 11 : Generation of Plagiarism Report and Correcting the Draft Copy of Report x) Week 12 : Publication of Copyright / Research Paper Based of Topic. xi) Week 13 : Final Demonstration of Project.
4.	Report Writing Guidelines 1. Hardware Based Projects : i) Title ii) Abstract iii) Introduction iv) Aim and Objectives v) Specifications vi) Block Diagram vii) Circuit Diagram viii) Selection of components, calculations ix) Simulation Results x) PCB Art work xi) Testing Procedures xii) Enclosure Design xiii) Test Results xiv) Conclusion and future work xv) References

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2. Software Based Projects :

- i) Title
- ii) Abstract
- iii) Introduction
- iv) Scope of the Work
- v) Requirements of software project
- vi) Aim and Objectives
- vii) Proposed architecture/methodology
- viii) Details of Software used
- ix) Algorithm and flow chart
- x) User Interface
- xi) Experimentation
- xii) Test Results
- xiii) Conclusion and Future work
- xiv) Project source code & program
- xv) References

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Program: B. Tech. (Electronics and Computer Engineering)							Semester: V		
Course: Internship – IV							Code: ECIN504		
Teaching Scheme (Hrs/week)				Evaluation Scheme (Marks)					
Lecture	Practical	Tutorial	Credit	CIE	ETE	TW	OR	PR	Total
-	-	-	02	-	-	25	-	-	25
Preamble:									
Internships serve as vital educational and career development experiences, offering practical exposure in a specific field. Employers seek individuals who possess the necessary skills and an understanding of industry environments, practices, and cultures. This internship is designed as a structured, short-term, supervised training program, often centered on specific tasks or projects with clear timelines. The primary goal is to immerse technical students in an industrial setting, providing experiences that cannot be replicated in the classroom. This exposure aims to develop competent professionals who understand the social, economic, and administrative factors influencing the operations of industrial organizations.									
Course Objectives:									
1. Exposure to students to the industrial environment, which cannot be provided in the classroom and hence creating deployable professionals for the industry. 2. Learn to implement the technical knowledge in real industrial situations.									
Course Outcomes: After completion of this course, students will be able to -									
CO1	Gain exposure to industry practices and understand how academic concepts are applied in professional settings.								
CO2	Develop and demonstrate effective communication and teamwork skills within a work environment.								
CO3	Improve your problem-solving and time management skills by working in real-world industry settings.								
Internship Requirements									
1. Internship Duration: It is mandatory for all students to undergo an internship after every semester during vacations for the duration of 3 to 5 weeks. Internships completed during this period will be considered for the assessment of Term Work (TW). 2. Internship Opportunities: Students can explore various opportunities for internships at: a. Industries b. Research labs or organizations c. Collegiate clubs d. In-house research projects e. Online internships 3. Support and Assistance: Students can seek assistance for securing internships from: a. The Training and Placement cell, along with departmental coordinators b. Department or institute faculty members c. Personal contacts d. Directly connecting with industries or organizations									

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4. **Request Letter:** Once an industry, research organization, or collegiate club is identified, students must obtain a request letter from the concerned department or placement office. This letter, in the standard format must be duly signed by the authority, should be addressed to the HR manager or relevant authority.
5. **Confirmation Letter:** Students must submit the confirmation letter from the industry, research organization, or collegiate club to the Internship Coordinator and the Head of Department (HOD) office.
6. **Joining Report:** Upon commencing the internship, students must submit the joining report, joining letter, or a copy of the confirmation email to the Internship Coordinator and the HOD office.
7. **Faculty Mentor:** A faculty member will be assigned as a mentor to a group of students. The mentor will be responsible for monitoring, evaluating, and assessing student internship activities. The faculty mentor is also required to visit the internship location and submit formal feedback to the Internship Coordinator.
8. **Faculty Visits:** Faculty members are advised to visit the internship site once or twice during the internship period to monitor progress.
9. **Progress Report:** Students must submit progress report fortnightly to their faculty guide and the final internship report to the Internship Coordinator and department office.
10. **Evaluation Report:** After the completion of the internship, the mentor, along with the assessment panel members, should submit the evaluation report of the students to the department office and the Internship Coordinator.
11. **Internship Certificate:** Students must receive the Internship Certificate from the industry and submit it to the Internship Coordinator and department office.
12. **Presentation and Assessment:** Students are required to give a presentation on their internship work as part of the term work. The internship diary and report will also be verified and assessed.

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Semester - VI

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Program: Electronics and Computer Engineering							Semester: VI		
Course: Web Technology							Code: ECPC611		
Teaching Scheme (Hrs/week)				Evaluation Scheme (Marks)					
Lecture	Practical	Tutorial	Credit	CIE	ETE	TW	OR	PR	Total
03	-	-	03	40	60	-	-	-	100
Prerequisites:									
• Computer Programming (C/C++) • Fundamentals of Computer Networks • Database Management Systems • Object-Oriented Programming Concepts									
Course Objectives:									
1. To understand the fundamentals of web technologies and Internet architecture. 2. To develop responsive and interactive web applications using HTML5, CSS3, Bootstrap and JavaScript. 3. To design server-side web applications using Node.js, Express.js and MongoDB. 4. To develop Single Page Applications using React and deploy modern web applications.									
Course Outcomes: After completion of this course, students will be able to -									
CO1	Explain the architecture and components of modern web technologies.								
CO2	Develop responsive and interactive client-side applications using JavaScript and DOM manipulation								
CO3	Design dynamic web applications using PHP and MySQL.								
CO4	Apply Git and GitHub for collaborative web application development.								
CO5	Design RESTful backend applications using Node.js, Express.js and MongoDB.								
CO6	Build component-based front-end applications using React and integrate them with backend services.								
Course Contents:									
Unit	Description								Duration (Hrs.)
1.	Foundations of Web Technologies Evolution of Internet and World Wide Web, Client-Server Architecture, Static and Dynamic Websites, HTTP & HTTPS Protocol, URL, DNS, Web Browsers and Web Servers. HTML5: Fundamentals, Semantic HTML, Tables, Lists, Forms,CSS3, Responsive Web Design, Bootstrap Framework, Flexbox and CSS Grid.								07

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2.	Client-Side Web Development JavaScript ES6: Fundamentals, Variables, Data Types, Operators, Functions, Arrays, Objects, DOM Manipulation, Events, Form Validation, Browser Objects, JSON, AJAX, Fetch API, Local Storage, Session Storage, Error Handling	07
3.	Server-Side Web Programming with PHP Introduction to PHP: PHP Syntax, Variables, Operators, Decision Making, Loops, Functions, Arrays, String Handling, Form Processing using GET and POST, File Handling, Cookies, Sessions, Exception Handling, File Uploading, Email Validation,	07
4.	Database Connectivity Introduction to MySQL, CRUD Operations using PHP and MySQL, Prepared Statements, Transactions, Authentication and Login Module, Introduction to REST APIs and JSON Data Exchange, Git Installation, Repository Creation, Commit, Branching, Merging, Clone, Push, Pull, GitHub Repository Management, Pull Requests, Conflict Resolution	06
5.	Backend Development with Node.js Introduction to Node.js Runtime Environment, NPM Package Manager, Modules, Express.js Framework, Routing, Middleware, RESTful API Development, MongoDB: Fundamentals, CRUD Operations, Mongoose ODM, Database Connectivity.	06
6.	Front-End Application Development with React Introduction to React, React Architecture, JSX, Functional Components, Props, State Management, Hooks (useState, useEffect), Event Handling, Forms, API Integration, Component-Based Application Development, Building and Deploying a Simple React Application.	06
TOTAL		39

Text Books:

1. Jeffrey C. Jackson, Web Technologies – A Computer Science Perspective, Pearson Education.
2. Luke Welling and Laura Thomson, PHP and MySQL Web Development, 5th Edition, Addison-Wesley.
3. Jon Duckett, HTML and CSS: Design and Build Websites, Wiley.
4. Jon Duckett, JavaScript and jQuery: Interactive Front-End Web Development, Wiley.



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Reference Books:
1. Robin Nixon, Learning PHP, MySQL & JavaScript, O'Reilly. 2. David Sklar, PHP Cookbook, O'Reilly. 3. Ethan Brown, Web Development with Node and Express, O'Reilly. 4. Alex Banks and Eve Porcello, Learning React, O'Reilly. 5. Scott Chacon and Ben Straub, Pro Git, Apress.
E-Resources:
1. MongoDB University 2. Git Documentation 3. GitHub Skills 4. NPTEL – Web Technologies 5. NPTEL – Database Management Systems

BACK TO STRUCTURE

DEPARTMENT OF ELECTRONICS AND COMPUTER ENGINEERING

Program: Electronics and Computer Engineering							Semester: VI		
Course: Web Technology Lab							Code: ECPC611P		
Teaching Scheme (Hrs/week)				Evaluation Scheme (Marks)					
Lecture	Practical	Tutorial	Credit	CIE	ETE	TW	OR	PR	Total
-	02	-	02	-	-	-	50	-	100
Prerequisites:									
• Computer Programming (C/C++) • Fundamentals of Computer Networks • Database Management Systems • Object-Oriented Programming Concepts									
Course Objectives:									
1. To develop practical skills in designing responsive and interactive web pages using HTML5, CSS3, Bootstrap, JavaScript, DOM and AJAX. 2. To develop server-side web programming skills using PHP, including form handling, session and cookie management, and database operations using MySQL. 3. To develop proficiency in modern web development tools and frameworks including Git/GitHub, Node.js, Express.js, MongoDB, React and REST APIs for developing full-stack web applications.									
Course Outcomes: After completion of this course, students will be able to -									
CO1	Design and develop responsive and dynamic web pages using HTML5, CSS3, Bootstrap, JavaScript, DOM manipulation and AJAX.								
CO2	Develop server-side web applications using PHP with form handling, session/cookie management and CRUD operations using MySQL.								
CO3	Develop and integrate modern web applications using Git/GitHub, Node.js, Express.js, MongoDB, React and REST APIs.								

List of Experiments:	
GROUP A: (Any Four)	
1. Design a responsive web page using HTML5, CSS3 and Bootstrap. 2. Develop a JavaScript-based form with client-side validation. 3. Create a dynamic web page using DOM manipulation and AJAX. 4. Develop a PHP program for handling user registration using GET and POST. 5. Implement session and cookie management in PHP. 6. Perform CRUD operations using PHP and MySQL.	
GROUP B: (Any Four)	
1. Create and manage a Git repository using Git and GitHub. 2. Develop REST APIs using Node.js and Express.js. 3. Connect MongoDB with Node.js using Mongoose. 4. Develop a React application using functional components and Hooks. 5. Integrate React with REST APIs.	

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| 6. Develop and deploy a simple full-stack web application using PHP/MySQL or React/Node.js. |
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Reference Books:

- | |
|---|
| <ol style="list-style-type: none">1. Robin Nixon, Learning PHP, MySQL & JavaScript, O'Reilly.2. David Sklar, PHP Cookbook, O'Reilly.3. Ethan Brown, Web Development with Node and Express, O'Reilly.4. Alex Banks and Eve Porcello, Learning React, O'Reilly.5. Scott Chacon and Ben Straub, Pro Git, Apress. |
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E-Resources:

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| <ol style="list-style-type: none">1. MongoDB University2. Git Documentation3. GitHub Skills4. NPTEL – Web Technologies5. NPTEL – Database Management Systems |
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BACK TO STRUCTURE

DEPARTMENT OF ELECTRONICS AND COMPUTER ENGINEERING

Program: Electronics and Computer Engineering							Semester: VI		
Course: Power Electronics and EV Technology							Code: ECPC612		
Teaching Scheme (Hrs/week)				Evaluation Scheme (Marks)					
Lecture	Practical	Tutorial	Credit	CIE	ETE	TW	OR	PR	Total
03	-	-	03	40	60	-	-	-	100
Prerequisites:									
- Basic Electronics and Basic Electrical Engineering - Electronic Circuit Design									
Course Objectives:									
- To understand the characteristics and operation of power semiconductor devices. - To analyze controlled and uncontrolled power converter circuits. - To study battery technologies and Battery Management Systems used in Electric Vehicles. - To understand Electric Vehicle architecture, charging systems and powertrain. - To develop knowledge of modern EV technologies and energy management techniques.									
Course Outcomes: After completion of this course, students will be able to -									
CO1	Explain the characteristics and operation of power semiconductor devices.								
CO2	Analyze the performance of single-phase power rectifier circuits.								
CO3	Apply DC-DC converters and inverter concepts in electric vehicle applications.								
CO4	Analyze battery technologies, Battery Management Systems and battery pack configurations.								
CO5	Explain the architecture, powertrain and charging technologies of Electric Vehicles.								
CO6	Design basic battery pack configurations and evaluate EV energy management and safety techniques.								
Course Contents:									
Unit	Description								Duration (Hrs.)
1.	Introduction to Power Semiconductor Devices Introduction to Power Electronics, Applications of Power Electronics, Characteristics of Power Semiconductor Devices, Power Diode, SCR, TRIAC, DIAC, Power BJT, Power MOSFET, IGBT, Static and Switching Characteristics, Gate Drive Circuits, Protection of Power Devices, Heat Sinks and Thermal Management.								07
2.	Single-Phase Power Rectifiers UJT Relaxation Oscillator, Single Phase Half Wave Rectifier, Full Wave Rectifier, Bridge Rectifier, Performance Parameters, Ripple Factor, Efficiency, Single Phase Half Controlled Rectifier, Fully Controlled Rectifier using SCR, Freewheeling Diode, Effect of RL Load, Commutation Basics, Applications in Battery Charging.								07
3.	Power Converters for Electric Vehicles DC-DC Converters (Buck, Boost, Buck-Boost), Chopper Principles, Introduction to PWM, Single Phase Voltage Source Inverter (VSI), H-Bridge Inverter, Applications of Converters and Inverters in EVs,								07

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	Regenerative Braking Concept, Power Electronic Converter Selection for EV Systems.	
4.	Battery Technology and Battery Management System (BMS) Introduction to Battery Technologies, Lead Acid, NiMH, Lithium-Ion, LiFePO4 Batteries, Battery Parameters, State of Charge (SOC), State of Health (SOH), Depth of Discharge (DOD), C-rate, Cell Balancing Techniques, Battery Management System Architecture, Battery Protection, Thermal Management, Battery Charging Algorithms (CC-CV), Series and Parallel Connected Battery Banks, Battery Pack Design Considerations.	06
5.	Electric Vehicle Technology Introduction to Electric Vehicles, Evolution of EVs, Types of EVs (BEV, HEV, PHEV, FCEV), EV Architecture, Powertrain Components, Electric Motors used in EVs (BLDC, PMSM, Induction Motor), EV Controllers, Transmission Systems, Auxiliary Systems, Regenerative Braking, Energy Management.	06
6.	EV Charging Infrastructure and Emerging Technologies EV Charging Standards, AC and DC Chargers, Charging Levels (Level 1, Level 2, Level 3), Fast Charging, Bharat DC Charger, CCS, Wireless Charging, Vehicle-to-Grid (V2G), Renewable Energy Integration, Safety Standards.	06
TOTAL		39
Text Books:		
1. Muhammad H. Rashid, Power Electronics: Circuits, Devices and Applications, Pearson. 2. P. S. Bimbhra, Power Electronics, Khanna Publishers. 3. James Larminie and John Lowry, Electric Vehicle Technology Explained, Wiley. 4. Iqbal Husain, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press.		
Reference Books:		
1. Ned Mohan, Power Electronics: Converters, Applications and Design, Wiley. 2. Krishnan R., Electric Motor Drives, Pearson. 3. Ali Emadi, Advanced Electric Drive Vehicles, CRC Press. 4. Gregory L. Plett, Battery Management Systems, Artech House.		
E-Resources:		
1. NPTEL – Power Electronics 2. NPTEL – Electric Vehicles 3. SWAYAM – Electric Vehicle Technology		

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DEPARTMENT OF ELECTRONICS AND COMPUTER ENGINEERING

Program: Electronics and Computer Engineering							Semester: VI		
Course: Power Electronics and EV Technology Lab							Code: ECPC612P		
Teaching Scheme (Hrs/week)				Evaluation Scheme (Marks)					
Lecture	Practical	Tutorial	Credit	CIE	ETE	TW	OR	PR	Total
03	-	-	03	40	60	-	-	-	100
Prerequisites:									
• Basic Electronics and Basic Electrical Engineering • Electronic Circuit Design									
Course Objectives:									
1. To develop practical understanding of power semiconductor devices and their characteristics, switching behavior and applications in power electronic circuits. 2. To develop practical skills in analyzing and simulating controlled rectifiers, DC-DC converters, PWM techniques and power electronic circuits used in electrical energy conversion. 3. To develop practical understanding of electric vehicle battery systems, battery management, EV charging, regenerative braking and motor drive technologies.									
Course Outcomes: After completion of this course, students will be able to -									
CO1	Analyze the characteristics and switching behavior of power semiconductor devices such as SCR, MOSFET, IGBT and UJT for power electronic applications.								
CO2	Design, implement and simulate power electronic circuits including controlled rectifiers, DC-DC converters and PWM generation techniques.								
CO3	Analyze and evaluate EV battery systems, battery management, charging methods, regenerative braking and BLDC motor drives for electric vehicle application								
List of Experiments:									
GROUP A: (Any Five)									
1. Study the V-I characteristics of SCR. 2. Study the switching characteristics of MOSFET and IGBT. 3. Study the operation of single-phase controlled Half Wave rectifier using SCR. 4. Study the operation of single-phase controlled Full Wave rectifier using SCR. 5. Design and simulate Buck and Boost converters. 6. Simulation of PWM generation for DC-DC converters. 7. Study the UJT Relaxation Oscillator									
GROUP B: (Any Three)									
1. Battery charging and discharging characteristics of Lithium-ion batteries. 2. Design a battery pack using series and parallel connected cells. 3. Measurement of State of Charge (SOC) and State of Health (SOH). 4. Study of Battery Management System using simulation/software. 5. Study of EV charging methods and charging standards. 6. Simulation of regenerative braking in an electric vehicle. 7. Study of BLDC motor drive for EV applications.									



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Reference Books:
1. Ned Mohan, Power Electronics: Converters, Applications and Design, Wiley. 2. Krishnan R., Electric Motor Drives, Pearson. 3. Ali Emadi, Advanced Electric Drive Vehicles, CRC Press. 4. Gregory L. Plett, Battery Management Systems, Artech House.
E-Resources:
1. NPTEL – Power Electronics 2. NPTEL – Electric Vehicles 3. SWAYAM – Electric Vehicle Technology

BACK TO STRUCTURE

DEPARTMENT OF ELECTRONICS AND COMPUTER ENGINEERING

Program: B. Tech. (Electronics and Computer Engineering)							Semester: VI		
Course: Electronics System Design							Code: ECPE602A		
Teaching Scheme (Hrs/week)				Evaluation Scheme (Marks)					
Lecture	Practical	Tutorial	Credit	CIE	ETE	TW	OR	PR	Total
03	-	-	03	40	60	-	-	-	100
Prerequisites:									
- Basic Electronics - Electronics Circuit Design									
Course Objectives:									
- To understand the electronic product design process. - To develop system specifications and architectures. - To design electronic hardware and PCB. - To understand testing, verification and reliability. - To understand industrial product development.									
Course Outcomes: After completion of this course, students will be able to -									
CO1	Analyze customer requirements and formulate engineering specifications for electronic product development.								
CO2	Design system architecture by applying functional decomposition, hardware–software partitioning, and design constraints.								
CO3	Develop electronic hardware circuits by selecting appropriate components, interfaces, power supplies, and protection techniques.								
CO4	Design PCB layouts by applying routing, grounding, shielding, thermal management, and EMC design guidelines.								
CO5	Evaluate electronic products using appropriate testing, verification, reliability, quality assurance, and Design for Manufacturing (DFM)/Design for Testability (DFT) techniques.								
CO6	Develop electronic product prototypes by applying rapid prototyping, product optimization, certification requirements, documentation, and industrial design practices.								
Course Contents:									
Unit	Description								Duration (Hrs.)
1.	Electronic Product Design Process: Product life cycle, product development process, customer requirement analysis, engineering specifications, design methodology, feasibility analysis, product documentation and design review.								06
2.	System Specification and Architecture: Requirement analysis, functional decomposition, system architecture, hardware/software partitioning, interface specification, design constraints, performance, power and cost optimization.								07
3.	Electronic Circuit and Hardware Design: Power supply design, analog and digital interface circuits, component								07

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	selection, signal conditioning, protection circuits (ESD, surge, reverse polarity), design guidelines for reliability and manufacturability.	
4.	PCB Design, Packaging and EMC: PCB stack-up, component placement, routing techniques, grounding, power distribution, shielding, thermal management, PCB manufacturing overview, EMI/EMC design guidelines.	07
5.	Testing, Verification and Reliability: Prototype development, functional testing, environmental testing, debugging techniques, reliability concepts, quality assurance, Design for Manufacturing (DFM) and Design for Testability (DFT).	06
6.	System Integration and Industrial Applications: System integration methodology, product documentation, design review, rapid prototyping, product certification overview (CE, FCC, BIS, RoHS), Industrial case studies: Smart Electric Vehicle Battery Management System (BMS) and Wearable Health Monitoring System.	06
TOTAL		39

Text Books:

1. The Art of Electronics, 3rd Edition, Cambridge University Press, 2015.
2. Computers as Components: Principles of Embedded Computing System Design, 3rd Edition, Morgan Kaufmann (Elsevier), 2012.
3. Embedded System Design: A Unified Hardware/Software Introduction, 2nd Edition, John Wiley & Sons, 2002.

Reference Books:

1. Product Design and Development, 7th Edition, McGraw-Hill Education, 2020.
2. Electromagnetic Compatibility Engineering, 1st Edition, John Wiley & Sons, 2009.
3. Printed Circuit Board Design Techniques for EMC Compliance, 2nd Edition, IEEE Press / John Wiley & Sons, 2000.
4. Real-Time Concepts for Embedded Systems, 1st Edition, CRC Press, 2003.
5. Designing Embedded Hardware, 2nd Edition, O'Reilly Media, 2005.

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E-Resources:

1. Electronic Systems Design: Hands-on Circuits and PCB Design with CAD Software, NPTEL, IIT Delhi (Prof. Ankur Gupta)
[NPTEL Course: Electronic Systems Design: Hands-on Circuits and PCB Design with CAD Software](#)
2. Embedded Systems Design, NPTEL, IIT Kharagpur (Prof. Indranil Sengupta, Prof. Kamalika Dutta)
[NPTEL Archive: Embedded Systems Design](#)
3. Introduction to Embedded System Design, NPTEL, IIT Jammu & NSUT
[NPTEL Course Catalogue: Introduction to Embedded System Design](#)
4. PCB Design Tutorials, Altium Academy (YouTube)
Altium Academy YouTube Channel
5. PCB Design and Signal Integrity, Altium Resource Center
[Altium Resource Center](#)
6. KiCad PCB Design Documentation and Tutorials, KiCad Official Documentation
[KiCad Documentation](#)
7. MIT OpenCourseWare – Circuits and Electronics
[MIT OpenCourseWare: Circuits and Electronics](#)

BACK TO STRUCTURE

DEPARTMENT OF ELECTRONICS AND COMPUTER ENGINEERING

Program: B. Tech. (Electronics and Computer Engineering)							Semester: VI		
Course: Data Science and Visualization							Code: ECPE602B		
Teaching Scheme (Hrs/week)				Evaluation Scheme (Marks)					
Lecture	Practical	Tutorial	Credit	CIE	ETE	TW	OR	PR	Total
03	-	-	03	40	60	-	-	-	100
Prerequisites:									
- Python Programming - Database Management Systems - Fundamentals of Statistics									
Course Objectives:									
- To understand the fundamentals of Data Science and the data analytics lifecycle. - To apply statistical methods and data preprocessing techniques for data analysis. - To perform exploratory data analysis using Python libraries. - To visualize multidimensional data using modern visualization tools. - To develop interactive dashboards and analytical reports for engineering applications.									
Course Outcomes: After completion of this course, students will be able to -									
CO1	Explain the fundamentals of Data Science and data analytics.								
CO2	Apply statistical methods and data preprocessing techniques for data analysis.								
CO3	Perform exploratory data analysis using Python libraries.								
CO4	Analyze datasets using suitable analytical techniques.								
CO5	Develop effective data visualizations and dashboards using appropriate tools.								
CO6	Analyze multidimensional datasets using visualization techniques for engineering applications.								
Course Contents:									
Unit	Description							Duration (Hrs.)	
1.	Introduction to Data Science Introduction to Data Science, Data Analytics Lifecycle, Role of Data Scientist, Data Science Process, Types of Data (Structured, Semi-Structured and Unstructured), Quantitative and Qualitative Data, Sources of Data, Big Data vs Small Data, Engineering Applications of Data Science, Introduction to Python ecosystem (NumPy, Pandas, Matplotlib, Seaborn, Plotly).							06	
2.	Statistics and Data Preprocessing Population and Sample, Measures of Central Tendency, Measures of Dispersion, Correlation and Covariance, Probability Basics, Conditional Probability, Bayes Theorem, Hypothesis Testing, Missing Value Handling, Data Cleaning, Outlier Detection, Data Transformation, Feature Scaling and Data Normalization.							07	

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3.	Exploratory Data Analysis (EDA) Data Import using Pandas, Data Manipulation, Data Aggregation, Filtering, Grouping, Data Wrangling, Exploratory Data Analysis, Feature Engineering (Introduction), Correlation Analysis, Statistical Summaries, Time Series Data Analysis, Engineering Dataset Analysis using Python.	07
4.	Data Analysis Techniques Introduction to Regression, Classification and Clustering, Linear Regression Overview, Logistic Regression Overview, K-Means Clustering, Decision Trees (Introduction), Model Evaluation Metrics (Accuracy, Precision, Recall, F1-Score, Confusion Matrix), Dimensionality Reduction Overview (PCA), Engineering Case Studies.	07
5.	Testing, Verification and Reliability: Prototype development, f Data Visualization and Dashboard Design Principles of Data Visualization, Dashboard Design Guidelines, Data Storytelling, Charts (Line, Bar, Pie, Histogram, Box Plot, Scatter Plot, Heat Map, Pair Plot), Interactive Visualization using Plotly, Dashboard Development using Streamlit/Tableau (Introduction), Report Generation, .functional testing, environmental testing, debugging techniques, reliability co	06
6.	Advanced Data Visualization Multidimensional Data Visualization, Parallel Coordinates, Scatter Plot Matrix, Treemap, Network Graphs, Geospatial Visualization (Introduction), Principal Component Analysis (Visualization Perspective), Interactive Dashboards, Visualization of Engineering Datasets, Industrial Case Studies, quality assurance, Design for Manufacturing (DFM) and Design for Testability (DFT).	06
TOTAL		39

Text Books:

1. Jiawei Han, MichelineKamber, Jian Pei. Data Mining: Concepts and Techniques, 3rd Edition
2. Joel Grus, Data Science from Scratch, O'Reilly Media Inc., ISBN: 9781491901427
3. Colin ware, Information visualization perception for design, MK publication

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Reference Books:

1. Big data black book, Dream tech publication
2. Getting Started with Business Analytics: Insightful Decision-Making , David Roi Hardoon, Galit Shmueli, CRC Press
3. Business Analytics , James R Evans, Pearson
4. Python Data science Handbook, *Jake VanderPlas, Orielly publication*
5. Data Science for Business: What You Need to Know about Data Mining and Data-Analytic Thinking, Vovost Foster, Fawcett Tom

E-Resources:

1. handbook for visualizing : a handbook for data driven design by Andy krik:<http://book.visualisingdata.com/>
2. <https://www.programmer-books.com/introducing-data-science-pdf/>
3. An Introduction to Statistical Learning with Applications in R:
<http://faculty.marshall.usc.edu/gareth-james/ISL/>
4. <https://nptel.ac.in/courses/106/106/106106179/>
5. <https://nptel.ac.in/courses/106/106/106106212/>
6. <https://nptel.ac.in/courses/106/105/106105174/>

BACK TO STRUCTURE

DEPARTMENT OF ELECTRONICS AND COMPUTER ENGINEERING

Program: B. Tech. (Electronics and Computer Engineering)							Semester: VI		
Course: Wireless Sensor Networks							Code: ECPE602C		
Teaching Scheme (Hrs/week)				Evaluation Scheme (Marks)					
Lecture	Practical	Tutorial	Credit	CIE	ETE	TW	OR	PR	Total
03	-	-	03	40	60	-	-	-	100
Prerequisites:									
- Fundamentals of Computer Systems and Networks - Cryptography and Network Security - Microcontrollers and Embedded Systems - Digital Communication									
Course Objectives:									
- To understand the architecture and characteristics of Wireless Sensor Networks. - To analyze sensor node design, wireless communication, and network protocols. - To study routing, localization, synchronization, and energy-efficient techniques. - To understand security mechanisms and quality of service in WSNs. - To explore IoT-enabled WSN applications and emerging technologies.									
Course Outcomes: After completion of this course, students will be able to -									
CO1	Explain the architecture, characteristics, and applications of Wireless Sensor Networks.								
CO2	Analyze sensor node design, wireless communication, and MAC protocols used in WSNs.								
CO3	Apply routing, localization, and synchronization techniques in Wireless Sensor Networks.								
CO4	Analyze energy-efficient communication and power management techniques in WSNs.								
CO5	Apply security mechanisms and Quality of Service techniques for Wireless Sensor Networks.								
CO6	Design WSN-based solutions for smart engineering applications using modern wireless technologies.								
Course Contents:									
Unit	Description								Duration (Hrs.)
1.	Introduction to Wireless Sensor Networks Introduction, Evolution of WSN, Characteristics, Applications, Design Challenges, WSN Architecture, Sensor Node Components, Types of Sensors, Sensor Network Topologies, Deployment Strategies, Communication Models, Comparison of WSN, MANET and IoT Networks.								06
2.	Sensor Node Design and Communication Protocols Sensor Node Hardware Architecture, Microcontroller, Sensor Interfaces, ADC, Memory, Radio Transceiver, Power Unit, Wireless Communication Technologies, IEEE 802.15.4, ZigBee, Bluetooth Low Energy (BLE), LoRaWAN, NB-IoT (Introduction), MAC Protocols for WSN (S-MAC, T-MAC), Duty Cycling, Low-Power Communication Techniques.								07

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3.	Routing, Localization and Synchronization Data-Centric Routing, Hierarchical Routing (LEACH), Chain-Based Routing (PEGASIS), Geographic Routing (Overview), Data Aggregation Techniques, Localization Methods (GPS-Based and GPS-Free), Time Synchronization, Coverage and Connectivity, Network Scalability.	07
4.	Energy Management and Security in WSN Energy Consumption Model, Energy Harvesting Concepts, Sleep Scheduling, Power Management Techniques, QoS Requirements, Reliability, Secure Communication, Node Authentication, Key Management (Overview), Secure Routing, Privacy Issues, Intrusion Detection, Secure Data Aggregation, Challenges in WSN Security.	07
5.	Wireless Sensor Networks for IoT Applications Integration of WSN with IoT, Edge Computing (Introduction), Cloud Connectivity, MQTT and CoAP (Overview), Smart Agriculture, Smart Healthcare, Smart Grid, Smart Home, Environmental Monitoring, Industrial Automation, Precision Farming, Structural Health Monitoring, Wearable Sensor Networks.	06
6.	Emerging Trends and Case Studies Wireless Multimedia Sensor Networks, Underwater Sensor Networks, Body Area Networks (WBAN), Industrial Wireless Sensor Networks (IWSN), AI-enabled WSN, Digital Twins (Introduction), 5G-enabled Sensor Networks, TinyML (Introduction), Industrial Case Studies, Future Research Directions in WSN	06
TOTAL		39

Text Books:

1. Kazem Sohraby, Daniel Minoli and Taieb Znati, Wireless Sensor Networks: Technology, Protocols and Applications, Wiley.
2. Holger Karl and Andreas Willig, Protocols and Architectures for Wireless Sensor Networks, Wiley.
3. C. S. Raghavendra, Krishna Sivalingam and Taieb Znati, Wireless Sensor Networks, Springer.
4. Feng Zhao and Leonidas Guibas, Wireless Sensor Networks, Morgan Kaufmann.

Reference Books:

1. Anna Hac, Wireless Sensor Network Designs, Wiley.
2. Edgar Callaway, Wireless Sensor Networks: Architectures and Protocols, CRC Press.
3. Waltenegus Dargie and Christian Poellabauer, Fundamentals of Wireless Sensor Networks, Wiley.
4. Ian F. Akyildiz et al., selected papers on Wireless Sensor Networks.



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E-Resources:

1. NPTEL – Wireless Ad Hoc and Sensor Networks
2. NPTEL – Internet of Things

BACK TO STRUCTURE

DEPARTMENT OF ELECTRONICS AND COMPUTER ENGINEERING

Program: B. Tech. (Electronics and Computer Engineering)							Semester: VI		
Course: Cloud Computing							Code: ECPE603A		
Teaching Scheme (Hrs/week)				Evaluation Scheme (Marks)					
Lecture	Practical	Tutorial	Credit	CIE	ETE	TW	OR	PR	Total
03	-	-	03	40	60	-	-	-	100
Prerequisites:									
- Fundamentals of Computer Systems and Networks - Operating Systems - Database Management Systems - Web Technologies - Python Programming									
Course Objectives:									
- To understand the fundamentals of cloud computing and cloud service models. - To explore concepts of virtualization, cloud services, and cloud storage. - To develop simple cloud-based applications using cloud platforms. - To understand cloud security and resource management. - To explore cloud applications in engineering and emerging technologies.									
Course Outcomes: After completion of this course, students will be able to -									
CO1	Explain the fundamentals of cloud computing and cloud service models.								
CO2	Apply virtualization and cloud services for deploying applications.								
CO3	Analyze cloud storage, databases, and computing services.								
CO4	Develop simple cloud-based applications using cloud platforms.								
CO5	Apply basic cloud security and management techniques.								
CO6	Design cloud-based solutions for engineering applications.								
Course Contents:									
Unit	Description								Duration (Hrs.)
1.	Introduction to Cloud Computing Evolution of Computing, Distributed Computing, Grid Computing, Utility Computing, Introduction to Cloud Computing, Characteristics of Cloud Computing, Cloud Architecture, Advantages and Challenges, Cloud Service Models (IaaS, PaaS, SaaS), Deployment Models (Public, Private, Hybrid, Community), Cloud Applications.								07
2.	Virtualization and Cloud Services Introduction to Virtualization, Hypervisors, Virtual Machines, Virtualization of Servers, Storage and Networks, Introduction to Containers, Docker Fundamentals, Comparison of Virtual Machines and Containers, Compute, Storage and Networking Services, Load Balancing and Auto Scaling (Overview).								07

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3.	Cloud Storage and Cloud Platforms Cloud Storage Concepts, Object, Block and File Storage, SQL and NoSQL Databases (Overview), Cloud Platforms: Amazon Web Services (AWS), Microsoft Azure and Google Cloud Platform (Overview), Identity and Access Management (Basic Concepts), Cloud File Sharing and Backup Services.	07
4.	Cloud Application Development Cloud Application Architecture, Web Application Deployment, REST API Overview, Introduction to Microservices, Docker-based Application Deployment, Introduction to Serverless Computing, Hands-on with AWS Educate/Azure Student/Google Cloud (or equivalent educational platform).	07
5.	Cloud Security and Management Cloud Security Basics, Authentication and Authorization, Data Encryption, Backup and Disaster Recovery, High Availability, Monitoring Cloud Resources, Cloud Cost Management, Green Cloud Computing, Best Practices for Cloud Usage.	06
6.	Cloud Applications and Emerging Trends Cloud for IoT, Artificial Intelligence and Machine Learning, Smart Cities, Smart Healthcare, Smart Agriculture, Smart Manufacturing, Edge Computing, Multi-Cloud (Introduction), Future Trends in Cloud Computing, Industrial Case Studies.	05
TOTAL		39

Text Books:

1. Rajkumar Buyya, Christian Vecchiola and S. Thamarai Selvi, Mastering Cloud Computing, McGraw-Hill Education.
2. Thomas Erl, Ricardo Puttini and Zaigham Mahmood, Cloud Computing: Concepts, Technology & Architecture, Pearson.
3. Barrie Sosinsky, Cloud Computing Bible, Wiley.
4. Michael Miller, Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online, Que Publishing.

Reference Books:

1. Kai Hwang, Geoffrey Fox and Jack Dongarra, Distributed and Cloud Computing, Morgan Kaufmann.
2. George Reese, Cloud Application Architectures, O'Reilly.
3. Nigel Poulton, Docker Deep Dive.
4. Anthony T. Velte, Toby J. Velte and Robert Elsenpeter, Cloud Computing: A Practical Approach, McGraw-Hill.



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E-Resources:

1. Cloud Computing – IIT Kharagpur
2. Cloud Computing and Distributed Systems – IIT Kanpur

BACK TO STRUCTURE

DEPARTMENT OF ELECTRONICS AND COMPUTER ENGINEERING

Program: B. Tech. (Electronics and Computer Engineering)							Semester: VI		
Course: Internet of Things (IoT)							Code: ECPE603B		
Teaching Scheme (Hrs/week)				Evaluation Scheme (Marks)					
Lecture	Practical	Tutorial	Credit	CIE	ETE	TW	OR	PR	Total
03	-	-	03	40	60	-	-	-	100
Prerequisites:									
- Python Programming - Fundamentals of Computer Systems and Networks - Microcontroller and Applications - Embedded Systems Fundamentals									
Course Objectives:									
- To understand the architecture and building blocks of Internet of Things. - To describe communication protocols and networking technologies used in IoT. - To develop IoT applications using embedded platforms and sensors. - To study cloud integration, device management, and data visualization for IoT. - To design IoT solutions for smart engineering and industrial applications.									
Course Outcomes: After completion of this course, students will be able to -									
CO1	Explain the architecture and building blocks of Internet of Things.								
CO2	Apply IoT communication protocols and networking technologies for connected devices.								
CO3	Analyze cloud, edge, and gateway technologies used in IoT systems.								
CO4	Develop IoT applications using Arduino, ESP32, Raspberry Pi, and sensors.								
CO5	Apply IoT cloud platforms for data acquisition, visualization, and remote monitoring.								
CO6	Design IoT solutions for smart engineering and industrial applications.								
Course Contents:									
Unit	Description								Duration (Hrs.)
1.	Introduction to Internet of Things Introduction to Embedded Systems, Evolution of IoT, Characteristics, IoT Architecture, Building Blocks of IoT, Physical and Logical Design, Sensors, Actuators, Smart Objects, IoT Design Methodology, IoT Ecosystem, Design Challenges, Applications in Smart Cities, Healthcare, Agriculture, Industry 4.0, Smart Homes, and Transportation.								07
2.	IoT Communication Protocols and Security IoT Communication Models, IPv6 for IoT, IEEE 802.15.4 Overview, ZigBee, Bluetooth Low Energy (BLE), Wi-Fi, LoRaWAN, NB-IoT (Overview), MQTT, CoAP, REST APIs, Device Discovery, Introduction to IoT Security, Authentication, Authorization, Secure Communication, Privacy, Secure Firmware Updates, Common Security Threats and Countermeasures.								07

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3.	IoT Architecture, Edge and Cloud Computing IoT Gateway, Edge Computing, Fog Computing, Cloud Computing for IoT, IoT Middleware, Device Management, Cloud Platforms (ThingSpeak, AWS IoT Core, Azure IoT Hub – Overview), Data Storage, Real-Time Data Processing, Dashboard Creation, Integration of IoT Devices with Cloud Services.	07
4.	IoT Application Development Arduino Uno and ESP32 Architecture, Raspberry Pi Overview, Arduino IDE, ESP32 Programming Basics, GPIO Programming, Sensor and Actuator Interfacing (LED, LDR, LM35/DHT11, Ultrasonic Sensor, PIR Sensor, Relay), Wi-Fi Communication, Data Logging, Sending Sensor Data to Cloud Platforms, Remote Monitoring and Control, Introduction to Node-RED.	07
5.	IoT Data Management and Visualization IoT Data Acquisition, Data Logging Techniques, Time-Series Data, ThingSpeak and Blynk Platforms, Dashboard Design, Data Visualization, Alert and Notification Systems, Remote Device Monitoring, Device Provisioning, Firmware Management (Overview), Introduction to Digital Twins and Predictive Maintenance.	06
6.	Industrial IoT and Smart Applications Industrial Internet of Things (IIoT), Smart Manufacturing, Smart Grid, Smart Energy Metering, Smart Agriculture, Smart Healthcare, Connected Vehicles, Environmental Monitoring, Smart Campus, Wearable Devices, EV Charging Infrastructure Monitoring, Industrial Case Studies, Future Trends in IoT (AIoT, TinyML, 5G-enabled IoT).	05
TOTAL		39

Text Books:

1. Arshdeep Bahga and Vijay Madisetti, Internet of Things – A Hands-on Approach, Universities Press.
2. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton and Jerome Henry, IoT Fundamentals, Cisco Press.
3. Adrian McEwen and Hakim Cassimally, Designing the Internet of Things, Wiley.
4. Raj Kamal, Internet of Things: Architecture and Design Principles, McGraw-Hill.



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Reference Books:
1. Olivier Hersent, David Boswarthick and Omar Elloumi, The Internet of Things – Key Applications and Protocols, Wiley. 2. Maciej Kranz, Building the Internet of Things, Wiley. 3. Perry Lea, Internet of Things for Architects, Packt. 4. Samuel Greengard, The Internet of Things, MIT Press.
E-Resources:
NPTEL Course Introduction To Internet Of Things By Prof. Sudip Misra IIT Kharagpur https://onlinecourses.nptel.ac.in/

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DEPARTMENT OF ELECTRONICS AND COMPUTER ENGINEERING

Program: B. Tech. (Electronics and Computer Engineering)							Semester: VI		
Course: Augmented and Virtual Reality							Code: ECPE603C		
Teaching Scheme (Hrs/week)				Evaluation Scheme (Marks)					
Lecture	Practical	Tutorial	Credit	CIE	ETE	TW	OR	PR	Total
03	-	-	03	40	60	-	-	-	100
Prerequisites:									
- Object-Oriented Programming - Basic Programming Concepts - Fundamentals of Linear Algebra (Desirable)									
Course Objectives:									
- To understand the fundamentals of Augmented Reality (AR), Virtual Reality (VR), and Extended Reality (XR). - To study AR/VR hardware components, sensors, tracking, and display technologies. - To explore techniques for virtual world representation, rendering, and interaction. - To develop basic AR/VR applications using modern development platforms. - To explore engineering, industrial, healthcare, and educational applications of AR/VR.									
Course Outcomes: After completion of this course, students will be able to -									
CO1	Explain the fundamentals, architecture, and applications of AR, VR, and XR technologies.								
CO2	Analyze AR/VR hardware components, sensors, displays, and tracking technologies.								
CO3	Apply rendering, interaction, and navigation techniques in virtual environments.								
CO4	Develop basic AR/VR applications using Unity and AR development tools.								
CO5	Analyze mobile AR technologies and immersive user experience design for engineering applications.								
CO6	Design AR/VR solutions for industrial, healthcare, education, and smart engineering applications.								
Course Contents:									
Unit	Description								Duration (Hrs.)
1.	Introduction to Augmented and Virtual Reality Introduction to Virtual Reality (VR), Augmented Reality (AR), Mixed Reality (MR), Extended Reality (XR), Evolution of AR/VR, Components of AR/VR Systems, Characteristics of Immersive Systems, Applications in Education, Healthcare, Manufacturing, Defence, Entertainment, Smart Cities, Digital Twin (Introduction), Challenges and Future Scope.								06
2.	AR/VR Hardware and Tracking Technologies Input Devices, Output Devices, Head Mounted Displays (HMD), Optical and Video See-through Displays, Motion Controllers, Haptic Devices, IMU, GPS, Depth Sensors, RGB Cameras, LiDAR (Overview), Position and Orientation Tracking, Inside-Out and Outside-In Tracking, Marker-based and Markerless Tracking, Visual SLAM (Introduction), Eye Tracking and								07

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	Gesture Recognition.	
3.	Virtual World Representation and Rendering 3D Coordinate Systems, Transformations, Scene Graph, Virtual Environment Modeling, Lighting, Texturing, Animation Basics, Collision Detection, Rendering Pipeline, Real-Time Rendering, Introduction to Unity Rendering Engine, Audio Rendering, Haptic Rendering, Performance Optimization.	07
4.	Interaction Design and AR/VR Application Development User Interaction Techniques, Navigation Methods, Object Manipulation, User Experience (UX) Principles, Human Factors in AR/VR, Introduction to Unity 3D, Scene Creation, Game Objects, Components, Prefabs, Camera, Lighting, Basic C# Scripting, Asset Management, Build Process.	07
5.	Augmented Reality Development AR System Architecture, Vuforia Engine, AR Foundation (Overview), ARCore and ARKit (Overview), Marker-based and Markerless AR Development, Plane Detection, Object Recognition, Image Tracking, Mobile AR Applications, User Interface Design for AR, Testing and Performance Optimization.	06
6.	Industrial Applications and Emerging Trends Industrial AR/VR Applications, Smart Manufacturing, Digital Twin Applications, Medical Training, Remote Assistance, Virtual Prototyping, Robotics, Smart Maintenance, Smart Education, Architecture and Construction, Automotive and EV Applications, Metaverse (Introduction), OpenXR, AI-assisted AR/VR, Future Trends and Industrial Case Studies.	06
TOTAL		39
Text Books:		
1. Steven M. LaValle, Virtual Reality, Cambridge University Press. 2. Dieter Schmalstieg and Tobias Höllerer, Augmented Reality: Principles and Practice, Addison-Wesley. 3. Alan B. Craig, Understanding Augmented Reality, Morgan Kaufmann. 4. Tony Parisi, Learning Virtual Reality, O'Reilly Media.		
Reference Books:		
1. Burdea, G. and Coiffet, P., Virtual Reality Technology, Wiley. 2. Jonathan Linowes, Augmented Reality for Developers, Packt. 3. Unity Technologies, Unity User Manual and Documentation. 4. Gregory Kipper and Joseph Rampolla, Augmented Reality: An Emerging Technologies Guide to AR, Syngress. 5. Jason Jerald, The VR Book: Human-Centered Design for Virtual Reality, ACM Books.		
E-Resources:		



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| <ol style="list-style-type: none">1. https://nptel.ac.in/courses/106/106/106106138/2. https://www.coursera.org/learn/introduction-virtual-reality3. https://www.coursera.org/learn/ar |
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DEPARTMENT OF ELECTRONICS AND COMPUTER ENGINEERING

Program: B. Tech. (Electronics and Computer Engineering)							Semester: VI		
Course: Artificial Intelligence and Machine Learning							Code: ECMD604		
Teaching Scheme (Hrs/week)				Evaluation Scheme (Marks)					
Lecture	Practical	Tutorial	Credit	CIE	ETE	TW	OR	PR	Total
03	-	-	03	40	60	-	-	-	100
Prerequisites:									
• Python Programming									
Course Objectives:									
1. To understand the fundamentals of statistics, probability, artificial intelligence and machine learning.									
2. To apply supervised and unsupervised machine learning algorithms for solving real-world problems.									
3. To analyze and evaluate machine learning models using suitable performance metrics.									
4. To understand neural networks, deep learning architectures and their applications.									
5. To explore recent advances in artificial intelligence including Generative AI and Large Language Models.									
Course Outcomes: After completion of this course, students will be able to -									
CO1	Apply statistical and probabilistic concepts for data analysis and machine learning applications.								
CO2	Perform data preprocessing and implement machine learning workflows for predictive analytics.								
CO3	Develop and evaluate supervised machine learning models for regression and classification problems.								
CO4	Apply unsupervised learning and dimensionality reduction techniques to extract knowledge from data								
CO5	Analyze advanced machine learning techniques including ensemble learning and model optimization.								
CO6	Implement artificial intelligence and deep learning models for solving complex engineering problems.								
Course Contents:									
Unit	Description								Duration (Hrs.)
1.	Statistics and Probability for AI/ML: Introduction to Statistics and Data Analytics, Types of Data and Data Representation, Measures of Central Tendency (Mean, Median, Mode), Measures of Dispersion (Range, Variance, Standard Deviation), Correlation and Covariance, Probability Fundamentals, Conditional Probability, Bayes Theorem, Probability Distributions (Binomial Distribution, Poisson Distribution, Normal Distribution), Sampling Techniques, Hypothesis Testing.								06
2.	Fundamentals of Machine Learning and Data Preprocessing: Introduction to Machine Learning, Types of Machine Learning (Supervised Learning, Unsupervised Learning, Reinforcement Learning), Machine								06

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	Learning Workflow, Data Collection and Dataset Preparation, Data Cleaning and Handling Missing Values, Feature Engineering, Feature Scaling and Normalization, Training, Validation and Testing Datasets, Performance Evaluation Metrics.	
3.	Supervised Learning: Regression and Classification Concepts, Linear Regression, Multiple Linear Regression, Logistic Regression, K-Nearest Neighbour (KNN), Naïve Bayes Classifier, Decision Tree, Random Forest, Support Vector Machine (SVM), Confusion Matrix, Accuracy, Precision, Recall, F1 Score, ROC Curve.	06
4.	Unsupervised Learning and Dimensionality Reduction: Clustering Techniques, K-Means Clustering, Hierarchical Clustering, DBSCAN, Association Rule Mining, Apriori Algorithm, Market Basket Analysis, Dimensionality Reduction Techniques, Principal Component Analysis (PCA), Feature Selection Techniques.	07
5.	Advanced Machine Learning and Model Optimization: Ensemble Learning Techniques (Bagging, Boosting, AdaBoost, Gradient Boosting), Overfitting and Underfitting, Bias and Variance Tradeoff, Cross Validation Techniques, Hyperparameter Tuning, Model Selection and Performance Comparison, Recommendation Systems, Introduction to Reinforcement Learning, Model Deployment Concepts,	07
6.	Artificial Intelligence, Neural Networks and Deep Learning: Introduction to Artificial Intelligence, Applications of AI, Types of AI (ANI, AGI, ASI), Introduction to Artificial Neural Networks (ANN), Biological Neuron and Artificial Neuron Model, Perceptron and Multilayer Perceptron, Activation Functions, Feed Forward Neural Networks, Backpropagation Algorithm, Introduction to Deep Learning, Convolutional Neural Networks (CNN), Recurrent Neural Networks (RNN), Long Short-Term Memory (LSTM), Applications of Deep Learning in Computer Vision and Natural Language Processing, Generative AI and Large Language Models (LLMs).	07
TOTAL		39
Text Books:		
1. Andreas C. Müller and Sarah Guido, Introduction to Machine Learning with Python, O'Reilly Media. 2. Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras & TensorFlow, O'Reilly Media. 3. Wes McKinney, Python for Data Analysis, O'Reilly Media. 4. Peter Bruce, Andrew Bruce and Peter Gedeck, Practical Statistics for Data Scientists, O'Reilly Media. 5. Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, Pearson. 6. Ian Goodfellow, Yoshua Bengio and Aaron Courville, Deep Learning, MIT Press.		

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Reference Books:

1. Trevor Hastie, Robert Tibshirani and Jerome Friedman, The Elements of Statistical Learning, Springer.
2. Gareth James, Daniela Witten, Trevor Hastie and Robert Tibshirani, An Introduction to Statistical Learning, Springer.
3. Jiawei Han, Micheline Kamber and Jian Pei, Data Mining: Concepts and Techniques, Morgan Kaufmann.
4. Tom M. Mitchell, Machine Learning, McGraw-Hill.
5. Kevin P. Murphy, Probabilistic Machine Learning: An Introduction, MIT Press.
6. Mehryar Mohri, Afshin Rostamizadeh and Ameet Talwalkar, Foundations of Machine Learning, MIT Press.
7. Charu C. Aggarwal, Neural Networks and Deep Learning, Springer.
8. Richard S. Sutton and Andrew G. Barto, Reinforcement Learning: An Introduction, MIT Press.

E-Resources:

1. Google, Machine Learning Crash Course, Google Developers. <https://developers.google.com/machine-learning/crash-course>
2. Scikit-learn Developers, Scikit-learn User Guide, Scikit-learn. https://scikit-learn.org/stable/user_guide.html
3. TensorFlow Developers, TensorFlow Tutorials, TensorFlow. <https://www.tensorflow.org/tutorials>
4. PyTorch Developers, PyTorch Tutorials, PyTorch. <https://pytorch.org/tutorials/>
5. Gareth James, Daniela Witten, Trevor Hastie and Robert Tibshirani, An Introduction to Statistical Learning, Springer. <https://www.statlearning.com/>
6. Ian Goodfellow, Yoshua Bengio and Aaron Courville, Deep Learning, MIT Press. <https://www.deeplearningbook.org/>
7. Massachusetts Institute of Technology, MIT OpenCourseWare, MIT. <https://ocw.mit.edu/>
8. Kaggle, Kaggle Learn, Kaggle. <https://www.kaggle.com/learn>
9. Python Software Foundation, Python Documentation, Python. <https://docs.python.org/3/>
10. OpenAI, OpenAI Cookbook, OpenAI. <https://cookbook.openai.com/>

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DEPARTMENT OF ELECTRONICS AND COMPUTER ENGINEERING

Program: B. Tech. (Electronics and Computer Engineering)							Semester: VI		
Course: Artificial Intelligence and Machine Learning Lab							Code: ECMD604P		
Teaching Scheme (Hrs/week)				Evaluation Scheme (Marks)					
Lecture	Practical	Tutorial	Credit	CIE	ETE	TW	OR	PR	Total
-	02	-	01	-	-	-	50	-	50
Prerequisites:									
• Python Programming									
Course Objectives:									
1. To develop practical understanding of statistical measures, probability distributions, correlation, covariance and sampling techniques using Python. 2. To develop the ability to apply statistical inference techniques, including hypothesis testing, to analyze and interpret real-world datasets. 3. To develop practical skills in preprocessing data and implementing supervised and unsupervised machine learning algorithms for solving data-driven problems.									
Course Outcomes: After completion of this course, students will be able to -									
CO1	Implement statistical measures, probability distributions, correlation, covariance and sampling techniques using Python for data analysis.								
CO2	Apply hypothesis testing and interpret statistical results for given datasets.								
CO3	Preprocess datasets and implement supervised and unsupervised machine learning algorithms such as Linear Regression, Logistic Regression, KNN, Naïve Bayes, Decision Tree, Random Forest, SVM and K-Means clustering.								

List of Experiments:

Group A: Statistics and Probability (Any 3)

- Implement statistical measures such as Mean, Median, Mode, Variance and Standard Deviation using Python libraries.
- Perform correlation and covariance analysis on a real-world dataset.
- Implement and visualize Binomial, Poisson and Normal probability distributions.
- Perform hypothesis testing and interpret the results for a given dataset.
- Apply sampling techniques and analyze sample statistics for different datasets.

Group B: Machine Learning (Any 5)

- Perform data preprocessing including handling missing values, encoding categorical variables and feature scaling.
- Implement Linear Regression and evaluate the model performance.
- Implement Logistic Regression for classification problems.
- Implement and compare K-Nearest Neighbour (KNN) and Naïve Bayes classifiers.

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5. Implement Decision Tree and Random Forest algorithms for classification.
6. Implement Support Vector Machine (SVM) for classification tasks.
7. Implement K-Means clustering and analyze cluster formation.
8. Apply Principal Component Analysis (PCA) for dimensionality reduction and feature extraction.

Group C: Artificial Intelligence and Deep Learning (Any 2)

1. Develop an Artificial Neural Network (ANN) using TensorFlow/Keras for classification problems.
2. Implement Convolutional Neural Networks (CNN) for image classification.
3. Implement Recurrent Neural Networks (RNN) or Long Short-Term Memory (LSTM) networks for sequence prediction or sentiment analysis.
4. Demonstrate applications of Generative AI and Large Language Models (LLMs) using pre-trained models.

Reference Books:

1. Trevor Hastie, Robert Tibshirani and Jerome Friedman, The Elements of Statistical Learning, Springer.
2. Gareth James, Daniela Witten, Trevor Hastie and Robert Tibshirani, An Introduction to Statistical Learning, Springer.
3. Jiawei Han, Micheline Kamber and Jian Pei, Data Mining: Concepts and Techniques, Morgan Kaufmann.
4. Tom M. Mitchell, Machine Learning, McGraw-Hill.
5. Kevin P. Murphy, Probabilistic Machine Learning: An Introduction, MIT Press.
6. Mehryar Mohri, Afshin Rostamizadeh and Ameet Talwalkar, Foundations of Machine Learning, MIT Press.
7. Charu C. Aggarwal, Neural Networks and Deep Learning, Springer.
8. Richard S. Sutton and Andrew G. Barto, Reinforcement Learning: An Introduction, MIT Press.

E-Resources:

1. TensorFlow Developers, TensorFlow Tutorials, TensorFlow.
<https://www.tensorflow.org/tutorials>
2. PyTorch Developers, PyTorch Tutorials, PyTorch. <https://pytorch.org/tutorials/>
3. Massachusetts Institute of Technology, MIT OpenCourseWare, MIT. <https://ocw.mit.edu/>
4. Kaggle, Kaggle Learn, Kaggle. <https://www.kaggle.com/learn>
5. Python Software Foundation, Python Documentation, Python. <https://docs.python.org/3/>
6. OpenAI, OpenAI Cookbook, OpenAI. <https://cookbook.openai.com/>

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DEPARTMENT OF ELECTRONICS AND COMPUTER ENGINEERING

Program: B. Tech. (Electronics and Computer Engineering)							Semester: VI		
Course: Quality Management System – III							Code: ECVS607		
Teaching Scheme (Hrs/week)				Evaluation Scheme (Marks)					
Lecture	Practical	Tutorial	Credit	CIE	ETE	TW	OR	PR	Total
-	02	-	01	-	-	25	-	-	25
Prerequisites:									
Quality Management System – I, Quality Management System – II.									
Course Objectives:									
1. To understand basic principles and terms related to statistical process control.									
2. To understand Kaizen philosophy of continuous, incremental improvement & Six Sigma, data-driven methodology aimed at reducing defects and process variation.									
3. To understand processes in Business process management and know significance of concept customer driven quality.									
Course Outcomes: After completion of this course, students will be able to -									
CO1	Apply control charts for process controls to perform statistical analysis.								
CO2	Apply kaizen and six sigma for industrial processes								
CO3	Gain knowledge in customer relationship management								
Course Contents:									
Unit	Description								Duration (Hrs.)
1.	Statistical process Control: Specification and control limits, types of control charts, control charts for variables and attributes, Pareto diagram, process flow diagram, cause and effect diagram, check sheets and histogram, Experimental design.								08
2.	Six Sigma and Kaizen- Continuous Improvement: Key six sigma concepts, quality level, three sigma’s’, defects per million opportunities, implementation, DMAIC, DMADV Concept of Kaizen, lean, 5S, kaizen vs innovation, CWQC, Kaizen practice, QFD, QCC, Poka yoke, quality of work life Taguchi quality engineering, loss function, orthogonal arrays, signal to noise ratio Parameter and tolerance design								09
3.	Customer driven quality and business process management: Customers perception of quality, customer relationship management and its components, customer retention programs CRM modules, CRM in B2B and B2C context, e- CRM. BMP: introduction and BMP implementation framework.								09
TOTAL								26	



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Text Books:

1. Kanishka Bedi, "Quality Management", Oxford University Press.
2. Subburaj Ramasamy, "Total Quality Management", McGraw Hill Education.

Reference Books:

1. Dale H. Besterfield, "Total Quality Management", Pearson Education.
2. Poornima M. Charantimath, "Total Quality Management", Pearson, 2nd Edition.
3. V. K. Khanna, "TQM: Planning, Design and Implementation", New Age International Publishers.

E-Resources:

1. 1. Dr. N. Venkateshwarlu, "Quality Engineering & Management", NPTEL Course,
https://onlinecourses.swayam2.ac.in/e-learning/preview/nou25_me09

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Program: B. Tech. (Electronics and Computer Engineering)							Semester: V		
Course: Internship – V							Code: ECIN605		
Teaching Scheme (Hrs/week)				Evaluation Scheme (Marks)					
Lecture	Practical	Tutorial	Credit	CIE	ETE	TW	OR	PR	Total
-	-	-	02	-	-	25	-	-	25
Preamble:									
Internships serve as vital educational and career development experiences, offering practical exposure in a specific field. Employers seek individuals who possess the necessary skills and an understanding of industry environments, practices, and cultures. This internship is designed as a structured, short-term, supervised training program, often centered on specific tasks or projects with clear timelines. The primary goal is to immerse technical students in an industrial setting, providing experiences that cannot be replicated in the classroom. This exposure aims to develop competent professionals who understand the social, economic, and administrative factors influencing the operations of industrial organizations.									
Course Objectives:									
1. Exposure to students to the industrial environment, which cannot be provided in the classroom and hence creating deployable professionals for the industry. 2. Learn to implement the technical knowledge in real industrial situations.									
Course Outcomes: After completion of this course, students will be able to -									
CO1	Gain exposure to industry practices and understand how academic concepts are applied in professional settings.								
CO2	Develop and demonstrate effective communication and teamwork skills within a work environment.								
CO3	Improve your problem-solving and time management skills by working in real-world industry settings.								
Internship Requirements									
1. Internship Duration: It is mandatory for all students to undergo an internship after every semester during vacations for the duration of 3 to 5 weeks. Internships completed during this period will be considered for the assessment of Term Work (TW). 2. Internship Opportunities: Students can explore various opportunities for internships at: f. Industries g. Research labs or organizations h. Collegiate clubs i. In-house research projects j. Online internships 3. Support and Assistance: Students can seek assistance for securing internships from: e. The Training and Placement cell, along with departmental coordinators f. Department or institute faculty members g. Personal contacts h. Directly connecting with industries or organizations									

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4. **Request Letter:** Once an industry, research organization, or collegiate club is identified, students must obtain a request letter from the concerned department or placement office. This letter, in the standard format must be duly signed by the authority, should be addressed to the HR manager or relevant authority.
5. **Confirmation Letter:** Students must submit the confirmation letter from the industry, research organization, or collegiate club to the Internship Coordinator and the Head of Department (HOD) office.
6. **Joining Report:** Upon commencing the internship, students must submit the joining report, joining letter, or a copy of the confirmation email to the Internship Coordinator and the HOD office.
7. **Faculty Mentor:** A faculty member will be assigned as a mentor to a group of students. The mentor will be responsible for monitoring, evaluating, and assessing student internship activities. The faculty mentor is also required to visit the internship location and submit formal feedback to the Internship Coordinator.
8. **Faculty Visits:** Faculty members are advised to visit the internship site once or twice during the internship period to monitor progress.
9. **Progress Report:** Students must submit progress report fortnightly to their faculty guide and the final internship report to the Internship Coordinator and department office.
10. **Evaluation Report:** After the completion of the internship, the mentor, along with the assessment panel members, should submit the evaluation report of the students to the department office and the Internship Coordinator.
11. **Internship Certificate:** Students must receive the Internship Certificate from the industry and submit it to the Internship Coordinator and department office.
12. **Presentation and Assessment:** Students are required to give a presentation on their internship work as part of the term work. The internship diary and report will also be verified and assessed.

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