



JOY UNIVERSITY

Established vide Tamil Nadu State Pvt. Universities Act 2019



SCHOOL OF COMPUTATIONAL INTELLIGENCE

Outcome Based Curriculum Framework with CBCS

for

***BACHELOR OF TECHNOLOGY – ELECTRONICS AND
COMMUNICATION (ARTIFICIAL INTELLIGENCE
AND MACHINE LEARNING)***

(B.Tech. ECE - AI & ML)

Students admitted from 2025 -26 onwards



VISION

♣ To create and nurture a multidisciplinary global university with highest academics, research and ethical standards in a creative and innovative environment.

MISSION

♣ To be a premier University of choice for all stakeholders and contribute for academic demographic dividend. To inculcate quality, integrity, team work, compassion, ethics in new generation students for catering to various needs of society.

QUALITY OBJECTIVES

- To disseminate knowledge with skills through teaching, training, seminars, workshops, conferences and symposia in Engineering and Technology, Art and Design, Management and Commerce, Allied Health Sciences, Physical and Life Sciences, Arts, Humanities and Social Sciences, Law and Agricultural Sciences to enable students to meet the current needs and trends of industries, business and society.
- To provide technical and scientific solutions to real time problems posed by industries, business and society in all Schools of Joy University.
- To inculcate quality, integrity, team work, compassion, ethics in new generation students for catering to various needs of society.
- To promote the spirit of entrepreneurship in the young generation to help and create more career opportunities in the society by incubating a nurturing technology product idea backed by Technology Business Incubation.
- To identify and nurture leadership and innovate skills in students to become future leaders to enrich society.
- To develop collaborations and partnerships with International global and reputed Universities, research establishments, Government and NGO's, industries and businesses. To support both faculties and students for international exposure.

SCHOOL OF COMPUTATIONAL INTELLIGENCE

VISION

The SOCI envisions a 'cooperatively competitive' academic environment in the thematic areas of the school and relevant research backed by quality education to churn out graduates with professional acumen, exceptional leadership and a humane heart to meet both national and global needs.

MISSION

The SOCI offers a value-based, technology-oriented education striving to achieve high levels of academic excellence, intellectually competence and exemplary values. The tri-value system of our school is designed to deliver education through three interconnected values: **Learning, Transmutation and Transformation.**

PROGRAMME EDUCATIONAL OBJECTIVES

PEO 1: Graduates will have the ability and attitude to acquire new skills and adapt recent technological changes.

PEO 2: To prepare the graduates to serve in the industries related to Computer Science and Engineering or Electronics and communication engineering or to do higher education and research.

PEO 3: Graduates will work with professionalism and ethics by contributing to the advancement of the society.

GRADUATE ATTRIBUTES

The Graduate Attributes of B.Tech ECE (AI & ML) are:

GA 1 Apply appropriate knowledge of electronics, communication engineering, computer science, and AI/ML to identify, formulate, analyse, and solve complex engineering problems, reaching substantiated conclusions.

GA2: Continuously self-learn and effectively engage with advanced tools, frameworks, and emerging technologies in electronics, communication, and intelligent systems.

GA3: Design and develop sustainable solutions in communication, embedded systems, and AI-driven applications, considering economic, societal, and environmental contexts.

GA4: Think critically, creatively, and analytically to address challenges in signal processing, wireless systems, IoT, and intelligent automation, while working effectively, independently, and collaboratively in research, technology development, and entrepreneurial ventures.

GA5: Apply ethical principles, professional responsibilities, and evolving data security, privacy, and regulatory frameworks in the deployment of AI/ML-based communication and electronic systems.

GA6: Effectively communicate engineering concepts, designs, and solutions in the field of ECE–AI & ML through clear technical reports, design documentation, presentations, and oral discussions with diverse stakeholders.

GA7: Be motivated to engage in independent and life-long learning in the broadest context of evolving technologies in electronics, communication, artificial intelligence, and machine learning.

PROGRAMME OUTCOMES

On completion of the **B.Tech ECE (Artificial Intelligence & Machine Learning) Programme**, students should be able to:

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: Life-long learning: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES

PSO 1: Understanding of ethical considerations and societal impacts related to AI/ML systems, ensuring responsible and fair use of technology.

PSO 2: Proficiency in handling, cleaning, and preprocessing large datasets to extract meaningful insights and improve model predictions.

PSO 3: Ability to design, implement, and evaluate AI/ML models for real-world applications, optimizing performance and accuracy.

Summary of Credits

Semester	I	II	III	IV	V	VI	VII	VIII	Total
Credits	20	22	21	20	24	20	20	21	168
Contact Hrs./Week	24	26	24	22	26	24	17	06	169

SEMESTER WISE CREDIT STRUCTURE

Sl. No.	Category of Courses	1 st Year		2 nd Year		3 rd Year		4 th Year		Total
		Sem I	Sem II	Sem III	Sem IV	Sem V	Sem VI	Sem VII	Sem VIII	
1.	Departmental Core	08	07	20	11	12	11	07	–	76
2.	Programme Specific Electives (PSE)	–	–	–	06	06	06	06	06	30
3.	Open Electives	–	–	–	–	03	03	03	–	09
4.	Applied Sciences	08	11	–	–	–	–	–	–	19
5.	Internships/ Field Visits	–	–	–	–	–	–	02	–	02
6.	Project	–	–	–	–	–	–	02	15	17
7.	Skill Enhancement Course	–	01	–	03	03	–	–	–	07
8.	Ability Enhancement Courses (AECC)	03	–	–	–	–	–	–	–	03
9.	Value-Added Course	01	02	01	–	–	–	–	–	04
Total		20	21	21	20	24	20	20	21	167

B.Tech ECE (Artificial Intelligence & Machine Learning)

Semester – I

(Total Credits: 20)

SI.No	Course Code	Course Title	L	T	P	Contact Hrs / Wk	Credits
1.	25BTEM111	Core Course Fundamentals of Computing	3	0	0	3	3
2.	25BTEM112	Core Course Introduction to Programming	3	0	0	3	3
3.	25BTEM113	Applied Science Mathematics – I	3	1	0	4	4
4.	25BTEM114	Applied Science Physics I	3	1	0	4	4
5.	25BTEM211	Core Course Fundamentals of Computing Lab	0	0	2	2	1
6.	25BTEM212	Core Course Introduction to Programming Lab	0	0	2	2	1
7.	25AEEN911	Ability Enhancement Compulsory Course (AECC) Effective Communication	3	0	0	3	3
8.	25BTEM911	Value-Added Course Performing Arts/Sports	3	0	0	3	1
		Total	18	2	4	24	20

Semester – II

(Total Credits: 21)

Sl.No	Course Code	Course Title	L	T	P	Contact Hrs / Wk	Credits
1.	25BTEM121	Core Course Python Programming	3	0	0	3	3
2.	25BTEM122	Applied Science Probability, Statistics and Stochastic Processes	3	0	0	3	3
3.	25BTEM123	Applied Science Mathematics II	3	1	0	4	4
4.	25BTEM124	Applied Science Physics II	3	0	0	3	3
5	25BTEM125	Core Course Fundamentals of Electrical and Electronics	3	0	0	3	3
6	25BTEM221	Core Course Python Programming Lab	0	0	2	2	1
7	25BTEM222	Applied Science Physics Lab	0	0	2	2	1
8	25BTEM223	Skill Enhancement Course Extended Reality and its Applications Lab	0	0	2	2	1
9	25BTEM224	Fundamentals of Electrical and Electronics Lab	0	0	2	2	1
9	25EVST921	Value Added Course Environmental Science	2	0	0	2	2
		TOTAL	17	1	8	26	22

Semester – III

(Total Credits: 21)

Sl.No	Course Code	Course Title	L	T	P	Contact Hrs / Wk	Credits
1.	25BTEM131	Core Course Network Analysis	3	0	0	3	3
2.	25BTEM132	Core Course Signals and Systems	3	0	0	3	3
3.	25BTEM133	Core Course Digital Design	3	0	0	3	3
4.	25BTEM134	Core Course Electronic Devices and Circuits	3	0	0	3	3
5.	25BTEM135	Core Course Object-Oriented Programming with Java	3	0	0	3	3
6.	25BTEM136	Core Course Professional Ethics	2	0	0	2	2
7.	25BTEM231	Core Course Digital Design Lab	0	0	2	2	1
8.	25BTEM232	Core Course Electronic Devices and Circuits lab	0	0	2	2	1
9.	25BTEM233	Core Course Object-Oriented Programming with Java Lab	0	0	2	2	1
10.	25BTEM931	Value Added Course Indian Constitution	1	0	0	1	1
		Total	18	0	06	24	21

Semester – IV

(Total Credits: 20)

Sl.No	Course Code	Course Title	L	T	P	Contact Hrs / Wk	Credits
1.	25BTEM141	Core Course Analog Circuits	3	0	0	3	3
2.	25BTEM142	Core Course Control System	3	0	0	3	3
3.	25BTEM143	Core Course Microprocessor and Microcontroller	3	0	0	3	3
4.	25BTEM341	Programme Specific Elective (PSE) I Database Management Systems	3	0	0	3	3
	25BTEM342	Artificial Intelligence					
	25BTEM343	Operating System					
5.	25BTEM344	Programme Specific Elective (PSE) II Full Stack Development	3	0	0	3	3
	25BTEM345	Edge AI					
	25BTEM346	Machine Learning					
6	25BTEM241	Core Course Analog Circuits Lab	0	0	2	2	1
7	25BTEM242	Core Course Microprocessor and Microcontroller Lab	0	0	2	2	1
8	25BTEM841	Skill Enhancement Course Engineering Economics and Foreign Trade	3	0	0	3	3
		Total	18	0	04	22	20

Semester – V

(Total Credits: 24)

Sl.No	Course Code	Course Title	L	T	P	Contact Hrs / Wk	Credits
1.	25BTEM151	Core Course Embedded System and IoT's	3	0	0	3	3
2.	25BTEM152	Core Course Digital Signal Processing	3	0	0	3	3
3.	25BTEM153	Core Course Applied Electromagnetic Theory	3	1	0	4	4
4.	25BTEM351	Programme Specific Elective (PSE) III Deep Learning	3	0	0	3	3
	25BTEM352	Operations Research and Optimization					
	25BTEM353	Satellite Communication					
5.	25BTEM354	Programme Specific Elective (PSE) I Quantum Machine Learning	3	0	0	3	3
	25BTEM355	Biomedical Signal Processing					
	25BTEM356	Computer Network					
6	25BTEM251	Core Course Digital Signal Processing Lab	0	0	2	2	1
7	25BTEM252	Core Course Embedded System and IoT lab	0	0	2	2	1
8	25BTEM851	Skill Enhancement Course Principles of Management	3	0	0	3	3
9	25BTEM051	Open Elective I (Generic) Artificial Intelligence Python	3	0	0	3	3
	25BTEM052	Programming					
	25BTEM053	Computer Networks					
		Total	21	01	04	26	24

Semester – VI
(Total Credits: 20)

SI.No	Course Code	Course Title	L	T	P	Contact Hrs / Wk	Credits
1.	25BTEM161	Core Course Wireless Sensor Technology	3	0	0	3	3
2.	25BTEM162	Core Course Digital Image Processing	3	0	0	3	3
3.	25BTEM163	Core Course Cryptography and Network Security	3	0	0	3	3
4.	25BTEM361 25BTEM362 25BTEM363	Programme Specific Elective (PSE) V Applied Artificial Intelligence Computer Vision Predictive Analysis	3	0	0	3	3
5.	25BTEM364 25BTEM365 25BTEM366	Programme Specific Elective (PSE) VI Applied Machine Learning Internet of Things Data Visualization	3	0	0	3	3
6.	25BTEM261	Core Course Digital Image Processing Lab	0	0	2	2	1
7.	25BTEM262	Core Course Cryptography and Network Security Lab	0	0	2	2	1
8.	25BTEM061 25BTEM062 25BTEM063	Open Elective II (Generic) AI Tools Internet of Things Cybersecurity	3	0	0	3	3
		Total	18	0	04	24	20

Semester – VII

(Total Credits: 20)

Sl.No	Course Code	Course Title	L	T	P	Contact Hrs / Wk	Credits
1.	25BTEM171	Core Course Microwave and Antenna	3	0	0	3	3
2.	25BTEM172	Core Course VLSI Design	3	0	0	3	3
3.	25BTEM371 25BTEM372 25BTEM373	Programme Specific Elective (PSE) VII Opto Electronics Fuzzy Logic Digital Marketing	3	0	0	3	3
4.	25BTEM374 25BTEM375 25BTEM376	Programme Specific Elective (PSE) VIII Pattern Recognition Wireless Communication Computational and Systems Biology	3	0	0	3	3
5	25BTEM271	Core Course Microwave and Antenna lab	0	0	2	2	1
6	25BTEM471	Industrial Internship	0	0	0	0	2
7	25BTEM571	Mini Project	0	0	0	0	2
8	25BTEM071 25BTEM072 25BTEM073	Open Elective III Advanced Python Programming Optimization Algorithms Computing (Latest)	3	0	0	3	3
		Total	15	0	02	17	20

Semester – VIII (Total Credits: 21)

Sl.No	Course Code	Course Title	L	T	P	Contact Hrs / Wk	Credits
1.	25BTEM581	Capstone Project	0	0	0	0	15
2.	25BTEM381 25BTEM382 25BTEM383	Programme Specific Elective (PSE) IX	3	0	0	3	3
		Game Theory for Machine Learning					
		Robotics					
3.	25BTEM384 25BTEM385 25BTEM386	Programme Specific Elective (PSE) X	3	0	0	3	3
		Natural Language Processing					
		Web Data Mining					
		Generative AI					
		Total	06	0	0	06	21

Semester I

Programme	B.Tech ECE (AI&ML)	Programme Code	BTEM			
Course Code	25BTEM 111	Number of Hours/Week	3			
Semester	I	Max. Marks	100			
Year	I	Credits	3			
Core Course						
Course Title	FUNDAMENTALS OF COMPUTING			L	T	P
			3	0	0	
L-Lecture Hours	T-Tutorial Hours	P-Practical Hours				
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students for:						
<ul style="list-style-type: none"> • To have a comprehensive understanding of a foundational understanding of computersystems. • To learn about various number systems including decimal, binary, octal, and hexadecimal • To develop a comprehensive grasp of how computers function, the types of software usedand the significance of networking in today’s digital world. • To explore various types of software applications including operating systems, word processors, database management systems and Internet 						
UNIT	TOPICS				HOURS	
I	Introduction to Computer Evolution of Computers, Generations of Computers, Classification of Computers, The Computer System, Computing Concepts, Applications of Computers. Memory and storage systems Computer Software and Hardware components and its requirements- Storage Devices, Computer Viruses Types Of Viruses – Spreading of Virus, Prevention of Computer Virus, Virus Detection, Computer Security, Maintenance, Desktop functions, Dialog boxes, Single Document Interface (SDI), Multiple Document Interface (MDI), Windows Controls, Main Menu Display, Categories of Menus, Main and Context Sensitive Menus, Booting/Shutting Down.				12	
II	Microsoft software MS DOS, MS Word System, MS Excel System, MS Power pointSystem, MS Access System, MS Publisher. Number System Decimal Number System, Binary Number System, Octal Number System,Hexadecimal Number System, BCD, XS,3, Gray Code, Alphanumeric Codes, (ASCII, EBCDIC).				12	
III	Computer Software Machine language, Mnemonics, High level Language, Assembler, Compiler, Interpreter, System Development Programs, System Management Programs, Standard Application Programs, Unique Application Programs, Problem Solving, Structuring the Logic				12	

IV	Memory management Introduction, History, Functions, Process, Memory File, Management Device, Security Management, Types of Operating Systems, Providing User Interface, Popular Operating Systems.	12
V	THE INTERNET AND WORLD WIDE WEB History of the Internet-The Internet Applications-Understanding World Wide Web-Web Browsers-Browsing the Internet-Using a Search Engine- Email Service-Protocols used in the Internet. DATA COMMUNICATIONS AND NETWORKS Introduction-Data Communication Using Modem-Computer Networks- Network Topologies-Network Protocols and Software-Applications of Network.	12

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

- CO1:** Understand the basic concepts of computers.
- CO2:** Analyze the basics of number systems.
- CO3:** Apply system development programs to create and manage simple software projects.
- CO4:** Analyze the performance of different memory management techniques and their impact on system efficiency.
- CO5:** Evaluate the knowledge of Internet history to understand current Internet technologies and to solve problems in communication and information access.

Text Books:

1. Fundamentals of Computers, E. Balagurusamy, Tata McGraw Hill Education Private Limited, 2009.

Reference Books:

1. Introduction to Computer Fundamentals, Bright Siaw Afriyie, Second edition, Trafford Publishing, Canada, 2003-2006.
2. Computer Fundamentals, P. K. Sinha, BPB Publications, Sixth Edition, 2004.
3. Operating System Concepts, Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Wiley publishers, Ninth edition, 2013.
4. Computer Networks, Andrew S. Tanenbaum, David J. Wetherall, Fifth edition, Prentice Hall, 2011.
5. Computing Fundamentals: Introduction to Computers, Faithe Wempen, Wiley 2014.

Mapping of Course Outcomes (CO's) with PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	0	1	1	0	0	0	2	0	0	0	1	3	2	0	0
CO2	3	3	0	2	3	0	0	0	0	0	1	3	2	0	0
CO3	3	3	3	2	2	0	0	0	0	0	3	3	2	1	1
CO4	2	3	1	3	2	0	0	0	0	0	1	3	2	1	1
CO5	3	3	2	3	3	0	0	0	0	0	1	3	2	1	1

3 – High, 2 – Average, 1 – Low, 0-Null

Programme	B.Tech ECE (AI&ML)	Programme Code	BTEM			
Course Code	25BTEM211	Number of Hours/Week	2			
Semester	I	Max. Marks	100			
Year	I	Credits	1			
Core Course						
Course Title	FUNDAMENTALS OF COMPUTING LAB			L	T	P
				0	0	2
L-Lecture Hours	T-Tutorial Hours	P-Practical Hours				
LIST OF PROGRAMS						
<ol style="list-style-type: none"> 1. Basics of Microsoft Word. 2. Insert Table and Generating Chart. 3. Mail Merging. 4. Study on features of Microsoft Excel. 5. Incorporating the predefined functions in Excel. 6. Inserting table and generating chart in Excel. 7. Pivot chart, table and slicing in Excel. 8. Study on features in Microsoft PowerPoint. 9. Creating presentation incorporating the features of PowerPoint. 10. Study on HTML. 11. Basic web page design, formatting, inclusion of image and video. 12. Creation of Table. 13. Designing own web page. 						

On successful completion of this course, the student will be able to

- CO1:** Understand the basic functionalities of Microsoft Word
- CO2:** Apply advanced Excel features for data management.
- CO3:** Create complex data presentations using Excel pivot tables, charts, and slicers.
- CO4:** Develop professional presentations using advanced PowerPoint features.
- CO5:** Design and develop basic web pages using HTML

Mapping of Course Outcomes (CO's) with PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	0	1	1	0	0	0	2	0	0	0	1	3	2	0	0
CO2	3	3	0	2	3	0	0	0	0	0	1	3	2	0	0
CO3	3	3	3	2	2	0	0	0	0	0	3	3	2	1	1
CO4	2	3	1	3	2	0	0	0	0	0	1	3	2	1	1
CO5	3	3	2	3	3	0	0	0	0	0	1	3	2	1	1

3 – High, 2 – Average, 1 – Low, 0-Null

Programme	B. Tech ECE (AI&ML)	Programme Code	BTEM			
Course Code	25BTEM112	Number of Hours/Week	3			
Semester	I	Max. Marks	100			
Year	I	Credits	3			
Core Course						
Course Title	INTRODUCTION TO PROGRAMMING			L	T	P
				3	0	0
COURSE OBJECTIVES:						
The main aim of this course is to prepare the students for:						
<ul style="list-style-type: none"> • To learn the fundamental concepts of programming, including algorithms, flowcharts, and the logical approach to problem solving that is applicable to any programming language. • To acquire comprehensive understanding of the syntax, semantics and the basic constructs of C language • Learn to use of pointers, Arrays, and dynamic memory allocation which are key to understanding data structure, memory management. • Build a foundation for advanced programming and software development. To develop skills to handle complex programming challenges such as file handling, Debugging. 						
UNIT	TOPICS				HOURS	
I	Introduction to programming Algorithm, Formalism, Flow chart, Assembly language, Introduction to program, Program components, structure, Execution path, Programming paradigms introduction, Syntax and Semantics				9	
II	Introduction to C language History of C, Prerequisites of C, Features and its applications, Structure of C, Preprocessor directives, Data types and constants, variables and its types, Tokens, Identifiers and format specifiers, Operators and Enums, Data I/O, Decision making and Branching, Loop Introduction, programs with looping structure, ControlFlow programs with control flow				9	
III	Array and Strings Introduction to Array, Initialization, Single dimensional array, Multidimensional array, String, Functions with string: Read, Display string and string functions, String Arrays.				9	
IV	Functions and Pointers Function Introduction, Function calling, Return type, Function types, Recursion, Types of Recursions, Introduction to Pointers, Types Pointers, Programming exercises with pointers.				9	
V	Structures and Unions Introduction to structure and simple program using structure concepts, Introduction to Union and programs with union, Storage Classes- Introduction to DMA, Introduction to Pre-processor				9	

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

- CO1 :** Acquiring foundational knowledge of programming including Algorithm, Flowcharts, assembly language basics, Program structure.
- CO2 :** Understanding C language fundamentals
- CO3 :** Applying various types of arrays and string manipulation technique to manage and process data in programming scenarios
- CO4 :** Analyze and experiment with functions, develop recursive solutions, and apply pointers to solve complex problems.
- CO5 :** Develop modular programs using control structures, unions

Text Book

1. Introduction to Programming Languages 1st Edition by Arvind Kumar Bansal, CRC Press, Taylor and Francis group, 2014.
2. C Programming Language by Brian Kernighan and Dennis Ritchie, Prentice Hall Software, 1988.
3. Programming with C 2nd Edition Byron Gottfried Schaum's outlines, Tata McGraw-Hill publishers, 1998.

Reference Books

1. E. Balagurusamy, 'Programming in ANSI C', 3rd edition, Tata McGraw-Hill Publishers, 2004.
2. Eric C.R. Hehner, 'The Logic of Programming', Prentice hall of India, 1991.
3. C: Herbert Schildt, 'The Complete Reference', McGraw Hill, 4th edition, 2017

Mapping of Course Outcomes (CO's) with PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	3	2	1	0	0	0	0	1	3	0	0	0
CO2	3	3	0	0	0	0	1	0	0	0	0	3	1	0	0
CO3	3	2	2	0	0	1	1	0	0	0	0	3	0	1	1
CO4	3	2	2	0	0	0	0	0	0	0	0	3	1	0	1
CO5	3	3	2	2	2	0	0	0	0	0	0	3	3	0	1

3 – High, 2 – Average, 1 – Low, 0-Null

Programme	B.Tech ECE (AI&ML)	Programme Code	BTEM		
Course Code	25BTEM212	Number of Hours/Week	2		
Semester	I	Max. Marks	100		
Year	I	Credits	1		
INTRODUCTION TO PROGRAMMING LAB		L	T	P	
		0	0	2	
LIST OF PROGRAMS					
1. Write a C program to print Integer, Float, Character values					
2. a) Write a C program to demonstrate use of arithmetic operators					
b) Write a C program using increment and decrement operators					
3. a) Write a C program using Decision making constructs (Switch-case statement)					
b) Program to find if a number is Negative, Positive, or zero(using if..elseif..else statement)					
4. C program to perform factorial of a number					
a) Write a C program to print a message 5 times using “while” statement					
b) Illustrate the Do-while statement using C program					
c) Program using for loop statement					
5. a) Write a C program to implement “break” statement					
b) Write a program to demonstrate ‘continue’ statement					
6. Write a C program to insert elements into an array and display the array elements.					
7. Write a C program to perform multiplication of two matrices.					
8. Strings					
a) Program to accept a string and display it as reverse using C language					
b) Program to concatenate 2 string using C					
9. Arrays					
a) Program to illustrate the concepts of arrays					
b) Program to illustrate pointer to 2-dimensional array					
10. Write a C program to accept student mark details and display the name of the student with the highest marks using structures.					
11. Write a C program to implement the concept of unions.					

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1	Acquire foundational knowledge of programming including Algorithm, Flowcharts, assembly language basics, Program structure.
CO2	Understand C language fundamentals
CO3	Apply various types of arrays and string manipulation technique to manage and process data in programming scenarios
CO4	Analyze and experiment with functions, develop recursive solutions and pointers to solve complex problems.
CO5	Develop modular programs using control structures, unions

Mapping of Course Outcomes (CO's) with PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	3	2	1	0	0	0	0	1	3	0	0	0
CO2	3	3	0	0	0	0	1	0	0	0	0	3	1	0	0
CO3	3	2	2	0	0	1	1	0	0	0	0	3	0	1	1
CO4	3	2	2	0	0	0	0	0	0	0	0	3	1	0	1
CO5	3	3	2	2	2	0	0	0	0	0	0	3	3	0	1

3 – High, 2 – Average, 1 – Low, 0-Null

Programme	B. Tech ECE-AI&ML	Programme Code	BTEM			
Course Code	25BTEM113	Number of Hours/Week	4			
Semester	I	Max. Marks	100			
Year	I	Credits	4			
Applied Science Course						
Course Title	MATHEMATICS-I			L	T	P
				3	1	0
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students for:						
<ul style="list-style-type: none"> • To recall and remember basics of matrices, complex numbers, and differential calculus. • To understand the concepts of basic mathematical methods for matrices, complex numbers and differential calculus. • To apply methods to solve engineering problems. • To analyze engineering problems and evaluate. • To solve and evaluate the problems using matrices, complex numbers, and differential calculus. 						
UNIT	TOPICS				HOURS	
I	Introduction to Differentiation and its applications: Fundamentals of Differentiation, Rolle's Theorem, Mean value theorems, Taylor's and Maclaurin's theorems with remainders, Indeterminate forms and L'Hopital's rule, Maxima and Minima				10	
II	Integration and its applications: Double integral, Triple integral, change of order of integration, Change of variables, Beta and Gamma functions and their properties, Dirichlet's integral and its applications to area and volume, Liouville's extensions of Dirichlet's integral.				12	
III	Sequence: Real number system, Convergence of sequence and series, Tests for convergence				8	
IV	Series: Power series, Taylor's series, Series for exponential, trigonometric and logarithm functions, Fourier series: Half range sine and cosine series, Parseval's theorem.				8	
V	Advanced Multivariable Calculus: Limit, continuity and partial derivatives, Directional derivatives, Total derivative, Tangent plane and normal line, Maxima, minima and saddle points, Method of Lagrange multipliers, Gradient, curl and divergence				10	
VI	Advanced Matrix Theory: Introduction, types of matrices- symmetric, skew-symmetric, Hermitian, skew-Hermitian, orthogonal, unitary matrices, Rank of a matrix - echelon form, normal form, consistency of system of linear equations (Homogeneous and Non- Homogeneous). Inverse and rank of a matrix, rank-nullity theorem				12	

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1:	Understand the concepts of mean value theorems, higher order derivative, series expansion and associated problems
CO2:	Acquire problem solving skills for finding area and volume using multiple integrals
CO3	Analyze sequences and series, including Fourier series
CO4	Apply the differentiation of functions of two variables for maximization and minimization
CO5	Evaluate basic matrix operations, linear systems of equations

Text Books

- 1: Advanced Engineering Mathematics, 10th Edition, Erwin Kreyszig, 1998.
- 2: Calculus and Analytical Geometry, Thomas and Finney, 1996.
- 3: Engineering Mathematics-I, Veerarajan T, Tata McGraw-Hill, New Delhi, 2008.
- 4: Higher Engineering Mathematics, Ramana B.V, Tata McGraw Hill New Delhi, 11th Reprint, 2010.

Reference Books

- 1: Higher Engineering Mathematics, B.S. Grewal, Khanna Publishers, 36th Edition, 2010.

Mapping of Course Outcomes (CO's) with PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	1	0	0	0	1	0	0	0	2	1	1
CO2	3	2	1	1	2	0	0	0	1	0	0	0	1	2	1
CO3	2	3	2	1	1	0	0	0	1	0	0	0	0	1	2
CO4	3	2	2	2	2	0	0	0	1	0	0	0	1	1	2
CO5	3	2	1	1	2	0	0	0	1	0	0	0	1	2	1

3 – High, 2 – Average, 1 – Low, 0-Null

Programme	B.Tech ECE-AI & ML	Programme Code	BTEM			
Course Code	25BTEM114	Number of Hours/Week	4			
Semester	I	Max. Marks	100			
Year	I	Credits	4			
Applied Science Course						
Course Title	PHYSICS I			L	T	P
			3	1	0	
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
<ul style="list-style-type: none"> To impart knowledge on the basics of the vector and scalar representation of forces and moments with Special reference to differentiation and integration methods To acquire knowledge on moment of inertia and angular momentum To impart knowledge on the concept of central force problems and uniformly accelerating systems. 						
UNIT	TOPICS				HOURS	
I	Algebra of vectors -Describing motion: displacement, velocity, speed, acceleration; Cartesian, polar, spherical, and cylindrical polar coordinates; Mathematical tools- differentiation and integration methods, Taylor's series				12	
II	Concept of inertia ; concept of inertial and non-inertial frames; Newton's laws of motion; Application of Newton's laws: particles in gravitational field, simple harmonic motion, tension in a string, frictional force, viscous force, damped harmonic oscillator, forced harmonic oscillator and resonance. Concept of momentum- center of mass, conservation of momentum, momentum and flow of mass, work-energy theorem, conservative and non-conservative forces, conservation of energy, concept of power, conservation laws and particle collisions				12	
III	Concept of moment of inertia ; fixed axis rotation; angular displacement, angular velocity, and angular acceleration; vector nature of angular velocity; angular momentum; torque; conservation of angular momentum; gyroscope motion				12	
IV	Central forces ; central force motion as one-body problem; conservation laws in central force motion; Kepler's laws				12	
V	Galilean transformations ; uniformly accelerating systems; principle of equivalence; Physics in rotating coordinates systems				12	

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

- CO1:** Apply the concepts of polar, rectangular, cylindrical and spherical coordinates systems.
- CO2:** Ability to differentiate statics and kinematics.
- CO3:** Demonstrate the ability to solve the problems in Newton's laws.
- CO4:** Appreciate to understand rotational kinetic energy & angular momentum.
- CO5:** Acquire adequate knowledge on conservation laws.

Text Books:

1. An Introduction to Mechanics by Daniel Kleppner, Robert Kolenkow, 2nd edition, 2006.

Reference Books:

2. Mechanics: Course of Theoretical Physics - Vol. 1, L.D. Landau and E.M. Lifshitz, Third Edition, CBS Publishers, 2002.

Mapping of Course Outcomes (CO's) with PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	0	0	0	0	0	0	0	0	0	2	0	0	2
CO2	2	0	0	1	0	0	0	0	0	0	0	0	0	0	2
CO3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	2
CO4	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0
CO5	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0

3 – High, 2 – Average, 1 – Low, 0 – Null

Programme	B.Tech ECE (AI & ML)	Programme Code	BTEM			
Course Code	25AEEN911	Number of Hours/Week	3			
Semester	1	Max. Marks	100			
Year	1	Credits	3			
Ability Enhancement Compulsory Course (AECC)						
Course Title	EFFECTIVE COMMUNICATION			L	T	P
			3	0	0	
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
<p>The main learning objective of this course is to prepare the students to</p> <ul style="list-style-type: none"> To define and explain the fundamental concepts, types, and processes of communication. To develop active listening and effective speaking skills to enhance interpersonal communications. To improve reading comprehension skills through different techniques. To apply grammar and vocabulary rules and public communication for accurate sentence structure and effective written communication. To prepare and deliver effective presentations by planning, structuring, and overcoming stage fright. 						
UNIT	TOPICS				HOURS	
I	Introduction to Communication Definition of Communication, Types of Communication: Formal, Informal, Oral, Written, Verbal, non-verbal, interpersonal, intrapersonal Process of Communication: Sender, Message, Channel, Receiver, Feedback Barriers: Intrapersonal, Interpersonal, Organizational Overcoming Barriers				10	
II	Listening and Speaking Active Listening: Types of Listening, Reasons for poor listening Traits of the good listener, Effective Speaking: Achieving Confidence, Clarity, and Fluency, Public Speaking, Drafting the Speech				10	
III	Reading and Writing Reading Comprehension: Improving Comprehension Skills, Scanning and Skimming, Predicting the Content, Understanding the Gist, PQRS Technique Grammar and Vocabulary: Sentence Structure, Preposition, Punctuation, Articles, Common errors and Correct Usage, Word formation: Affixes, Active and Passive Vocabulary				13	
IV	Presentation Skills Planning: Occasion, Audience, Purpose, Thesis Statement, Material, Outlining and Structuring, Guidelines for Effective Delivery, Strategies for Reducing Stage Fright				8	
V	Practice: Grammar Bites, English Fluency Drills				4	

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

- CO1:** Analyze different types and processes of communication and the barriers that may arise.
- CO2:** Demonstrate active listening skills and strategies for confident and fluent public speaking.
- CO3:** Improve reading comprehension through effective reading techniques.
- CO4:** Apply proper grammar, sentence structures, and vocabulary for clear and correct written communication.
- CO5:** Create structured presentations, incorporating techniques to manage stage fright and engage the audience effectively.

Text Books

1. Kumar, Sanjay and Pushp Lata. *Communication Skills*. 2nd. ed., Oxford University Press, 2015.
2. Raman, Meenakshi and Sangeetha Sharma. *Technical Communication: Principles and Practice*, 4th ed., Oxford University Press, 2022.

Reference Books

1. Adair, John. *Effective Communication: The Most Important Management Skill of All*. Pan Books Publishers, 1997.
2. Gorrell, Robert M and Charlton Laird. *Modern English Handbook*. 6th ed., Pentice Hall Publications, 1976.
3. Rose, William. *GNVQ Core Skills Communication*. 2nd. ed., Pitman Publishing, 1995.

Mapping of Course Outcomes (CO's) with PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0
CO2	0	0	0	0	0	0	0	0	2	3	0	0	0	0	0
CO3	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0
CO4	0	0	0	0	0	0	0	0	0	3	0	0	0	0	1
CO5	0	0	0	0	0	0	0	0	3	3	0	0	0	0	2

3 – High, 2 – Average, 1 – Low , 0-Null

Semester II

Programme	B.Tech ECE (AI & ML)	Programme Code	BTEM			
Course Code	25BTEM121	Number of Hours/Week	3			
Semester	II	Max. Marks	100			
Year	I	Credits	3			
Core Course						
Course Title	PYTHON PROGRAMMING			L	T	P
				3	0	0
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students for:						
<ul style="list-style-type: none"> • To Understand the fundamentals of the Python programming language and its historical development • To Master Python basics, including data types, operators, tuples, dictionaries, and string manipulation. • To demonstrate object-oriented concept in python • To familiarize with machine learning tools in python 						
UNIT	TOPICS				HOURS	
I	Introduction to python programming Introduction to python; setting up python programming environment; variables; strings and its operations; special characters; stripping whitespace; numbers; comments; list and its operations; indexing; looping through lists; indentation; range function; slicing a list; copying list; looping through slice;				8	
II	Python datatypes Tuples and its operations; relational operators; conditional statements – if, if-else, if-elseif-else; multiple conditional blocks; dictionaries; key-value pairs – adding, modifying, removing; looping through dictionary; list of dictionaries; dictionary in a dictionary; user input function; type casting;				8	
III	Loop and function While loop; break and continue; functions; arguments; passing arguments – positional arguments, keyword arguments, default values; optional arguments; returning from function; passing arbitrary number of arguments; storing functions in modules; import specific function or module;				8	
IV	OOPs in python Classes;_init() method; instance of a class; accessing attributes;calling methods; creating multiple instances; inheritance – parent class, child class; importing classes; files – reading a file, writing to a file, appending to a file; exceptions – try-except block, else block;				8	
V	Python machine learning tools Python tools for machine learning; python modules – numpy, pandas, matplotlib, scipy; python-based machine learning libraries – pytorch, tensor flow; virtual environment; machine learning application using python tools;				8	

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1 : Comprehend the holistic view of programming language design and behavior

CO2 : Understand the programming concepts in abstract and paradigm level

CO3 : Structure python programs for solving problems

CO4 : Develop python programs using OOP concept

CO5 : Execute ML project using python tools

Text Books:

1. A Hands-On, Project-Based Introduction to Programming, Eric Matthes. Python Crash Course, 2nd Edition:No Starch Press, Inc., 2019.

Reference Books:

1. Boring Stuff with Python by Al Sweigart. AutomA ,William Pollock, 2015.

Mapping of Course Outcomes (CO's) with PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	3	0	0	1	0	1	0	1	0	2	0	1	1
CO2	3	3	2	3	1	2	0	2	1	1	0	2	1	1	2
CO3	3	2	3	2	3	1	1	0	0	1	0	2	2	2	2
CO4	3	2	3	2	1	2	1	0	1	1	0	1	2	1	3
CO5	2	2	3	3	3	0	1	3	1	1	1	1	3	3	3

3 – High, 2 – Average, 1 – Low , 0-Null

Programme	B.Tech ECE (AI & ML)	Programme Code	BTEM		
Course Code	25BTEM221	Number of Hours/WK	2		
Semester	II	Max. Marks	100		
Year	I	Credit	1		
Core Course					
Course Title	PYTHON PROGRAMMING LABORATORY		L	T	P
			0	0	2

Course Objective:

The main learning objective of this course is to prepare the students for:

1. To learn fundamentals in python programming language
2. To introduce python modules for application
3. To familiarize python framework for machine learning applications
4. To develop machine learning application using python
5. To implement research topic as part of python project

List of experiments:

S.NO	TITLE
1	Implement basic algebraic problems to get into python programming
2	Implement string manipulations problems using python
3	Implement problems using python datatypes such as tuple, list, dictionary etc.
4	Implement problems for python loops, conditional statements and functions
5	Implement object-oriented programming concepts in python to solve different problems
6	Implement problems for python file manipulations
7	Implement standard machine learning algorithms using python frameworks such as TensorFlow, PyTorch etc.
8	Implement advanced problems using python tools in a virtual environment as part of python project

Course outcome:

On successful completion of this course, the student will be able to

- CO1 : Develop basic coding skills in python
CO2 : Understand python datatypes, modules, frameworks etc.
CO3 : Implement standard ML algorithms using python tools
CO4 : Apply python frameworks for ML applications
CO5 : Create ML model for existing problems

Mapping of Course Outcomes (CO's) with PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	3	0	0	1	0	1	0	1	0	2	0	0	2
CO2	3	3	2	3	1	2	0	2	1	1	0	2	0	1	2
CO3	3	2	3	2	3	1	1	0	0	1	0	2	2	2	3
CO4	3	2	3	2	1	2	1	0	1	1	0	1	2	3	3
CO5	2	2	3	3	3	0	1	3	1	1	1	1	3	3	3

3 – High, 2 – Average, 1 – Low , 0-Null

Programme	B.Tech ECE (AI&ML)	Programme Code	BTEM			
Course Code	25BTEM122	Number of Hours/Week	3			
Semester	II	Max. Marks	100			
Year	I	Credits	3			
Applied Science Course						
Course Title	PROBABILITY, STATISTICS AND STOCHASTIC PROCESSES			L	T	P
				3	0	0
COURSE OBJECTIVES:						
<ul style="list-style-type: none"> • Understand fundamental probability concepts and their applications in real-world scenarios. • Analyze data using descriptive statistics such as mean, variance, and standard deviation. • Apply probability distributions (e.g., binomial, normal) to model and solve problems. • Conduct hypothesis testing and confidence intervals to make informed statistical inferences. • Utilize statistical tools and software for data analysis and decision-making in various fields. 						
UNIT	TOPICS				HOURS	
I	Introduction to Probability: Introduction to set algebra-sigma algebra-Borel sigma algebra-sequence of sets and its limits-lim-sup and lim-inf of sequence of sets; Axiomatic definition of probability-probability space-properties of probability functions-conditional probability-Bayes' rule-independence of events-continuity of probability functions-Borel Cantelli lemmas.				10	
II	Random variables -distribution function and its property probability mass and density functions-symmetric distribution and its properties- expectation-moments moment generating function-Markov inequality-Chebyshev's inequality.				6	
III	Joint distributions -marginal and conditional distributions-moments- independence of random variables-covariance, and correlation joint moment generating functions-additive properties of random variables-functions of random variables-ordered Statistics.				8	

IV	Special distributions: Discrete uniform-Bernoulli-binomial-geometric negative binomial-hypergeometric-Poisson-exponential-gamma-normal-bivariate normal distribution; Population- sample-parameters- distributions of the sample mean and the sample variance for a normal population-Chi-Square-t, F distributions-law of large numbers–central limit theorem-point estimation-method of moments-maximum likelihood estimator-unbiasedness.	8
V	Testing of hypothesis: Null and alternate hypothesis-Neyman Pearson fundamental lemma and its applications-tests for one sample and twosample problems for normal populations-tests for proportions- confidence interval estimation-confidence interval for parameters of normal population	10

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

- CO1: Understand Basic Probability Concepts
- CO2: Analyse Random Variables and Probability Distributions, Joint Distributions and Conditional Probability
- CO3: Implement the Central Limit Theorem and Law of Large Numbers
- CO4: Perform Hypothesis Testing and Statistical Inference, Regression and Correlation for Data Analysis
- CO5: Employ Statistical Tools in Engineering Applications

Text Books:

1. First Course in Probability, Sheldon Ross, 2022.
2. An Introduction to Probability and Statistics, V.K. Rohatgi and A.K. Md. E. Saleh, 2015.

Reference Books:

1. Introduction to Probability and Statistics, S. Milton and J.C. Arnold, 2003.
2. Introduction to Mathematical Statistics, R V Hogg, A Craig and J W McKean, 2019

Mapping of Course Outcomes (CO's) with PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	0	1	0	0	0	0	0	0	2	2	1	1
CO2	2	1	1	2	1	2	1	0	1	2	1	2	1	2	1
CO3	2	0	2	2	2	2	2	1	1	2	0	0	2	0	2
CO4	2	2	1	2	0	2	2	1	0	0	1	1	2	2	2
CO5	2	2	0	2	1	2	2	2	1	1	2	2	0	0	2

3 – High, 2 – Average, 1 – Low , 0-Null

Programme	B.Tech ECE (AI&ML)	Programme Code	BTEM			
Course Code	25BTEM123	Number of Hours/Week	4			
Semester	II	Max. Marks	100			
Year	I	Credits	4			
Applied Science Course						
Course Title	MATHEMATICS II			L	T	P
				3	1	0
COURSE OBJECTIVES:						
<ul style="list-style-type: none"> • To develop a strong understanding of vector spaces, subspaces, basis, and dimension, as well as how linear transformations relate to matrices and their properties. • To gain proficiency in solving systems of linear equations using techniques like Gaussian elimination, matrix operations, and determinants. • To compute eigenvalues and eigenvectors, and apply them to diagonalize matrices, a critical tool for solving differential equations. • To solve first-order and second-order ordinary differential equations (ODEs) with applications to physical, biological, and engineering problems. • To understand the interplay between linear algebra and differential equations, especially in systems of linear differential equations, using matrix methods such as the Laplace transform and matrix exponentials. 						
UNIT	TOPICS				HOURS	
I	Advanced Matrix Theory: Systems of linear equations: Elementary operations-row-reduced echelon matrices-Gauss elimination LU factorization-linear independence-rank of a matrix-solutions of linear systems-existence and uniqueness.				10	
II	Vector spaces: Vector space-subspaces-spanning space-bases and dimensions. Linear transformation-matrix representations of linear transformations-range space and rank-null space and nullity-the rank and nullity theorem-invertibility.				6	
III	Eigenvalues and eigenvectors: Eigen values-eigenvectors and some applications of eigenvalue problems-Hermitian, skew-Hermitian, unitary matrices and their eigenvalues-eigen bases.				8	
IV	Elementary Canonical Forms: Diagonalization: Annihilating polynomial-the minimal polynomial and the characteristic polynomial- Cayley-Hamilton theorem-real quadratic form; Inner product spaces: Inner product spaces-orthonormal bases- Gram-Schmidt process.				8	
V	Ordinary Differential Equations: Review of First Order ODE- Lipschitz condition-Picard's theorem; Linear differential equations: Linear dependence and Wronskian-linear ODE with constant coefficients of higher order characteristic equations- Cauchy-Euler equations-method of undetermined coefficients-method of variation of parameters- solutions methods using Laplace Transform				10	

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

- Learn different types of matrices, concept of rank, methods of matrix inversion and their applications, systems of linear equations, and manipulate vectors in various dimensions.
- Understand linear spaces, its basis and dimension with corresponding applications in the field of computerscience.
- Apply the concept of eigen values, eigen vectors, diagonalization of matrices and orthogonalization in inner product spaces for understanding physical and engineering problems.
- Understand the first- and second-order ordinary differential equations (ODEs), both analytically and numerically, with applications to real-world phenomena.
- Develop the skills to model physical systems using differential equations and linear algebra.

Text Books:

- Linear Algebra, Hoffman Kunze, 2015.
- Differential Equations, S. L Ross, 2007.

Reference Books:

- Introduction to Linear Algebra, Gilbert Strang, 2016.
- Advanced Engineering Mathematics, Erwin Kreyszig, 2010.

Mapping of Course Outcomes (CO's) with PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	0	1	0	0	0	0	0	0	2	2	1	1
CO2	2	1	1	2	1	2	1	0	1	2	1	2	1	2	1
CO3	2	0	2	2	2	2	2	1	1	2	0	0	2	0	2
CO4	2	2	1	2	0	2	2	1	0	0	1	1	2	2	2
CO5	2	2	0	2	1	2	2	2	1	1	2	2	0	0	2

3 – High, 2 – Average, 1 – Low , 0-Null

Programme	B.Tech ECE (AI&ML)	Programme Code	BTEM			
Course Code	25BTEM124	Number of Hours/Week	3			
Semester	II	Max. Marks	100			
Year	I	Credits	3			
Applied Science Course						
Course Title	PHYSICS II			L	T	P
				3	0	0
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
<ul style="list-style-type: none"> To understand the working principle of various lasers, fibre optics and its applications. To impart knowledge on acoustics and ultrasonics and its applications. To provide knowledge on magnetism and superconducting phenomenon. 						
UNIT	TOPICS				HOURS	
I	Introduction – Components of laser – Principle of laser action – Properties of laser – Spontaneous emission and stimulated emission – Einstein’s coefficients – Population inversion – Types of lasers – He-Ne laser – Nd- YAG laser – Semiconductor laser – Industrial applications of laser – Medical applications of laser – Holography				12	
II	Introduction – Propagation of light in optical fiber – Total internal reflection – Principle of optical fiber – Fractional Refractive index - Numerical aperture and acceptance angle – Types of optical fibers based on materials, modes of propagation and refractive index profile – Power losses in optical fibers – Fiber optic communication system – Fiber optic sensors – Temperature and Displacement – Fibre endoscope				12	
III	Introduction – Classification of sound – Characteristics of musical sound – Pitch – Loudness – Quality – Intensity of sound – Weber Fechner Law – Reverberation – Reverberation Time – Sabine’s Formula – Factors affecting the acoustics of a building – Absorption Coefficient – Measurement of Absorption coefficient				12	
IV	Introduction – Production of ultrasonic waves – Magnetostriction Effect – Magnetostriction generator – Piezoelectric Effect – Properties of ultrasonics - Acoustic grating – Applications of ultrasonics – Industrial applications – SONAR – NDT --- Medical Applications				12	
V	Types of electronic materials: metals, semiconductors, and insulators, Dia, Para, Ferro magnetic materials properties, Temperature effects - Hysteresis curve, Hard and soft magnetic engineering materials - Applications: Magnetic recording and reading – Hard disc. Superconductors: Properties of superconducting materials - Type I and Type II superconductors- Applications: Maglev.				12	

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

- CO1:** Understand the concept of lasers and apply laser action in industries.
- CO2:** Explain and interpret the principle of fiber optics for different types of industrial sensors.
- CO3:** Discern the laws governing acoustics and implement the same in acoustic quieting.
- CO4:** Apply the fundamentals of ultrasonics in non-destructive testing.
- CO5:** Evaluate and perceive various laws governing magnetism with special reference to magnetic confinement for future power generation.

Text Books:

1. Engineering Physics, D.K. Bhattacharya and Poonam Tandon, New Delhi: Oxford University Press (2017)
2. Engineering Physics, S.Mani Naidu, New Delhi: Pearson India Education Services Pvt. Ltd., (2014)

Reference Books:

1. Engineering Physics, R.K. Gaur and S.L.Gupta, New Delhi: Dhanpat Rai Publications (P) Ltd. (2008)
2. Engineering Physics, Shatendra Sharma and Jyotsna Sharma, New Delhi: Pearson India Education Services Pvt. Ltd., (2019)
3. Engineering Physics, Dattu R. Joshi, New Delhi: Tata McGraw Hill Education Private Ltd., (2010)
4. A Textbook of Engineering Physics, M. N. Avadhanulu and P. G. Kshirsagar, New Delhi: S.Chand and Company Ltd., (2009)
5. Principles of Physics, Jearl Walker, David Halliday and Robert Resnick, Wiley India Pvt. Ltd., New Delhi (2014), Tenth Edition
6. Sears and Zemansky's University Physics with Modern Physics, Hugh D. Young and Roger A. Freedman, Pearson Education, New Delhi (2018), Fourteenth Edition.

Mapping of Course Outcomes (CO's) with PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	0	0	0	0	0	0	0	0	0	2	2	0	0
CO2	2	0	0	3	0	0	0	0	0	0	0	0	1	0	0
CO3	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0
CO4	2	1	0	0	0	0	0	0	0	0	0	0	2	0	0
CO5	2	2	2	0	0	0	0	0	0	0	0	0	0	0	0

3 – High, 2 – Average, 1 – Low , 0-Null

Programme	B.Tech ECE (AI&ML)	Programme Code	BTEM			
Course Code	25BTEM222	Number of Hours/Week	2			
Semester	II	Max. Marks	100			
Year	I	Credits	1			
Applied Science Course						
Course Title	PHYSICS LAB			L	T	P
				0	0	2
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
At the end of the courses, the student will be able to						
<ol style="list-style-type: none"> 1. Understand the concept of lasers and its action in industries. 2. Explain the principle of fiber optics for different types of industrial sensors. 3. Apply the basics of Lasers and Optical fibers. 4. Study the principles and applications of acoustics. 5. Discern the laws governing acoustics and its applications in acoustic quieting. 6. Relate the application of light in optical devices. 						
<u>List of experiments</u>						
1	Wavelength Determination – LASER diffraction					
2	Particle size Determination – LASER diffraction					
3	Attenuation of an Optical fibre– Fibre Optic Cable					
4	Numerical Aperture measurement of an Optical Fibre– Fibre Optic Cable					
5	Determination of Planck’s constant – LED					
6	Reverberation Time of a hall - Acoustics					
7	Refractive index of a prism – Spectrometer					
8	Wavelength of Mercury spectrum – Diffraction grating – Spectrometer					

Mapping of Course Outcomes (CO's) with PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	0	0	0	0	1	0	0	0	0	0	0	2	0	0	2
CO2	0	0	0	1	0	0	0	0	0	0	0	1	0	0	2
CO3	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2
CO4	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2
CO5	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0

3 – High, 2 – Average, 1 – Low , 0-Null

Programme	B.Tech ECE (AI&ML)	Programme Code	BTEM			
Course Code	25BTEM125	Number of Hours/Week	3			
Semester	II	Max. Marks	100			
Year	I	Credits	3			
Core Course						
Course Title	FUNDAMENTALS OF ELECTRICAL AND ELECTRONICS			L	T	P
			3	0	0	
L-Lecture Hours		T-Tutorial Hours		P-Practical Hours		
COURSE OBJECTIVES						
<p>This course aims to understand the basic concepts of electrical and electronic circuits, develop problem-solving skills related to electrical engineering, and introduce fundamental principles of electronics and their applications.</p> <ul style="list-style-type: none"> • To understand the basic concepts of electrical and electronic circuits. • To develop problem-solving skills related to electrical engineering. • To introduce fundamental principles of electronics and their applications 						
UNIT	TOPICS					HOURS
I	<p>Overview: Overview of electronics and communication engineering field, applications and as a programme. Terminology and Definitions: Current, EMF/voltage/electric potential, potential difference, resistance and conductance, components and circuit. Ohm's law: Statement, specific resistance, limitations, resistors in parallel and series and their combinations. Simple problems. Kirchhoff's laws: Statements of current and voltage laws and simple problems. Power and Energy: Definitions, units and simple problems.</p>					8
II	<p>Circuit Theory: Analysis of simple circuits using nodal and mesh analysis, and Thevenin's and Norton's Theorems. Electrical Components: Types and applications of resistors, capacitors, and inductors; introduction to power sources like batteries and AC/DC sources; basics of transformers.</p>					8
III	<p>Alternating Current (AC) Fundamentals: Definitions and waveforms of AC voltage and current, RMS and average values, phasors and their application in circuit analysis, and basic AC circuit analysis including impedance, reactance, and resonance.</p>					9
IV	<p>Basics of Electronics: Introduction to semiconductors, diode characteristics and applications, transistor types, configurations, and operation, and basic operational amplifiers</p>					9
V	<p>Measuring Instruments: Overview of measuring instruments including multimeters and oscilloscopes, measurement of voltage, current, resistance, and frequency, and basics of digital multimeters.</p>					9

COURSE OUTCOMES:

CO1:	Describe the differences between AC and DC circuits and their applications.
CO2:	Use circuit analysis techniques to solve simple electrical circuits
CO3	Compare and contrast the characteristics of different electronic components like diodes and transistors.
CO4:	Assess the efficiency and performance of electrical circuits based on given specifications.
CO5:	Design and implement a simple electronic circuit that meets specific requirements.

Textbooks

1. "Fundamentals of Electric Circuits" by Charles K. Alexander and Matthew N.O. Sadiku, fifth edition 2017
2. "Electrical Engineering: Principles and Applications" by Allan R. Hambley, sixth edition 2016

Reference Books

1. "The Art of Electronics" by Paul Horowitz and Winfield Hill, fifth edition, 2016
2. "Basic Electric Circuit Theory" by Thomas L. Floyd, ninth edition, 2007
3. "Circuit Analysis: Theory and Practice" by David A. Santos, seventh edition, 2008

Mapping of Course Outcomes (COs) with PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	3	2	2	1	1	2	1	1	0	0	0	2	2	1	1
CO2	3	3	2	2	2	1	1	0	1	0	1	2	3	2	1
CO3	3	2	3	2	2	2	1	1	0	0	0	2	3	3	2
CO4	3	3	3	3	2	2	2	1	0	1	2	3	2	2	2
CO5	3	3	3	2	3	2	2	2	2	3	2	3	3	3	3

3 – high, 2 – Average, 1 - low , 0-null

Course Code	24BTEC225	Number of Hours/Wk	2		
Semester	II	Max. Marks	100		
Year	I	Credit	1		
Core Course					
Course Title	Fundamentals of Electrical and Electronics Engineering Lab	L	T	P	
		0	0	2	
COURSE OBJECTIVES					
This course aims to understand the basic concepts of electrical and electronic circuits, develop problem-solving skills related to electrical engineering, and introduce fundamental principles of electronics and their applications.					
<ul style="list-style-type: none"> To understand the basic concepts of electrical and electronic circuits. To develop problem-solving skills related to electrical engineering. To introduce fundamental principles of electronics and their applications. 					

List of experiments:

S.NO	TITLE
1	Identify and study the operation of common electronic components like resistors, capacitors, diodes, and transistors.
2	Verify Ohm's Law through practical experimentation by varying voltage and measuring current.
3	Measure and calculate the total resistance in series and parallel resistor combinations.
4	Analyze a circuit using nodal analysis and verify node voltages experimentally.
5	Simplify complex circuits using Thevenin's and Norton's theorems and verify experimentally.
6	Study the charging and discharging behavior of RC circuits, and analyze the frequency response of RL and RLC circuits
7	Plot the I-V characteristic curve for a diode and study its rectification properties.

COURSE OUTCOMES:

CO1:	Describe the differences between AC and DC circuits and their applications.
CO2:	Use circuit analysis techniques to solve simple electrical circuits
CO3:	Compare and contrast the characteristics of different electronic components like diodes and transistors.
CO4:	Assess the efficiency and performance of electrical circuits based on given specifications.
CO5:	Design and implement a simple electronic circuit that meets specific requirements.

Text Books

- "Fundamentals of Electric Circuits" by Charles K. Alexander and Matthew N.O. Sadiku, fifth edition 2017

4. "Electrical Engineering: Principles and Applications" by Allan R. Hambley, sixth edition 2016

Reference Books

4. "The Art of Electronics" by Paul Horowitz and Winfield Hill, fifth edition, 2016

5. "Basic Electric Circuit Theory" by Thomas L. Floyd, ninth edition, 2007

6. "Circuit Analysis: Theory and Practice" by David A. Santos, seventh edition, 2008

Programme	B.Tech ECE (AI&ML)	Programme Code	BTEM			
Course Code	25EVST921	Number of Hours/Week	2			
Semester	II	Max. Marks	100			
Year	I	Credits	2			
Value Added Course						
Course Title	ENVIRONMENTAL SCIENCE			L	T	P
				2	0	0
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
<p>The main learning objective of this course is to prepare the students to:</p> <ul style="list-style-type: none"> • To understand the Environmental Foundations • To differentiate between renewable and non-renewable resources and assess the impacts of land use changes, land degradation, and water resource exploitation. • To study the causes and effects of pollution and its impacts on earth • To analyse the population causes, its effects and control measures. 						
UNIT	TOPICS				HOURS	
I	Introduction to Environmental studies Definition and Scope of Environmental Studies - Interdisciplinary Nature of Environmental Science-Historical Perspectives on Environmental Issues- Principles of Sustainability and Sustainable Development, Ecosystem- Structure and functions of ecosystem--Aquatic ecosystems				6	
II	Natural Resources- Renewable and Non-renewable Resources Land resources and land use change, Land degradation, soil erosion, Desertification- Deforestation- exploitation of surface and ground water, floods, droughts, conflicts over water Energy resources: Renewable and non-renewable energy sources, use of alternate energy sources, growing energy needs, case studies.				6	
III	Biodiversity and Conservation Levels of biological diversity- genetic, species and ecosystem diversity, Biogeographic zones of India; Biodiversity patterns and global biodiversity hot spots.				6	

IV	<p>Environmental Pollution Environmental pollution: types, causes, effects and controls; Air, water, soil and noise pollution - Nuclear hazards and human health risks-Solid waste management: Control measures of urban and industrial waste. Pollution case studies, Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture, Environment Laws: Environment Protection Act; Wildlife Protection Act; Forest Conservation Act. International agreements: Montreal and Kyoto protocols and Convention on Biological Diversity (CBD), Nature reserves, tribal populations and rights, and human wildlife conflicts in Indian context.</p>	12
V	<p>Human Communities and the Environment Human population growth: Impacts on environment, human health and welfare- Resettlement and rehabilitation of project affected persons, Disaster management: floods, earthquake, cyclones and landslides, Environmental movements- Chipko, Silent valley, Bishnoi's of Rajasthan</p>	10

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1:	Define environmental studies and its interdisciplinary nature
CO2:	Analyze the structure and functions of various ecosystems, including aquatic ecosystems.
CO3:	Evaluate the growing energy needs and the role of alternative energy sources
CO4:	Understand levels of biodiversity (genetic, species, and ecosystem) and identify biodiversity hotspots, with a focus on conservation strategies.
CO5:	Evaluate the effects of human population growth on the environment and the importance of disaster management, resettlement, and environmental movements

Textbooks

1. Environmental and Sustainable Development, Keiji Ujikawa, Mikio Ishiwatari, Eric vanHullebusch, 1st Edition springer publishers Singapore, 2022.
2. Environmental Science: Toward A Sustainable Future, Dorothy F. Bourse and Richard T. Wright, 13th edition, Pearson publishers, 2017.
3. Social Learning in Environmental Management: Towards a Sustainable Future, Meg Keen, Valerie A. Brown, Rob Dyball, 2012.
4. Principles of Environmental Science, William P. Cunningham and Mary Ann Cunningham, 10th edition, Mc graw hill publishers, 2004.
5. Visualizing Environmental Science, Linda R. Berg, Mary Catherine Hager and David M. Hassenzahl, 2017.

Reference Books:

1. Waste Water Treatment, Rao, M.N., Datta, A.K., Oxford and IBH Publishing Co. Pvt. Ltd, 1987.
2. Fundamentals of Ecology, Odum, E.P., Odum, H.T., and Andrews, J., , Saunders, Philadelphia, 1971, USA.

Mapping of Course Outcomes (CO's) with PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	0	0	1	0	0	0	2	0	0	0	0	0	0	0	0
CO2	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0
CO3	0	1	1	0	0	0	1	0	0	0	0	0	0	0	0
CO4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CO5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1

3 – High, 2 – Average, 1 – Low , 0-Null

Semester III

Programme	B.Tech ECE (AI & ML)	Programme Code	BTEM			
Course Code	25BTEM131	Number of Hours/Week	3			
Semester	V	Max. Marks	100			
Year	III	Credits	3			
Core Course						
Course Title	NETWORK ANALYSIS			L	T	P
				3	0	0
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students:						
<ul style="list-style-type: none"> • Understand graph theory concepts and apply them to the analysis of electrical networks. • Analyze electric networks using nodal, loop, cut-set, and generalized branch analysis techniques. • Model and analyze two-port networks and filters used in communication and electronic systems. • Analyze network functions using pole–zero concepts and determine system stability and realizability. • Synthesize one-port networks using standard synthesis techniques for practical circuit realization. 						
UNIT	TOPICS				HOURS	
I	Network Topology Linear Oriented Graphs -incidence matrix of a linear oriented graph – Kirchoff's Laws in incidence matrix formulation –nodal analysis of networks (independent and dependent sources) – Circuit matrix of linear oriented graph –Kirchoff's laws in fundamental circuit matrix formulation.				8	
II	Loop analysis of electric networks (with independent and dependent sources) - Planar graphs –Mesh analysis- Duality –Cut set matrix -Fundamental cut set matrix –Relation between circuit, cut set and incidence matrices – Kirchoff's laws in fundamental cut-set formulation –Node-pair analysis – Analysis using generalized branch model (node, loop and node pair analysis) –Tellegen's theorem.				12	
III	Modeling Two-port networks-application examples-amplifiers, transmission lines, passive filters. Review of network parameter sets for two-port networks (z, y, h, g, T parameters, equivalent circuits and inter-relationship between parameters). (Review may be done using assignments/homeworks). Image parameter description of a reciprocal two-port network -- Image impedance - Characteristic impedance - propagation constant—derivation of characteristic impedance and propagation constant for T and Pi networks under sinusoidal steady state -- Attenuation constant and phase constant. Filter terminology: Low pass, high pass, band-pass and band-reject filters. Constant k and m-derived filters -- low pass, high pass, band-pass and band-stop filters -- design--effect of cascading multiple sections. Resistive T, Pi and lattice attenuators				10	

IV	Network Functions: Review of Network functions for one port and two port networks: – pole zero location for driving point and transfer functions- Impulse response of Network functions from pole-zero plots- Sinusoidal steady-state frequency response from pole-zero plots. Hurwitz polynomials – properties - Positive real functions – Properties of positive real functions – passivity-necessary and sufficient conditions for positive real functions- physical realizability.	10
V	Synthesis of one port networks: Synthesis of reactive one-ports by Foster's and Cauer methods (forms I and II) -Synthesis of LC, RC and RL driving-point functions.	8

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1:	Apply network topology concepts in the formulation and solution of electric network problems
CO2:	Apply two-port network analysis in the design and analysis of filter and attenuator networks.
CO3:	Identify the properties and characteristics of network functions, and verify the mathematical constraints for their physical realization.
CO4:	Synthesize passive one-port networks using standard Foster and Cauer forms.
CO5:	Analyze electrical networks using advanced matrix-based methods such as nodal, mesh, cut-set, and generalized branch analysis techniques.

Text Books:

1. K. S. Suresh Kumar, – Electric Circuit Analysis, Pearson Publications, 2013.
2. Ravish R. Singh, "Network Analysis and Synthesis", McGraw-Hill Education, 2013

Reference Books:

1. Franklin Kuo, – Network Analysis and Synthesis, 2nd Ed., Wiley India.
2. Van Valkenburg M.E., – Introduction to Modern Network Synthesis, Wiley Eastern, 1960 (reprint 1986).
3. Van Valkenburg M.E., – Network Analysis, Prentice Hall India, 2014.
4. Charles A. Desoer and Ernest S. Kuh, – Basic Circuit Theory, Tata McGraw Hill Edition.
5. Chakrabarti, A., "Circuit Theory Analysis and Synthesis", Dhanpat Rai & Co., Seventh - Revised edition, 2018
6. S. K. Bhattacharya, – Network Analysis and Synthesis, Pearson Education India.

Mapping of Course Outcomes (CO's) with PO's & PSO's

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	2	1	0	0	1	0	0	0	2	3	2	1
CO2	3	3	2	2	1	0	0	1	0	0	0	2	3	2	1
CO3	3	3	2	2	2	0	1	1	0	0	0	2	3	3	2
CO4	3	3	2	3	1	0	0	1	0	0	0	2	3	3	2
CO5	3	3	3	3	2	0	0	1	0	0	0	2	3	3	3

3 – high, 2 – Average, 1 - Low , 0-Null

Programme	B.Tech ECE (AI&ML)	Programme Code	BTEM			
Course Code	25BTEM132	Number of Hours/Week	3			
Semester	III	Max. Marks	100			
Year	II	Credits	3			
Core Course						
Course Title	SIGNALS AND SYSTEMS			L	T	P
				3	0	0
COURSE OBJECTIVES:						
The main aim of learning this course is:						
<ul style="list-style-type: none"> • Understanding the fundamental characteristics of signals and systems. • Understanding the concepts of vector space, inner product space and orthogonal series. • Understanding signals and systems in terms of both the time and transform domains, taking advantage of the complementary insights and tools that these different perspectives provide. • Development of the mathematical skills to solve problems involving convolution, filtering, modulation and sampling. 						
UNIT	TOPICS				HOURS	
I	Classification of Signals: Continuous-time vs discrete-time signals, analog vs digital signals, energy and power signals, deterministic vs random signals. Signal Operations: Scaling, time shifting, time inversion, and time scaling of signals. Signal Properties: Symmetry (even and odd signals), periodicity of signals, and absolute integrability. Elementary Signals: Unit step, unit impulse, ramp, exponential, sinusoidal signals.				9	
II	Systems: Classification of Systems: Continuous-time vs discrete-time systems, linear vs nonlinear systems, causal vs non-causal systems, time-invariant vs time-varying systems, stable vs unstable systems. System Properties: Linearity, time/shift invariance, causality, and stability. LTI and LSI Systems: Continuous-time linear time-invariant (LTI) systems, discrete-time linear shift-invariant (LSI) systems. Impulse and Step Response: Impulse response and step response of systems. Response to Arbitrary Input: Convolution in continuous and discrete time domains. System Representation: Representation of systems using differential equations for continuous-time systems and difference equations for discrete-time systems.				9	
III	Fourier Series and Transforms: Fourier Series Representation: Fourier series representation of continuous-time periodic signals, Fourier series of discrete-time periodic signals, properties of Fourier series. Continuous-Time Fourier Transform (CTFT): Fourier transform of continuous-time signals, properties of CTFT (linearity, timeshifting, time scaling, etc.), Parseval's theorem, and time-bandwidth product. Discrete-Time Fourier Transform (DTFT): Fourier transform of discrete-time signals, properties of DTFT (linearity, time shifting, time scaling, etc.). Relationships among Fourier Representations: Relationship between Fourier series, CTFT, and DTFT.				9	
IV	Laplace Transform and Sampling: Laplace Transform: Definition of the Laplace transform, region of convergence				9	

	(ROC), properties of Laplace transforms (linearity, time shifting, scaling, initial value theorem, final value theorem, etc.), inverse Laplace transform. Sampling: Sampling theorem for bandlimited signals, aliasing in the sampling process, and Nyquist rate. Signal Reconstruction: Ideal signal reconstruction using interpolators, zero-order hold, and first-order hold methods.	
V	Z-Transform and Discrete Fourier Transform: Z-Transform: Definition of the z-transform, region of convergence (ROC) for z-transform, properties of the z-transform (linearity, time shifting, scaling, etc.), inverse z-transform (using partial fraction expansion and power series methods). Discrete Fourier Transform (DFT): Definition and properties of the DFT, relationship between DFT and DTFT, computation of DFT, inverse DFT.	9

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

- CO1: To Understand different types of signals-continuous and discrete, odd and even, periodic and aperiodic etc
- CO2: Be able to classify systems based on their properties
- CO3: To familiarize the concepts of transform based continuous time and discrete time
- CO4: Analyze continuous time and discrete time signals and systems by using appropriate mathematical tools
- CO5: Determine Fourier transforms for continuous-time and discrete-time signals (or impulse response functions), and understand how to interpret and plot Fourier transform magnitude and phase functions

Text Book

1. "Signals and Systems" by Alan V. Oppenheim, Alan S. Willsky, S. Hamid Nawab, 1997.
2. D.C. Lay, Linear Algebra and its Applications (2/e), Pearson, 2016.
3. "Digital Signal Processing" by John G. Proakis, Dimitris G. Manolakis, 2007.

Reference Books

1. "Signal Processing and Linear Systems" by B.P. Lathi, 1998.
2. "Signals and Systems: Continuous and Discrete" by Roger E. Ziemer, William H. Tranter, 1998

Mapping of Course Outcomes (CO's) with PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2	2	1	1	1	1	1	1	1	2	1	1
CO2	2	2	2	1	2	2	2	1	0	1	0	2	2	1	1
CO3	2	1	3	3	2	2	2	1	2	0	2	1	2	2	2
CO4	2	2	2	2	2	3	2	1	2	0	2	1	2	0	1
CO5	2	3	3	2	1	1	1	1	1	1	2	1	1	0	2

3 – High, 2 – Average, 1 – Low, 0-Null

Programme	B.Tech ECE (AI&ML)	Programme Code	BTEM			
Course Code	25BTEM133	Number of Hours/Week	3			
Semester	III	Max. Marks	100			
Year	II	Credits	3			
Core Course						
Course Title	DIGITAL DESIGN			L	T	P
				3	0	0
COURSE OBJECTIVES:						
The main aim of this course is to prepare the students for:						
<ul style="list-style-type: none"> • To teach various number systems, binary codes and their applications • To familiarize the students the importance of error detection and error correction codes. • To inculcate concepts of K-MAP to simplify a Boolean expression • To facilitate students in designing a logic circuit 						
UNIT	TOPICS				HOURS	
I	Number Representations: Binary numbers: binary, octal, and hexadecimal number systems; conversion between different number systems; signed and unsigned numbers; representation of negative numbers using 1's complement and 2's complement. Integer representation: fixed-point number representation; range and precision of fixed-point numbers; overflow and underflow conditions. Floating-point representation, Arithmetic operations in binary: binary addition, subtraction, multiplication, and division; overflow detection and handling.				7	
II	Combinatorial Circuits: Boolean Algebra: fundamental theorems and postulates; simplification of Boolean expressions using algebraic techniques. Logic Gates: basic gates (AND, OR, NOT), universal gates (NAND, NOR), XOR and XNOR gates. Minimization of Boolean functions: simplification using Boolean identities; Karnaugh map (K-map) technique for 2, 3, 4, and 5 variables; don't care conditions in K-maps. Combinational Circuits: design and analysis of arithmetic circuits (adders, subtractors); code converters (Binary to Gray, Gray to Binary, BCD to Binary, etc.); multiplexers, demultiplexers, encoders, decoders.				12	
III	Sequential Circuits: Introduction to sequential circuits: difference between combinational and sequential circuits; clock signals and timing diagrams. Latches and Flip-Flops: SR Latch, D Latch, JK Flip-Flop, D Flip-Flop, T Flip-Flop; timing constraints: setup time, hold time, propagation delay. Counters: asynchronous (ripple) counters and synchronous counters; modulus of counters; design of up-down counters, ring counters, Johnson counters. Shift Registers: serial-in serial-out (SISO) registers, serial-in parallel-out (SIPO) registers, parallel-in serial-out (PISO) registers; applications of shift registers.				12	
IV	Data Converters: purpose of sample and hold circuits in digital signal processing; working principle and block diagram. Analog to Digital Converters (ADCs): working principle of ADCs and Digital to Analog Converters (DACs): working principle of DACs				7	
V	Memory and Programmable Logic: Introduction to memory: classification of memory: volatile vs non-volatile, primary vs secondary; characteristics of memory: access time, memory cycle time, and bandwidth. Random Access Memory (RAM): types of RAM: Static				7	

	RAM (SRAM) and Dynamic RAM (DRAM); memory cell architecture and organization. Memory decoding: address decoding techniques for RAM; row and column address selection. Read Only Memory (ROM): types of ROM: PROM, EPROM, EEPROM, Programmable Logic Array (PLA) architecture; Programmable Array Logic (PAL) structure	
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COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1 :Understand various number systems and their arithmetic operations.

CO2 :Design and analyze combinatorial circuits using Boolean algebra, K-maps, and logicgates.

CO3 :Work with sequential circuits like latches, flip-flops, counters, and shift registers.

CO4 :Interface and design systems using data converters like ADCs and DACs.

CO5 :Explore different types of memory and programmable logic devices and apply them indigital systems.

Text Book

1. "Digital Design" by M. Morris Mano, Michael D. Ciletti, 2013.
2. Digital Systems: Principles and Applications" by Ronald J. Tocci, Neal S. Widmer, Gregory L. Moss,2004.
3. "Microelectronics: Digital and Analog Circuits and Systems" by Jacob Millman and Arvin Grabel,1987.

Reference Books

1. Roth (2004), Fundamentals of Logic Design, 5th Edition, Thomson, India, 2018.
2. S. Palnitkar, Verilog HDL: A Guide to Digital Design and Synthesis, Pearson, 2nd Ed, 2003.
3. F. Vahid, Digital Design, 1st Ed., Wiley India, 2011.

Mapping of Course Outcomes (CO's) with PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	0	1	0	0	0	0	0	0	2	2	1	1
CO2	3	3	3	2	3	2	1	0	1	2	1	2	3	2	1
CO3	3	3	3	2	2	2	2	1	1	2	0	0	2	0	2
CO4	3	2	3	2	3	2	2	1	0	0	1	1	2	2	2
CO5	3	3	3	2	3	2	2	2	1	1	2	2	3	0	2

3 – High, 2 – Average, 1 – Low , 0-Null

Programme	B.Tech ECE (AI&ML)	Programme Code	BTEM			
Course Code	25BTEM 134	Number of Hours/Week	3			
Semester	III	Max. Marks	100			
Year	II	Credits	3			
Core Course						
Course Title	ELECTRONIC DEVICES AND CIRCUITS			L	T	P
				3	0	0
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students for:						
<ul style="list-style-type: none"> • To Comprehensive understanding of fundamental data structures and algorithms. • To equip algorithms with the skills to analyze and implement various computational techniques. • Learn to select appropriate data structures for solving complex problems, optimize algorithm performance, and gain insight into advanced topics such as dynamic programming and NP- completeness. 						
UNIT	TOPICS				HOURS	
I	P-N Junction diode: Qualitative Theory of P-N Junction, P-N Junction as a diode , diode equation , voltamper characteristics temperature dependence of V-I characteristic , ideal versus practical –resistance levels(static and dynamic), transition and diffusion capacitances, diode equivalent circuits, load line analysis ,breakdown mechanisms in semiconductor diodes , zener diode characteristics. Special purpose electronic devices: Principal of operation and Characteristics of Tunnel Diode with the help of energy band diagrams, Varactor Diode, SCR and photo diode				8	
II	RECTIFIERS, FILTERS: P-N Junction as a rectifier ,Half wave rectifier, , full wave rectifier, Bridge rectifier , Harmonic components in a rectifier circuit, Inductor filter, Capacitor filter, L- section filter, II- section filter and comparison of various filter circuits, Voltage regulation using zener diode.				8	
III	BIPOLAR JUNCTION TRANSISTOR: The Junction transistor, Transistor current components, Transistor as an amplifier, Transistor construction, Input and Output characteristics of transistor in Common Base, Common Emitter, and Common collector configurations. α and β Parameters and the relation between them, BJT Specifications. BJT Hybrid Model, h-parameter representation of a transistor, Analysis of single stage transistor amplifier using h-parameters: voltage gain, current gain, Input impedance and Output impedance. Comparison of transistor configurations in terms of A_i , R_i , A_v , and R_o				8	

IV	TRANSISTOR BIASING AND STABILISATION: Operating point , the D.C and A.C Load lines, Need for biasing , criteria for fixing, operating point, B.J.T biasing, Fixed bias, Collector to base bias ,Self bias techniques for stabilization, Stabilization factors, (s, sI , sII), Bias Compensation using diode and transistor , (Compensation against variation in VBE, ICO,) Thermal run away, Condition for Thermal stability.	8
V	FIELD EFFECT TRANSISTOR AND FET AMPLIFIER JFET (Construction, principal of Operation and Volt –Ampere characteristics). Pinch- off voltage-Small signal model of JFET. FET as Voltage variable resistor, Comparison of BJT and FET. MOSFET (Construction, principal of Operation and symbol), MOSFET characteristics in Enhancement and Depletion modes. FET Amplifiers: FET Common source Amplifier, Common Drain Amplifier, Generalized FET Amplifier, FET biasing.	8

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

1. Understand and Analyse the different types of diodes, operation and its characteristics
2. Design and analyse the DC bias circuitry of BJT and FET
3. Design biasing circuits using diodes and transistors.
4. To analyze and design diode application circuits, amplifier circuits and oscillators employing BJT, FET devices.
5. Evaluate and troubleshoot electronic circuits involving diodes, BJTs, and FETs to ensure optimal performance in practical applications.

TEXT BOOKS:

1. Integrated Electronics Analog Digital Circuits, Jacob Millman and D. Halkias, McGraw Hill.
2. Electronic Devices and Circuits Theory, Boylestad, Prentice Hall Publications.
3. Electronic Devices and Circuits, S.Salivahanan,N.Suresh kumar, McGraw Hill.
4. Electronic Devices and Circuits,Balbir kumar ,shail b.jain, PHI Privated Limted, Delhi.

REFERENCE BOOKS:

1. Electronic Devices and Circuits,K.Lal Kishore B.S Publications
2. Electronic Devices and Circuits, G.S.N. Raju, I.K. International Publications, New Delhi, 2006.
3. Electronic Devices and Circuits,A.P Godse, U.A Bakshi , Technical Publications
4. Electronic Devices and Circuits K.S. Srinivasan Anurdha Agencies

Mapping of Course Outcomes (CO's) with PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	0	2	3	1	0	2	1	1	0	2	2	2	0
CO2	3	3	2	2	3	1	0	2	1	2	1	2	2	3	3
CO3	3	3	3	3	2	1	1	2	2	1	1	3	2	3	3
CO4	2	3	3	3	3	2	2	3	2	2	2	3	3	3	3
CO5	2	3	3	3	3	2	2	3	2	2	2	3	3	3	3

3 – High, 2 – Average, 1 – Low , 0-Null

Programme	B.Tech ECE (AI & ML)	Programme Code		BTEM		
Course Code	25BTEM135	Number of Hours/Week		3		
Semester	III	Max. Marks		100		
Year	II	Credits		3		
Core Course						
Course Title	OBJECT ORIENTED PROGRAMMING WITH JAVA			L	T	P
				3	0	0
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students for:						
<ul style="list-style-type: none"> • To introduce the fundamentals of Java programming language. • To enable students to write object-oriented programs. • To familiarize students with advanced Java concepts like multithreading, exception handling, and collections. • To provide hands-on experience in developing real-world applications using Java. 						
UNIT	TOPICS					HOURS
I	Basics of Java Programming Introduction to Java: Features, JVM, JDK, and JRE. -Writing, compiling, and executing Java programs. -Data types, variables, and operators. -Control structures: Decision-making, loops. -Arrays and Strings: Declaration, initialization, and operations.					9
II	Object-Oriented Programming in Java Classes and Objects: Declaration, instantiation, and initialization. -Methods: Static, instance, and parameterized methods -Constructors and destructors.-Inheritance: Single, multilevel, hierarchical, and overriding. Polymorphism: Compile-time and runtime, Encapsulation and abstraction. Interfaces and abstract classes.					9
III	Exception Handling and Multithreading Exception handling: Try-catch block, multiple catch, finally, throw, and throws. Built-in exceptions and user-defined exceptions. Multithreading: Thread lifecycle, creating threads -Thread class, Runnable interface. Thread synchronization and inter-thread communication.					9
IV	File I/O and Streams Reading and writing files using FileReader, FileWriter, BufferedReader, and BufferedWriter. Byte and character streams. Serialization and deserialization.					9
V	GUI Programming and Event Handling Introduction to AWT and Swing-Layout managers -FlowLayout, GridLayout, BorderLayout.Event handling: ActionListener, MouseListener, KeyListener. Creating simple GUI applications.					9

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1:	Understand and apply Java syntax and semantics.
CO2:	Implement object-oriented programming concepts in Java.
CO3:	Develop Java applications with exception handling and multithreading.
CO4:	Use Java frameworks and APIs for GUI and database integration.
CO5:	Solve real-world problems using Java programming.

Text Books:

1. "Programming in Java" by K. Somasundaram, by **PHI Learning Pvt. Ltd.**
2. "Java: The Complete Reference" by Herbert Schildt

Reference Books:

1. "Thinking in Java" by Bruce Eckel
2. "Effective Java" by Joshua Bloch
3. "Java Programming for Beginners" by Mark Lassoff

Mapping of Course Outcomes (CO's) with PO's & PSO's

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	3	-	-	2	-	-	-	-	3	2	-
CO2	3	3	3	2	3	-	-	2	-	-	-	-	3	3	2
CO3	3	3	3	3	3	2	-	2	1	-	-	-	3	3	2
CO4	3	3	3	3	3	-	-	3	-	-	-	-	3	3	3
CO5	3	3	3	3	3	2	-	2	-	-	-	-	3	3	3

3 – high, 2 – Average, 1 - Low , 0-Null

Programme	B.Tech ECE (AI&ML)	Programme Code	BTEM			
Course Code	25BTEM136	Number of Hours/Week	2			
Semester	III	Max. Marks	100			
Year	II	Credits	2			
Core Course						
Course Title	PROFESSIONAL ETHICS			L	T	P
				2	0	0
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
<p>COURSE OBJECTIVES: The main learning objective of this course is to prepare the students to</p> <ul style="list-style-type: none"> • To identify and understand key concepts of human values, including ethics, integrity, and professional responsibility. • To explore moral theories and frameworks related to engineering ethics, and analyze how these impact decision-making. • To evaluate the role of engineers in society through the lens of social experimentation, responsibility, and professional codes of conduct. • To assess safety and risk management principles, rights and responsibilities, including intellectual property and occupational ethics. 						
UNIT	TOPICS				HOURS	
I	Human Values Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self-confidence – Character - Spirituality – Introduction to Yoga and meditation for professional excellence and stress management.				8	
II	Engineering Ethics Senses of Engineering Ethics – Variety of moral issues – Types of inquiry– Moral dilemmas – Moral Autonomy – Kohlberg’s theory – Gilligan’s theory – Consensus and Controversy – Models of professional roles - Theories about right action – Self-interest, Customs and Religion – Uses of Ethical Theories.				8	
III	Engineering as Social Experimentation Engineering as Experimentation – Engineers as responsible Experimenters– Codes of Ethics – A Balanced Outlook on Law.				8	
IV	Safety, Responsibilities and Rights Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk - Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination.				8	

V	Global issues Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership – Code of Conduct – Corporate Social Responsibility	8
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COURSE OUTCOMES:

On successful completion of this course, the student will be able to

- CO1:** Recognize the significance of human values and ethics in personal and professional life.
- CO2:** Analyze various moral theories and ethical dilemmas in engineering practices.
- CO3:** Evaluate the responsibilities of engineers as experimenters and decision-makers within legal and ethical frameworks.
- CO4:** Assess risk and safety issues, including intellectual property and employee rights in engineering contexts.
- CO5:** Apply ethical theories and frameworks to make informed engineering decisions.

Text Books:

- Naagarazan, R.S. A Textbook on Professional Ethics and Human Values, New Age International Limited Publishers: New Delhi, 2006.

Reference Books:

- Charles B. Fleddermann, –Engineering Ethics, Pearson Prentice Hall, New Jersey, 2004.
- Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, –Engineering Ethics – Concepts and Cases, Cengage Learning, 2009.

Mapping of Course Outcomes (CO's) with PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	0	0	0	0	0	2	0	0	2	2	0	0	1	0	0
CO2	0	0	0	0	0	0	0	0	0	3	0	0	2	0	0
CO3	0	0	0	0	0	0	0	0	0	3	0	0	2	0	0
CO4	0	0	0	0	0	0	0	0	0	3	0	0	2	0	0
CO5	0	0	0	0	0	0	2	0	0	3	0	0	1	0	0

3 – High, 2 – Average, 1 – Low, 0-Null

Pogramme	B.Tech ECE (AI&ML)	Programme Code	BTEM			
Course Code	25BTEM231	Number of Hours/Week	2			
Semester	III	Max. Marks	100			
Year	II	Credits	1			
Core Course						
Course Title	DIGITAL DESIGN LAB			L	T	P
				0	0	2
Digital design lab list of experiments						
<ol style="list-style-type: none"> 1. Verification and interpretation of truth table for AND, OR, NOT, NAND, NOR, Ex-OR, Ex-NOR gates 2. Construction of half and full adder using XOR and NAND gates and verification of its operation 3. To Study and Verify Half and Full Subtractor 4. Realization of logic functions with the help of Universal Gates (NAND, NOR) 5. Construction of a NOR gate latch and verification of its operation 6. Verify the truth table of RS, JK, T and D flip-flops using NAND and NOR gates 7. Design and Verify the 4-Bit Serial In - Parallel Out Shift Registers 8. Implementation and verification of decoder or de-multiplexer and encoder using logicgates 9. Implementation of 4x1 multiplexer and 1x4 demultiplexer using logic gates 10. Design and verify the 4- Bit Synchronous or Asynchronous Counter using JK Flip Flop 11. Verify Binary to Gray and Gray to Binary conversion using NAND gates only 12. Verify the truth table of one bit and two bit comparator using logic gates 						

Mapping of Course Outcomes (CO's) with PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	0	1	0	0	0	0	0	0	2	2	1	1
CO2	3	3	3	2	3	2	1	0	1	2	1	2	3	2	1
CO3	3	3	3	2	2	2	2	1	1	2	0	0	2	0	2
CO4	3	2	3	2	3	2	2	1	0	0	1	1	2	2	2
CO5	3	3	3	2	3	2	2	2	1	1	2	2	3	0	2

3 – High, 2 – Average, 1 – Low , 0-Null

Programme	B.Tech EC(AI&ML)	Programme Code	BTEM			
Course Code	25BTEM232	Number of Hours/Week	2			
Semester	III	Max. Marks	100			
Year	II	Credits	1			
Core Course						
Course Title	ELECTRONICS CIRCUITS AND DESIGN LAB			L	T	P
			0	0	2	
L-Lecture Hours	T-Tutorial Hours	P-Practical Hours				
COURSE OBJECTIVES:						
<ul style="list-style-type: none"> • Provide hands-on experience in studying the characteristics of semiconductor devices such as diodes, BJTs, FETs, SCR, and UJT. • Enable students to understand and analyze the operation of rectifiers, voltage regulators, and transistor biasing circuits. • Develop practical skills in using electronic instruments like CRO for measurement and analysis. • Train students to design and implement basic electronic circuits such as amplifiers and rectifiers. • Enhance troubleshooting skills and experimental analysis in electronic circuits. 						
<ol style="list-style-type: none"> 1. P-N Junction Diode Characteristics 2. Zener Diode Characteristics 3. V-I Characteristics 4. Zener Diode as Voltage Regulator 5. Rectifiers (without and with c-filter) 6. Half-wave Rectifier 7. Full-wave Rectifier 8. BJT Characteristics (CE Configuration) <ol style="list-style-type: none"> a. PartA: Input Characteristics b. Part B: Output Characteristics 9. FET Characteristics (CS Configuration) <ol style="list-style-type: none"> a. Part A: Drain Characteristics b. Part B: Transfer Characteristics 10. SCR Characteristics 11. UJT Characteristics 12. Transistor Biasing 13. CRO Operation and its Measurements 14. BJT-CE Amplifier 15. Emitter Follower-CC Amplifier 						

Course Outcomes:

By learning Data Structures and Algorithms, students will be able to

- Understand and analyze the V-I characteristics of semiconductor devices such as P-N junction diodes, Zener diodes, BJT, FET, SCR, and UJT.
- Design and implement rectifier circuits (half-wave and full-wave) with and without filters, and analyze their performance.
- Apply concepts of biasing to design and analyze transistor biasing circuits for stable operation.
- Use CRO effectively to measure voltage, frequency, phase, and waveform parameters in electronic circuits.
- Design and evaluate amplifier circuits such as CE and CC (emitter follower) configurations.
- Troubleshoot and interpret experimental results to ensure proper functioning of electronic circuits.

Mapping of Course Outcomes (CO's) with PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	0	2	3	1	0	2	1	1	0	2	2	2	0
CO2	3	3	2	2	3	1	0	2	1	2	1	2	2	3	3
CO3	3	3	3	3	2	1	1	2	2	1	1	3	2	3	3
CO4	2	3	3	3	3	2	2	3	2	2	2	3	3	3	3
CO5	2	3	3	3	3	2	2	3	2	2	2	3	3	3	3

3 – High, 2 – Average, 1 – Low , 0-Null

Programme	B.Tech ECE (AI & ML)	Programme Code	BTEM			
Course Code	25BTEM233	Number of Hours/Week	2			
Semester	III	Max. Marks	100			
Year	II	Credits	1			
Core Course						
Course Title	OBJECT ORIENTED PROGRAMMING WITH JAVA LAB			L	T	P
			0	0	2	
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students for:						
<ul style="list-style-type: none"> • To introduce the fundamentals of Java programming language. • To enable students to write object-oriented programs. • To familiarize students with advanced Java concepts like multithreading, exception handling, and collections. • To provide hands-on experience in developing real-world applications using Java. 						
PROGRAMS						
<ol style="list-style-type: none"> 1. Write a Java program to calculate the factorial of a number using loops. 2. Implement a program to demonstrate the use of arrays and string operations (reverse, concatenate, length). 3. Create a program to find the largest and smallest numbers in an array. 4. Create a class Student with properties name, roll Number, and marks. Write methods to calculate and display the grade. 5. Demonstrate single and multilevel inheritance using classes for Shape, Rectangle, and Square. 6. Implement polymorphism using method overloading and method overriding. 7. Write a program to handle Array Index Out Of Bounds Exception and Number Format Exception. 8. Create a multithreaded program to calculate the sum of odd and even numbers in an array using two threads. 9. Demonstrate thread synchronization by simulating a producer-consumer problem. 10. Write a program to copy the contents of one text file to another using File Reader and File Writer. 11. Implement a program to serialize and deserialize an object of a class Employee. 12. Create a program to count the number of words and characters in a text file. 13. Create a simple calculator using AWT/Swing with basic arithmetic operations. 14. Develop a GUI application to accept student details and display them in a table format. 15. Create a Java Swing application to simulate a login screen with username and password validation. 						

Course Outcomes:

By learning **Object Oriented Programming with Java**, students will be able to:

- CO1:** Apply object-oriented principles such as encapsulation, inheritance, abstraction, and polymorphism to develop Java programs.
- CO2:** Design and implement Java applications using control structures, arrays, strings, and methods to solve real-world computational problems.
- CO3:** Develop robust and reusable software components using exception handling, packages, and multithreading concepts.
- CO4:** Apply file handling and serialization techniques in Java to store, retrieve, and manage persistent data effectively.
- CO5:** Design and develop GUI-based Java applications using AWT/Swing for user interaction and event-driven programming.

Mapping of Course Outcomes (CO's) with PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	0	2	3	1	0	2	1	1	0	2	2	2	0
CO2	3	3	2	2	3	1	0	2	1	2	1	2	2	3	3
CO3	3	3	3	3	2	1	1	2	2	1	1	3	2	3	3
CO4	2	3	3	3	3	2	2	3	2	2	2	3	3	3	3
CO5	2	3	3	3	3	2	2	3	2	2	2	3	3	3	3

3 – High, 2 – Average, 1 – Low , 0-Null

Semester IV

Programme	B.Tech ECE (AI & ML)	Programme Code	BTEM			
Course Code	25BTEM141	Number of Hours/Week	3			
Semester	IV	Max. Marks	100			
Year	III	Credits	3			
Core course						
Course Title	ANALOG CIRCUITS			L	T	P
			3	0	0	
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students:						
1. Understand the principles of transistor biasing and stabilization techniques for reliable amplifier operation.						
2. Analyze small-signal BJT amplifiers using h-parameter and hybrid- π models to determine gain and impedance characteristics.						
3. Study the frequency response and multistage amplifiers, including distortion and coupling methods.						
4. Analyze FET biasing and amplifier configurations and compare their performance with BJT amplifiers.						
5. Understand the concept of feedback and oscillators and analyze different feedback amplifiers and sinusoidal oscillator circuits.						
•						
UNIT	TOPICS				HOURS	
I	Wave shaping circuits: First order RC differentiating and integrating circuits, First order RC low pass and high pass filters. Diode Clipping circuits - Positive, negative and biased clipper. Diode Clamping circuits - Positive, negative and biased clamper. Transistor biasing: Need, operating point, concept of DC load line, fixed bias, self-bias, voltage divider bias, bias stabilization.				9	
II	BJT Amplifiers- RC coupled amplifier (CE configuration) – need of various components and design, Concept of AC load lines, voltage gain and frequency response. Small signal analysis of CE configuration using small signal hybrid- π model for mid frequency and low frequency. (gain, input and output impedance). High frequency equivalent circuits of BJT, Miller effect, Analysis of high frequency response of CE amplifier.				8	
III	MOSFET amplifiers: MOSFET circuits at DC, MOSFET as an amplifier, Biasing of discrete MOSFET amplifier, small signal equivalent circuit. Small signal voltage and current gain, input and output impedance of CS configuration. CS stage with current source load, CS stage with diode-connected load. Multistage amplifiers - effect of cascading on gain and bandwidth. Cascade amplifier.				9	
IV	FEEDBACK AMPLIFIERS: Effect of positive and negative feedback on gain, frequency response and distortion. The four basic feedback topologies, Analysis of discrete BJT circuits in voltage-series and voltage-shunt feedback topologies - voltage gain, input and output impedance.				10	

V	OSCILLATORS: Classification, criterion for oscillation, Wien bridge oscillator, Hartley and Crystal oscillator. (working principle and design equations of the circuits; analysis of Wien bridge oscillator only required).	9
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COURSE OUTCOMES:

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

CO1	Analyze BJT biasing techniques and determine the operating point for stable amplifier operation.
CO2	Analyse basic amplifiers using BJT and MOSFET
CO3	Explain and analyze the frequency response and performance of multistage BJT amplifiers and coupling schemes..
CO4	Analyze FET biasing and amplifier configurations and compare their performance with BJT amplifiers.
CO5	Apply the principles of feedback and oscillator circuits to analyze amplifier stability and sinusoidal signal generation.

Text book:

1. Robert Boylestad and L Nashelsky, “Electronic Devices and Circuit Theory”, 11/e Pearson, 2015.
2. Sedra A. S. and K. C. Smith, “Microelectronic Circuits”, 6/e, Oxford University Press, 2013.

References:

1. David A. Bell – Electronic Devices and Circuits, 5th Edition, Oxford.
2. Adel S. Sedra, Kenneth C. Smith- Microelectronic Circuits Theory and Applications, Oxford.
3. Chinmoy Saha, Arindam Halder, Debaati Ganguly -Basic Electronics-Principles and Applications
4. Neamen D., “Electronic Circuits, Analysis and Design”, 3/e, TMH, 2007.

Mapping of Course Outcomes (CO’s) with PO’s & PSO’s

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	2	1	0	0	0	0	0	0	2	3	2	1
CO2	3	3	2	3	2	0	0	0	0	0	0	2	3	3	2
CO3	3	2	2	3	2	0	0	0	0	0	0	2	3	2	2
CO4	2	3	2	3	3	0	0	0	0	0	0	2	3	3	2
CO5	3	3	3	3	2	0	0	0	0	0	0	3	3	3	2

3 – High, 2 – Average, 1 – Low , 0-Null

Programme	B.Tech ECE (AI & ML)	Programme Code	BTEM			
Course Code	25BTEM142	Number of Hours/Week	3			
Semester	IV	Max. Marks	100			
Year	II	Credits	3			
Core course						
Course Title	CONTROL SYSTEM			L	T	P
				3	0	0
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students:						
<ul style="list-style-type: none"> • Understand the fundamental concepts, components, and classification of control systems. • Develop mathematical models of electrical and mechanical systems and obtain their transfer function representations. • Analyse time-domain and frequency-domain responses of control systems and evaluate system performance. • Assess system stability using classical stability criteria and graphical techniques. • Apply state-space methods to analyse controllability and observability of linear dynamic systems. 						
UNIT	TOPICS				HOURS	
I	Introduction: Basic Components of a Control System, Open-Loop Control Systems and Closed-Loop Control Systems, Examples of control system. Feedback and its effects: Types of Feedback Control Systems, Linear versus Nonlinear Control Systems, Time-Invariant versus Time-Varying Systems. Mathematical modelling of control systems: Electrical Systems and Mechanical systems. Transfer Function from Block Diagrams and Signal Flow Graphs: Impulse response and its relation with transfer function of linear systems. Block diagram representation and reduction methods, Signal flow graph and Mason's gain formula.				10	
II	Time Domain Analysis of Control Systems: Introduction-Standard Test signals, Time response specifications. Time response of first and second order systems to unit step input and ramp inputs, time domain specifications. Frequency domain analysis: Frequency domain specifications, correlation between time and frequency responses.				9	
III	Stability of linear control systems: Concept of BIBO stability, absolute stability, Routh Hurwitz Criterion, Effect of P, PI & PID controllers. Root Locus Techniques: Introduction, properties and its				9	

	construction, Application to system stability studies. Illustration of the effect of addition of a zero and a pole.	
IV	Nyquist stability criterion: Fundamentals and analysis Relative stability: gain margin and phase margin. Stability analysis with Bode plot. Design of Compensators: Need of compensators, design of lag and lead compensators using Bode plots.	9
V	State Variable Analysis of Linear Dynamic Systems: State variables, state equations, state variable representation of electrical and mechanical systems, dynamic equations, merits for higher order differential equations and solution. Transfer function from State Variable Representation, Solutions of the state equations, state transition matrix Concept of controllability and observability and techniques to test them - Kalman's Test.	13

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1	Analyze electromechanical systems by mathematical modelling and derive their transfer functions
CO2	Determine Transient and Steady State behaviour of systems using standard test signals
CO3	Determine absolute stability and relative stability of a system
CO4	Apply frequency domain techniques to assess the system performance and to design a control system with suitable compensation techniques
CO5	Analyze system Controllability and Observability using state space representation

Text Book:

1. Farid Golnaraghi, Benjamin C. Kuo, Automatic Control Systems, 9/e, Wiley India.
2. I.J. Nagarath, M.Gopal: Control Systems Engineering (5th-Edition) --New Age International Pub. Co., 2007.
3. Ogata K., Discrete-time Control Systems, 2/e, Pearson Education.

Reference Books

1. I.J. Nagarath, M.Gopal: Scilab Text Companion for Control Systems Engineering (3rd-Edition) --New Age International Pub. Co., 2007.
2. Norman S. Nise, Control System Engineering, 5/e, Wiley India.
3. Ogata K., Modern Control Engineering, Prentice Hall of India, 4/e, Pearson Education, 2002.

Mapping of Course Outcomes (CO's) with PO's & PSO's

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	0	1	1	1	1	0	2	3	2	2
CO2	3	3	2	2	3	0	1	1	1	1	0	2	2	2	3
CO3	3	3	2	3	3	0	1	1	1	1	0	2	2	2	3
CO4	3	3	3	3	3	0	1	1	1	1	0	2	3	3	3
CO5	3	3	2	3	3	0	1	1	1	1	0	2	3	3	3

3 - high, 2 - Average, 1 - Low , 0-Null

Programme	B.Tech ECE (AI & ML)	Programme Code	BTEM			
Course Code	25BTEM143	Number of Hours/Week	3			
Semester	IV	Max. Marks	100			
Year	II	Credits	3			
Core course						
Course Title	Microprocessor and Microcontroller			L	T	P
				3	0	0
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students:						
<ul style="list-style-type: none"> • To understand the evolution, architecture, and functional blocks of microprocessors and microcontrollers, with emphasis on 8086 and 8051. • To analyse the addressing modes, instruction sets, and programming model of the 8086 microprocessors. • To develop assembly language programs for the 8086 using various instructions, addressing modes, stack, and interrupts. • To understand and demonstrate the interrupt mechanism, interrupt handling, and interfacing techniques of memory and peripheral devices with microprocessors. • To acquire knowledge of peripheral interfacing ICs and develop basic low-level programs for microcontroller-based systems. 						
UNIT	TOPICS				HOURS	
I	Evolution of Microprocessor 8085 microprocessor (-Basic Architecture only). 8086 microprocessor – Architecture and signals, Physical Memory organization, Minimum and maximum mode of 8086 system and timings. Comparison of 8086 and 8088. Machine language Instruction format.				9	
II	Addressing modes and Instructions Addressing Modes of 8086. Instruction set – data copy /transfer instructions, arithmetic instructions, logical instructions, string manipulation instructions, branch instructions, unconditional and conditional branch instruction, flag manipulation and processor control instructions. Assembler Directives and operators. Assembly Language Programming with 8086.				9	
III	Stack and Interrupts Stack structure of 8086, programming using stack- Interrupts - Types of Interrupts and Interrupt Service Routine- Handling Interrupts in 8086- Interrupt programming. - Programmable Interrupt Controller - 8259, Architecture (Just mention the control word, no need to memorize the control word)- Interfacing Memory with 8086.				9	

IV	Interfacing Chips Programmable Peripheral Input/output port 8255 - Architecture and modes of operation Programmable interval timer 8254-Architecture and modes of operation- DMA controller 8257 Architecture (Just mention the control word, no need to memorize the control word of 8254 and 8257)	7
V	Microcontroller 8051 Architecture- Register Organization- Memory and I/O addressing- Interrupts and Stack- 8051 Addressing Modes- Instruction Set- data transfer instructions, arithmetic instructions, logical instructions, Boolean instructions, control transfer instructions-Simple programs.	11

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1	Illustrate the architecture, modes of operation and addressing modes of microprocessors (Cognitive knowledge: Understand)
CO2	Develop 8086 assembly language programs. (Cognitive Knowledge Level: Apply)
CO3	Demonstrate interrupts, its handling and programming in 8086. (Cognitive Knowledge Level: Apply)
CO4	Illustrate how different peripherals (8255,8254,8257) and memory are interfaced with microprocessors. (Cognitive Knowledge Level: Understand)
CO5	Outline features of microcontrollers and develop low level programs. (Cognitive Knowledge Level: Understand)

Text Books:

1. Bhurchandi and Ray, Advanced Microprocessors and Peripherals, Third Edition McGraw Hill.
2. Raj Kamal, Microcontrollers: Architecture, Programming, Interfacing and System Design, Pearson Education.
3. Ramesh Gaonkar, Microprocessor Architecture, Programming, and Applications with the 8085, Penram International Publishing Pvt. Ltd.

Reference Books:

1. Barry B. Brey, The Intel Microprocessors – Architecture, Programming and Interfacing, Eighth Edition, Pearson Education.
2. A. NagoorKani, Microprocessors and Microcontrollers, Second Edition, Tata McGraw Hill
3. Douglas V. Hall, SSSP Rao, Microprocessors and Interfacing, Third Edition, McGrawHill Education.

Mapping of Course Outcomes (CO's) with PO's & PSO's

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	0	0	1	0	0	0	0	0	0	1	2	1	0
CO2	2	3	2	1	3	0	0	0	0	0	0	1	2	1	2
CO3	2	3	3	2	2	0	0	0	0	0	0	2	1	1	2
CO4	3	2	3	3	2	0	0	0	0	0	0	2	2	1	2
CO5	2	2	2	1	2	0	0	0	0	0	0	2	2	2	2

high, 2 – Average, 1 - Low , 0-Null

Programme	B.Tech ECE (AI&ML)	Programme Code	BTEM			
Course Code	25BTEM341	Number of Hours/Week	3			
Semester	IV (PSE I)	Max. Marks	100			
Year	II	Credits	3			
Program Specific Elective						
Course Title	DATABASE MANAGEMENT SYSTEMS			L	T	P
			3	0	0	
L-Lecture Hours	T-Tutorial Hours	P-Practical Hours				
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students for:						
<ul style="list-style-type: none"> ● To learn data models, conceptualize and depict a database system using ER diagram ● To understand the internal storage structures in a physical DB design ● To know the fundamental concepts of transaction processing techniques ● To understand the concept of Database Design in Normalization techniques ● To know the manipulation of SQL Queries 						
UNIT	TOPICS				HOURS	
I	Unit I Data base System Applications, Purpose of Database Systems, View of Data, Data Abstraction, Instances and Schemas, data Models , the ER Model , Relational Model , Other Models , Database Languages , DDL , DML , database Access for applications Programs, data base Users and Administrator , Transaction Management , data base Architecture, Storage Manager , the Query Processor Data base design and ER diagrams , ER Model, Entities, Attributes and Entity sets , Relationships and Relationshipsets , ER Design Issues, Concept Design , Conceptual Design for University Enterprise. Introduction to the Relational Model, Structure, Database Schema, Keys, Schema Diagrams.				8	
II	Unit II Relational Query Languages, Relational Operations. Relational Algebra, Selection and projection set operations, renaming, Joins , Division , Examples of Algebra overviews , Relational calculus, Tuple relational Calculus, Domain relational calculus. Overview of the SQL Query Language, Basic Structure of SQL Queries, Set Operations, Aggregate Functions , GROUPLY , HAVING, Nested Sub queries, Views, Triggers.				8	
III	Unit III Normalization, Introduction, Non loss decomposition and functional dependencies, First, Second, and third normal forms, dependency preservation, Boyee/Codd normal form. Higher Normal Forms , Introduction, Multi, valued dependencies and fourth normal form, Join dependencies and Fifth normal form				8	

IV	Unit IV Transaction State, Implementation of Atomicity and Durability, Concurrent, Executions, Serializability, Recoverability, Implementation of Isolation, Testing for serializability, Lock , Based Protocols, Timestamp Based Protocols, Validation, Based Protocols , Multiple Granularity. Recovery and Atomicity, Log Based Recovery , Recovery with Concurrent Transactions, Buffer Management, Failure with loss of nonvolatile storage, Advance Recovery systems, Remote Backup systems.	8
V	Unit V File organization, various kinds of indexes. Query Processing, Measures of query cost, Selection operation, Projection operation, Join operation, set operation and aggregate operation, Relational Query Optimization, Transacting SQL queries, Estimating the cost, Equivalence Rules.	8

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

- CO1:** Install, configure, and interact with a relational database management system
- CO2:** Master the basics of SQL and construct queries using SQL
- CO3:** Design and develop a large database with optimal query processing
- CO4:** Develop efficient storage scheme of saving and retrieving Records and Files
- CO5:** Design the database with normalization techniques

Text Books

1. “Data base System Concepts”, Silberschatz, Korth, McGraw hill, Sixth Edition, 2010
2. “Data base Management Systems” , Raghurama Krishnan, Johannes Gehrke, TATA McGrawHill Third Edition, 2003

Reference Books

1. “Fundamentals of Database Systems”, Elmasri Navathe Pearson Education, 2015
2. “An Introduction to Database systems”, C.J. Date, A.Kannan, S.Swami Nadhan, Pearson, Eight Edition, 2019.

Mapping of Course Outcomes (CO's) with PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	0	2	2	0	0	0	0	0	0	0	0	0	0	2
CO2	2	2	0	0	0	0	0	0	0	0	0	0	1	1	3
CO3	2	0	3	3	2	3	0	1	2	0	2	1	0	0	3
CO4	2	2	2	2	2	3	0	1	2	0	2	1	2	0	1
CO5	0	0	0	2	1	1	1	1	1	1	2	1	1	0	2

3 – High, 2 – Average, 1 – Low , 0-Null

Programme	B.Tech ECE (AI&ML)	Programme Code	BTEM			
Course Code	25BTEM342	Number of Hours/Week	3			
Semester	IV (PSE I)	Max. Marks	100			
Year	II	Credits	3			
Program Specific Elective						
Course Title	ARTIFICIAL INTELLIGENCE			L	T	P
			3	0	0	
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students for:						
<ul style="list-style-type: none"> • To explore history and revolution of artificial intelligence • To formulate artificial intelligence problem by defining intelligent agent and its environment • To learn problem solving approaches through state space search and its differential algorithms. • To develop an AI model with the help of concepts such as state space search, adversarial search, knowledge representation, inference etc. 						
UNIT	TOPICS				HOURS	
I	Introduction to AI Introducing the structure and scope of the course; Introduction and History of AI; Turing Test; Chinese Room Argument; Milestones in AI; AI Project Discussion – Problem finding, Project resources, Report writing; Intelligent agent – Sensors and Actuators; Examples of Agents; Rationality – perfect and bounded rationality;				8	
II	Intelligent agent and state space search Intelligent agent and its environment; Types of environments; Multi- agent environment; Structure of the agent – table-based agent, percept based agent, state based agent, goal based agent, utility based agent; Subsumption architecture; Learning agent; State and State space definition; State space search; Problem formulation; 8 Queens problem; 8 Puzzle problem; Problem formulation examples;				8	
III	Uninformed and Informed Searches Uninformed search – Breadth first search, Depth first search, Depth limited search, Iterative deepening search, Bidirectional search, Uniform cost search; Informed Search – Greedy best first search, A* search, Memory-bounded search; Heuristic function;				8	
IV	Local search and adversarial search Search in complex environment; Local search and optimization problems; Hill-climbing search; Simulated annealing; Local beam search; Adversarial search; Game theory – Two-player zero-sum games – max and min, utility function, state space graph, game tree, tic-tac-toe example; Minimax search; Alpha-Beta pruning;				8	
V	Constraint satisfaction and Knowledge representation Constraint satisfaction problem; satisfiability; propagating constraints; forward checking; backward checking; Knowledge representation – Logic, Propositional logic, Reasoning, Modus Ponens; First order logic; quantifiers; Mathematics behind machine learning – Linear algebra basics				8	

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

- CO1 :** Describe the history behind artificial intelligence
- CO2 :** Illustrate fundamental AI concepts
- CO3 :** Demonstrate problem formulation in state space search
- CO4 :** Infers adversarial search with alpha-beta pruning
- CO5 :** Develop an AI model for existing problems

Text Books:

1. Stuart Russell and Peter Norvig. Artificial Intelligence: A Modern Approach. Prentice Hall Press, USA, 3rd edition, 2009

Reference Books:

1. Ian J. Goodfellow, Yoshua Bengio, and Aaron Courville. Deep Learning. MIT Press, Cambridge, MA, USA, 2016.
2. Gilbert Strang. Introduction to Linear Algebra. Wellesley-Cambridge Press, USA, 5th edition, 2016.

Mapping of Course Outcomes (CO's) with PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	1	0	0	1	0	3	0	1	0	3	2	0	0
CO2	3	2	3	3	0	2	0	0	0	2	0	1	0	3	3
CO3	3	1	2	2	0	2	0	0	0	2	1	1	1	1	3
CO4	3	1	2	2	0	2	0	0	0	2	1	1	0	1	2
CO5	2	2	3	3	3	1	3	3	3	2	2	1	3	3	3

3 – High, 2 – Average, 1 – Low, 0-Null

Programme	B .Tech ECE (AI&ML)	Programme Code	BTEM			
Course Code	25BTEM343	Number of Hours/Week	3			
Semester	IV (PSE I)	Max. Marks	100			
Year	II	Credits	3			
Program Specific Elective						
Course Title	OPERATING SYSTEM			L	T	P
				3	0	0
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students for:						
<ul style="list-style-type: none"> • To explore fundamental concepts in operating system • To understand essential functions of operating system • To equip process synchronization problems in real life applications • To acquire memory and file management concepts in operating system 						
UNIT	TOPICS				HOURS	
I	Introduction to Operating System Introduction, operating system operations, process management, memory management, storage management, protection and security, distributed systems, Operating system services and systems calls, system programs, operating system structure, operating systems generations.				9	
II	Process Management and Concurrency Process concepts, process state, process control block, scheduling queues, process scheduling, multithreaded programming, threads in UNIX, comparison of UNIX and windows, Process synchronization, critical section problem, Peterson's solution, synchronization hardware, semaphores, classic problems of synchronization, readers and writers' problem, dining philosophers' problem, monitors.				9	
III	Deadlocks and Memory Management System model, deadlock characterization, deadlock prevention, detection and avoidance, recovery from deadlock banker's algorithm. Swapping, contiguous memory allocation, paging, structure of the page table, segmentation, virtual memory, demand paging, page-replacement algorithms, allocation of frames, thrashing				9	

IV	File System Concept of a file, access methods, directory structure, file system mounting, file sharing, protection. File system implementation: file system structure, file system implementation, directory implementation, allocation methods, free-space management, efficiency and performance	9
V	I/O System Mass storage structure - overview of mass storage structure, disk structure, disk attachment, disk scheduling algorithms, swap space management, stable storage implementation, tertiary storage structure. I/O: Hardware, application I/O interface, kernel I/O subsystem, transforming I/O requests to hardware operations, streams, performance.	9

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1 : Differentiate basic functionalities in operating system

CO2 : Solve process synchronization and scheduling problems

CO3 : Implement mutual exclusion principles in real applications

CO4 : Develop system model to handle deadlock situations

CO5 : Design file and I/O system to improve performance

Text Books:

1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Operating System Principles, 9th edition, Wiley India Private Limited, New Delhi, 2012.
2. Andrew S. Tanenbaum, Herbert Bos, Modern Operating Systems, 4th edition, Prentice Hall of India, India, 2016.

Mapping of Course Outcomes (CO's) with PO's & PSO's

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9		PO 11	PO1 2	PSO 1		PSO 3
CO1	1	0	1	0	0	1	2	3	0	1	0	2	2	0	2
CO2	3	3	2	3	2	2	2	0	0	2	0	2	0	0	2
CO3	3	3	3	2	2	1	2	0	0	2	0	2	0	0	2
CO4	3	2	3	2	1	2	2	0	0	2	0	2	1	0	2
CO5	2	2	3	3	1	0	2	0	0	2	2	2	1	0	2

Programme	B.Tech ECE (AI&ML)	Programme Code	BTEM			
Course Code	25BTEM344	Number of Hours/Week	3			
Semester	IV (PSE II)	Max. Marks	100			
Year	II	Credits	3			
Program Specific Elective						
Course Title	FULL STACK DEVELOPMENT			L	T	P
			3	0	0	
COURSE OBJECTIVES:						
<p>The main learning objective of this course is to prepare the students for:</p> <ul style="list-style-type: none"> • Understand the fundamentals of front-end and back-end development. • Learn to design and develop responsive user interfaces using modern web technologies. • Develop skills to build server-side applications and APIs. • Gain knowledge of database design and integration in web applications. • <input type="checkbox"/> Build and deploy complete full stack web applications. 						
UNIT	TOPICS				HOURS	
I	Web Development Basics: Web development Basics - HTML & Web servers Shell - UNIX CLI Version control - Git & Github HTML, CSS				8	
II	Frontend Development: Javascript basics OOPS Aspects of JavaScript Memory usage and Functions in JS AJAX for data exchange with server jQuery Framework jQuery events, UI components etc. JSON data format.				8	
III	REACT JS: Introduction to React React Router and Single Page Applications React Forms, Flow Architecture and Introduction to Redux More Redux and Client-Server Communication				8	
IV	Java Web Development: JAVA PROGRAMMING BASICS, Model View Controller (MVC) Pattern MVC Architecture using Spring RESTful API using Spring Framework Building an application usingMaven				8	

V	Databases & Deployment: Relational schemas and normalization Structured Query Language (SQL) Data persistence using Spring JDBC Agile development principles and deploying application in Cloud	8
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TEXT BOOKS:

1. Web Design with HTML, CSS, JavaScript and JQuery Set Book by Jon Duckett
ProfessionalJavaScript for Web Developers Book by Nicholas C. Zakas
2. Learning PHP, MySQL, JavaScript, CSS & HTML5: A Step-byStep Guide to CreatingDynamic Websites by Robin Nixon
3. Full Stack JavaScript: Learn Backbone.js, Node.js and MongoDB. Copyright © 2015 BYAZAT MARDAN

REFERENCE BOOKS:

1. Full-Stack JavaScript Development by Eric Bush.
2. Mastering Full Stack React Web Development Paperback – April 28, 2017 by TomaszDyl , Kamil Przeorski , Maciej Czarnecki

COURSE OUTCOMES:

1. Develop a fully functioning website and deploy on a web server.
2. Gain Knowledge about the front end and back end Tools
3. Find and use code packages based on their documentation to produce working results in a project.
4. Create web pages that function using external data.
5. Implementation of web application employing efficient database access.

Mapping of Course Outcomes (CO's) with PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	1	0	0	1	0	3	0	1	0	3	2	0	0
CO2	3	2	3	3	0	2	0	0	0	2	0	1	0	3	3
CO3	3	1	2	2	0	2	0	0	0	2	1	1	1	1	3
CO4	3	1	2	2	0	2	0	0	0	2	1	1	0	1	2
CO5	2	2	3	3	3	1	3	3	3	2	2	1	3	3	3

3 – High, 2 – Average, 1 – Low , 0-Null

Programme	B.Tech ECE (AI&ML)	Programme Code	BTEM			
Course Code	25BTEM345	Number of Hours/Week	3			
Semester	IV (PSE II)	Max. Marks	100			
Year	II	Credits	3			
Program Specific Elective						
Course Title	EDGE AI			L	T	P
				3	0	0
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students for:						
<ul style="list-style-type: none"> • Understand the basics of Edge AI, AI, and Machine Learning. • Learn how AI models work on edge devices like sensors and IoT systems. • Develop skills to deploy AI models on edge platforms. • Understand techniques to optimize models for speed and low power. • Explore real-world applications of Edge AI in smart systems. 						
UNIT	TOPICS				HOURS	
I	Introduction, Perceptron Training Rule, Sigmoid neuron, fully connected neural network, Activation functions, Loss functions for regression and classification, Gradient Descent and Backpropagation, Batch and mini-batch processing, Stochastic Gradient Descent				8	
II	Regularization Techniques Optimization and Regularization: Overfitting, Cross-Validation, Feature Selection, Regularization (L2 penalty, dropout, ensembles, data augmentation techniques) Hyperparameter tuning				8	
III	Convolutional Neural Networks (CNN) Convolutional Neural Network, Weight Initialization, Visualizing filters of a CNN, Guided Backpropagation, Autoencoders, Regularization in autoencoders, Denoising Autoencoders, Standard CNN models such as Alexnet, VGG net, Inception net, Resnet				8	
IV	Recurrent neural networks (RNN) Recurrent neural networks, sequence modelling, backpropagation through time; Hyperparameters, Vanishing/exploding gradient problem, Gradient clipping, Long-short term memory (LSTM)				8	
V	Recurrent neural networks (RNN) Recurrent neural networks, sequence modelling, backpropagation through time; Hyperparameters, Vanishing/exploding gradient problem, Gradient clipping, Long-short term memory (LSTM)				8	

Textbooks:

Bishop Christopher, “Neural Networks for Pattern Recognition”, New York, NY: Oxford University, Press, ISBN: 9780198538646

Reference books:

Deep Learning by Ian Goodfellow, Yoshua Bengio and Aaron Courville published by MIT Press, 2016, ISBN: 9780262035613

Raj Kamal, “Internet of Things: Architecture and Design”, McGraw Hill Online references for edge computing and intelligence

COURSE OUTCOMES:

1. Design and implement FCNN models for applications such as classification and regression using ML/DL platform.
2. Apply regularization techniques for improving the model performance on validation/test datasets.
3. Design and/or select CNNs for various computer vision applications.
4. Apply and analyze RNNs for various applications that involve temporal/sequence learning tasks.
5. Deploy ML/DL models designed for vision and sequence learning applications on edge platforms.

Mapping of Course Outcomes (CO's) with PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	1	0	0	1	0	3	0	1	0	3	2	0	0
CO2	3	2	3	3	0	2	0	0	0	2	0	1	0	3	3
CO3	3	1	2	2	0	2	0	0	0	2	1	1	1	1	3
CO4	3	1	2	2	0	2	0	0	0	2	1	1	0	1	2
CO5	2	2	3	3	3	1	3	3	3	2	2	1	3	3	3

3 – High, 2 – Average, 1 – Low , 0-Null

Programme	B.Tech ECE (AI&ML)	Programme Code	BTEM			
Course Code	25BTEM346	Number of Hours/Week	3			
Semester	IV (PSE II)	Max. Marks	100			
Year	II	Credits	3			
PROGRAM SPECIFIC ELECTIVE						
Course Title	MACHINE LEARNING			L	T	P
				3	0	0
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students for:						
<ul style="list-style-type: none"> • To explore fundamental concepts in machine learning • To equip different concepts in machine learning with mathematical intuition • To construct an existing problem into standard machine learning paradigm • To develop an innovative ML model for research problems using different ML tools and standard datasets 						
UNIT	TOPICS				HOURS	
I	Introduction to machine learning Introduction to machine learning; Mathematics behind machine learning; Linear algebra - Vector space, system of linear equations, projection, Solving $Ax=b$, projection, least square problem, eigen values and vectors, eigen decomposition, singular value decomposition; Probability – expectation, variance, covariance; Multivariable calculus basics;				8	
II	Linear and Logistic Regression Linear Regression – cost function, optimization function; gradient descent – batch, mini-batch, stochastic; normal equation; regularization -ridge regression; feature scaling; logistic regression – sigmoid function, solving cost function; maximum likelihood estimation; gaussian discriminant analysis; naïve bayes;				8	
III	SVM and Bayesian learning Support vector machine – linear discriminant analysis, KKT theorem, primal-dual problem; Kernels – polynomial, gaussian; decision trees – information gain, gini index; Bayesian learning – bayes minimum risk classifier; multivariate normal distribution; softmax classifier; Non- linear functions – threshold, sigmoid, ReLU, tanh;				8	
IV	Neural Networks and CNN Neural networks; perceptron; multilayer perceptron; backpropagation algorithm; autoencoder – deep autoencoder, sparse auto encoder, denoising autoencoder; convolution; convolutional neural network – pooling, padding, strided convolution; CNN example – LeNet, AlexNet, VGGNet, ResNet, GoogleNet.				8	

V	Clustering and Dictionary learning Clustering – K-means, K-medoids; issues in deep learning – vanishing/exploding gradient problem, overfitting, covariate shift; momentum optimizer; Nesterov accelerated gradient; Adagrad; RMSprop; Ada delta; underdetermined system of linear equations; pursuit algorithms; sparse coding; dictionary learning;	8
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COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Infers mathematical concepts behind machine learning

CO2 : Distinguish different ML concepts in terms of applications

CO3 : Implement standard ML algorithms for applications

CO4 : Validate the ML models to improve the performance

CO5 : Develop an ML model for existing problems

Text Books:

1. Gilbert Strang. Introduction to Linear Algebra. Wellesley-Cambridge Press, USA, 5th edition, 2016.
2. Andrew Ng. Machine Learning Yearning. deeplearning.ai, 2018.

Reference Books:

1. Ian J. Goodfellow, Yoshua Bengio, and Aaron Courville. Deep Learning. MIT Press, Cambridge, MA, USA, 2016.
2. M. Elad, Sparse and Redundant Representations: From Theory to Applications in Signal and Image Processing, Springer, 2010.

Mapping of Course Outcomes (CO's) with PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	3	0	1	0	0	0	1	0	3	0	1	2
CO2	3	2	1	3	1	0	2	0	0	1	0	2	1	2	3
CO3	3	2	2	3	3	2	3	0	0	2	0	2	2	2	3
CO4	2	3	1	2	3	1	2	1	1	1	1	2	2	1	3
CO5	3	2	3	3	3	2	3	3	3	2	2	2	3	3	3

3 – High, 2 – Average, 1 – Low , 0-Null

Programme	B.Tech ECE (AI & ML)	Programme Code	BTEM			
Course Code	25BTEM241	Number of Hours/Week	2			
Semester	IV	Max. Marks	100			
Year	III	Credits	1			
Core Course						
Course Title	ANALOG CIRCUITS LAB			L	T	P
			0	0	2	
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students for:						
<ul style="list-style-type: none"> • Familiarize students with the Analog Integrated Circuits and Design and implementation of application circuits using basic Analog Integrated Circuits • Familiarize students with simulation of basic Analog Integrated Circuits. • Provide hands-on experience in testing, measuring, and analyzing the performance of analog IC-based circuits. • Develop skills in simulation of analog circuits using SPICE tools. 						
LIST OF EXPERIMENTS						
Fundamentals of operational amplifiers and basic circuits						
[Minimum SEVEN experiments are to be done]						
<ol style="list-style-type: none"> 1. Familiarization of Operational amplifiers – Inverting and Non inverting amplifiers, frequency response, Adder, Integrator, Comparators. 2. Measurement of Op-Amp parameters. 3. Difference Amplifier and Instrumentation amplifier. 4. Schmitt trigger circuit using Op–Amps. 5. Astable and Monostable multivibrator using Op-Amps. 6. Waveform generators using Op-Amps – Triangular and saw tooth 7. Wien bridge oscillator using Op-Amp – without & with amplitude stabilization. 8. RC Phase shift Oscillator. 9. Active second order filters using Op-Amp (LPF, HPF, BPF and BSF). 10. Notch filters to eliminate the 50Hz power line frequency. 11. Precision rectifiers using Op-Amp. 						
Application circuits of 555 Timer/565 PLL/ Regulator (IC 723) ICs						
[Minimum three experiments are to be done]						
<ol style="list-style-type: none"> 1. Astable and Monostable multivibrator using Timer IC NE555 2. DC power supply using IC 723: Low voltage and high voltage configurations, Short circuit and Fold-back protection. 3. A/D converters- counter ramp and flash type 4. D/A Converters – R-2R ladder circuit 						

5. Study of PLL IC: free running frequency lock range capture range

Simulation experiments [The experiments shall be conducted using SPICE]

1. Simulation of any three circuits from Experiments 3, 5, 6, 7, 8, 9, 10 and 11 of section I
2. Simulation of Experiments 3 or 4 from section II

Course Outcomes:

By learning Computer Networks, students will be able to

CO1:	Explain the characteristics, parameters, and basic configurations of operational amplifiers. <i>(Understanding)</i>
CO2:	Design and implement Op-Amp-based application circuits such as amplifiers, oscillators, filters, and waveform generators. <i>(Applying)</i>
CO3:	Analyze the performance of analog circuits including multivibrators, precision rectifiers, and instrumentation amplifiers. <i>(Analyzing)</i>
CO4:	Implement and test application circuits using ICs such as NE555, PLL, IC 723, ADCs, and DACs. <i>(Applying)</i>
CO5:	Simulate analog integrated circuits using SPICE and validate theoretical results with practical observations. <i>(Applying, Evaluating)</i>

Mapping of Course Outcomes (CO's) with PO's & PSO's

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	1	–	–	–	–	–	–	2	3	2	1
CO2	3	3	3	2	2	–	–	–	–	–	–	2	3	3	2
CO3	3	3	2	2	2	–	–	–	–	–	–	2	3	2	2
CO4	3	2	3	2	2	–	–	–	–	–	–	2	2	3	2
CO5	2	2	2	2	3	–	–	–	–	–	–	3	2	3	2

3 – high, 2 – Average, 1 - Low , 0-Null

Programme	B.Tech ECE (AI & ML)	Programme Code	BTEM		
Course Code	25BTEM242	Number of Hours/Week	2		
Semester	IV	Max. Marks	100		
Year	III	Credits	1		
Core Course					
Course Title	MICROPROCESSOR AND MICROCONTROLLER LAB		L	T	P
			0	0	2
L-Lecture Hours T-Tutorial Hours P-Practical Hours					
COURSE OBJECTIVES:					
The main learning objective of this course is to prepare the students for:					
<ul style="list-style-type: none"> • Familiarize students with the Analog Integrated Circuits and Design and implementation of application circuits using basic Analog Integrated Circuits • Familiarize students with simulation of basic Analog Integrated Circuits. • Provide hands-on experience in testing, measuring, and analyzing the performance of analog IC-based circuits. • Develop skills in simulation of analog circuits using SPICE tools. 					
LIST OF EXPERIMENTS					
8085 Microprocessor Programming					
<ol style="list-style-type: none"> 1. Data transfer using different addressing modes and block transfer. 2. (a) Arithmetic operations in binary and BCD: addition, subtraction, multiplication and division (b) Logical instructions- sorting of arrays in ascending and descending order. (c) Binary to BCD conversion and vice versa 					
8051 Microcontroller Programming					
<ol style="list-style-type: none"> 3. ALP programming for (a) Data transfer: Block data movement, exchanging data, sorting, finding largest element in an array. (b) Arithmetic operations: Addition, subtraction, multiplication and division. Computation of square and cube of 16-bit numbers. 4. ALP programming for the implementation of counters: HEX up and down counters, BCD up/down counters 5. (a) ALP programming for implementing Boolean and logical instructions: bit manipulation. (b) ALP programming for implementing conditional call and return instructions: Toggle the bits of port 1 by sending the values 55H and AAH continuously, Factorial of 					

a number

6. ALP programming for
 - (a) Generation of delay ELECTRICAL & ELECTRONICS ENGINEERING (b) Transmitting characters to a PC HyperTerminal using the serial port and displaying on the serial window
7. C Programs for stepper motor control.
8. C Programs for DC motor direction and speed control using PWM.
9. C Programs for Alphanumerical LCD panel/ keyboard interface.
10. C Programs for ADC interfacing.
11. Demo Experiments using 8085 Microprocessor Programming
 - (a) Digital I/O using PPI: square wave generation. (b) Interfacing D/A converter-generation of simple waveforms-triangular, ramp etc. (c) Interfacing A/D converter.
12. Demo Experiments using 8051 Microcontroller Programming ALP programming for implementing code conversion– BCD to ASCII, ASCII to BCD, ASCII to decimal, Decimal to ASCII, Hexadecimal to Decimal and Decimal to Hexadecimal.
13. a) Familiarization of Arduino IDE b) LED blinking with different ON/OFF delay timings with i) inbuilt LED ii) Externally interfaced LED
14. Arduino based voltage measurement of 12V solar PV module/ 12V battery and displaying the measured value using I2C LCD display.
15. Arduino based DC current measurement using Hall-effect current sensor like LEM LA55P sensor and displaying the value using I2C LCD module.
16. DC motor speed control using MOSFET driven by PWM signal from Arduino module.
17. Write a program on Arduino/Raspberry Pi to upload temperature and humidity data to thing speak cloud.
18. Write a program on Arduino/Raspberry Pi to retrieve temperature and humidity data from thing speak cloud.

Course Outcomes:

By learning, students will be able to

CO1:	Develop and execute assembly language programs for solving arithmetic and logical problems using microprocessor/microcontroller.
CO2:	Design and Implement systems with interfacing circuits for various applications.
CO3:	Execute projects as a team using microprocessor/microcontroller for real life applications.
CO4:	Analyze and troubleshoot microprocessor and microcontroller-based systems for efficient performance.
CO5:	Apply programming and interfacing skills to develop optimized solutions for real-world embedded applications.

Mapping of Course Outcomes (CO's) with PO's & PSO's

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	1	–	–	–	–	–	–	2	3	2	1
CO2	3	3	3	2	2	–	–	–	–	–	–	2	3	3	2
CO3	3	3	2	2	2	–	–	–	–	–	–	2	3	2	2
CO4	3	2	3	2	2	–	–	–	–	–	–	2	2	3	2
CO5	2	2	2	2	3	–	–	–	–	–	–	3	2	3	2

3 – high, 2 – Average, 1 - Low , 0-Null

Programme	B.Tech ECE (AI&ML)	Programme Code	BTEM			
Course Code	25BTEM841	Number of Hours/Week	3			
Semester	IV	Max. Marks	100			
Year	II	Credits	3			
Skill Enhancement Course						
Course Title	ENGINEERING ECONOMICS & FOREIGN TRADE			L	T	P
				3	0	0
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
<ul style="list-style-type: none"> • To understand basic economic principles relevant to engineering. • To analyze consumer and producer behavior using economic models. • To explore market structures and pricing mechanisms. • To apply cost estimation techniques in engineering decisions. • To gain awareness of foreign trade, globalization, and their impact. 						
UNIT	TOPICS				HOURS	
I	Introduction The themes of economics – scarcity and efficiency – three fundamental economic problems – society’s capability – Production possibility frontiers (PPF) – Productive efficiency Vs economic efficiency – economic growth & stability – Micro economies and Macro economies – the role of markets and government – Positive Vs negative externalities.				12	
II	Consumer and Producer Behaviour Market – Demand and Supply – Determinants – Market equilibrium – elasticity of demand and supply – consumer behavior – consumer equilibrium – Approaches to consumer behavior – Production – Short-run and long-run Production Function – Returns to scale – economies Vs diseconomies of scale – Analysis of cost – Short- run and long-run cost function – Relation between Production and cost function				12	
III	Product and Factor Market Product market – perfect and imperfect market – different market structures – Firm’s equilibrium and supply – Market efficiency – Economic costs of imperfect competition – factor market – Land, Labour and capital – Demand and supply – determination of factor price – Interaction of product and factor market – General equilibrium and efficiency of competitive markets.				12	

IV	Engineering Costs & Estimation Fixed, Variable, Marginal & Average Costs, Sunk Costs, Opportunity Costs, Recurring And Nonrecurring Costs, Incremental Costs, Cash Costs vs Book Costs, Life-Cycle Costs; Types Of Estimate, Estimating Models - Per-Unit Model, Segmenting Model, Cost Indexes, Power-Sizing Model. Inflation, Types of Index, Composite vs Commodity Indexes, Use of Price Indexes In Engineering Economic Analysis.	12
V	Foreign Trade Introduction, Definition of Foreign Trade, balance of Trade, difference between international and domestic business, Advantages and Disadvantages of International Business, Globalization of Markets, Trends in Globalization, Effects and Benefits of Globalization, balance of payment and foreign exchange.	12

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

Course Outcomes
CO 1: Understand the fundamental themes of economics
CO 2: Demonstrate market dynamics including demand and supply and their determinants.
CO 3: Appraise the firm equilibrium and supply in relation to market efficiency.
CO 4: Illustrate the different engineering cost concepts, including fixed, variable, and opportunity costs, and apply these concepts to perform break-even analysis.
CO 5: Evaluate the globalization trends, balance of payments and foreign exchange dynamics.

TextBook:

1. Karl E. Case and Ray C. fair, Principles of Economics, 7th edition, Pearson, Education Asia, New Delhi, 2022.

Reference Books:

1. Paul A. Samuelson, William D. Nordhaus, Sudip Chaudhuri and Anindya Sen, Economics, 19th edition, Tata McGraw Hill, New Delhi, 2021
2. William Boyes and Michael Melvin, Textbook of economics, Biztantra, 2022.
3. N. Gregory Mankiw, Principles of Economics, 8th edition, Thomson learning, New Delhi, 2021

Mapping of Course Outcomes (CO's) with PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	0	1	0	1	0	0	0	0	1	0	1	0	0	0	0
CO2	0	1	0	1	0	1	0	0	1	0	1	0	0	0	1
CO3	0	1	0	1	0	0	0	0	1	0	1	0	0	0	1
CO4	0	1	0	1	0	0	0	0	1	0	2	0	0	0	0
CO5	0	1	0	1	0	0	0	0	1	0	1	0	0	0	0

3 – High, 2 – Average, 1 – Low , 0-Null

Semester V

Programme	B.Tech ECE (AI & ML)	Programme Code	BTEM			
Course Code	25BTEM151	Number of Hours/Week	3			
Semester	V	Max. Marks	100			
Year	IV	Credits	3			
Programme Specific Elective						
Course Title	EMBEDDED SYSTEM AND IOT			L	T	P
			3	0	0	
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students to:						
<ul style="list-style-type: none"> • To provide knowledge on the basics, building blocks of Embedded System. • To discuss Input/output Interfacing & Bus Communication with processors. • To teach automation using scheduling algorithms and Real time operating system. • To discuss on different Phases & Modeling of a new embedded product. • To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills. 						
UNIT	TOPICS				HOURS	
I	INTRODUCTION TO EMBEDDED SYSTEMS Introduction to Embedded Systems –built in features for embedded Target Architecture - selection of Embedded processor – DMA-memory devices – Memory management methods-memory mapping, cache replacement policies- Timer and Counting devices, Watchdog Timer, Real Time Clock Software Development tools-IDE, assembler, compiler, linker, simulator, debugger, In circuit emulator, Target Hardware Debugging- Overview of functional safety standards for embedded systems.				9	
II	EMBEDDED NETWORKING BY PROCESSORS Embedded Networking: Introduction, I/O Device Ports & Buses-multiple interrupts and interrupt service mechanism – Serial Bus communication protocols -RS232 standard–RS485–USB–Inter Integrated Circuits (I2C)- CAN Bus –Wireless protocol based on Wifi , Bluetooth, Zigbee – Introduction to Device Drivers.				9	
III	RTOS BASED EMBEDDED SYSTEM DESIGN Introduction to basic concepts of RTOS- Need, Task, process & threads, interrupt routines in RTOS, Multiprocessing and Multitasking, Preemptive and non-preemptive scheduling, Task communication context switching, interrupt latency and deadline shared memory, message passing-, Interprocess Communication – synchronization between processes-semaphores, Mailbox, pipes,				9	

	priority inversion, priority inheritance, comparison of Real time Operating systems: VxWorks, uC/OS-II, RT Linux.	
IV	MODELLING WITH HARDWARE/SOFTWARE DESIGN APPROACHES Modelling embedded systems- embedded software development approach --Overview of UML modeling with UML, UML Diagrams-- Hardware/Software Partitioning, Co-Design Approaches for System Specification and modeling- CoSynthesis - features comparing Single-processor Architectures & Multi-Processor Architectures-- design approach on parallelism in uniprocessors & Multiprocessors.	9
V	Introduction to the Concept of IoT Devices – IoT Devices Versus Computers – IoT Configurations – Basic Components – Introduction to Arduino – Types of Arduino – Arduino Toolchain – Arduino Programming Structure – Sketches – Pins – Input/Output From Pins Using Sketches – Introduction to Arduino Shields – Integration of Sensors and Actuators with Arduino.	9

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1	Demonstrate the functionalities of processor internal blocks, with their requirement.
CO2	Analyze that Bus standards are chosen based on interface overheads without sacrificing processor performance
CO3	Explain the role and features of RT operating system, that makes multitask execution possible by processors
CO4	Illustrate that using multiple CPU based on either hardcore or softcore helps data overhead management with processing- speed reduction for uC execution
CO5	Recommend Embedded consumer product design based on phases of product development.

Text Books:

1. Rajkamal, 'Embedded System-Architecture, Programming, Design', TMH,2011.
2. Peckol, "Embedded system Design", JohnWiley&Sons,2010

Reference Books:

1. Lyla B Das," Embedded Systems-An Integrated Approach", Pearson2013
2. EliciaWhite," Making Embedded Systems",O'Reilly Series, SPD,2011

Mapping of Course Outcomes (CO's) with PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	2	0	0	0	0	0	0	2	3	2	2
CO2	3	3	2	1	2	0	0	0	0	0	0	2	3	2	3
CO3	3	2	2	1	2	0	0	0	0	0	0	2	3	3	3
CO4	3	2	2	1	2	0	0	0	0	0	0	2	3	3	3
CO5	3	2	3	1	1	1	0	1	0	1	1	2	3	3	2

3 – High, 2 – Average, 1 – Low , 0-Null

Programme	B.Tech ECE (AI & ML)	Programme Code	BTEM			
Course Code	25BTEM152	Number of Hours/Week	3			
Semester	V	Max. Marks	100			
Year	III	Credits	3			
Core Course						
Course Title	DIGITAL SIGNAL PROCESSING			L	T	P
			3	0	0	
L-Lecture Hours T-Tutorial Hours P-Practical Hours						

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students:

- To describe signals mathematically and understand how to perform mathematical operations on signals
- Analyze signals using DFT and FFT algorithms for frequency-domain representation and filtering.
- Design FIR and IIR digital filters to meet given frequency specifications.
- Realize digital filter structures and analyze their computational and numerical properties.
- Understand multirate DSP techniques, DSP processor architectures, and finite word-length effects.

UNIT	TOPICS	HOURS
I	Review of sampling Z-Transform and DTFT The Discrete Fourier Transform: DFT as a linear transformation (Matrix Relation), IDFT, Properties of DFT and examples (proof not necessary). Circular convolution, linear convolution using circular convolution, Filtering of long data sequences, overlap save and overlap add methods. Frequency Analysis of Signals using the DFT (concept only required)	9
II	Design of FIR Filters - Symmetric and Anti-symmetric FIR Filters, Design of linear phase FIR filters using Window methods, (rectangular, Hamming and Hanning). Design of IIR Digital Filters from Analog Filters (Butterworth), IIR Filter Design by Impulse Invariance, and Bilinear Transformation, Frequency Transformations in the Analog Domain.	9
III	Structures for the realization of Discrete-Time Systems - Block diagram and signal flow graph representations of filters. FIR Filter Structures: Linear structures, Direct Form. IIR Filter Structures: Direct Form, Transposed Form, Cascade Form and Parallel Form.	8
IV	Multi-rate Digital Signal Processing: Decimation and Interpolation (Time domain and Frequency Domain Interpretation), Anti-aliasing and anti-imaging filter. Efficient Computation of DFT:	9

	Fast Fourier Transform and computational advantage over DFT, Radix-2 Decimation in Time FFT Algorithm.	
V	Computer architecture for signal processing: Harvard Architecture, pipelining, MAC, Introduction to TMS320C67xx digital signal processor, Functional Block Diagram. Finite word length effects in DSP systems: Introduction, fixed-point and floating-point DSP arithmetic, ADC quantization noise.	9

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1	Illustrate fundamental properties and relations relevant to DFT and solve basic problems involving DFT-based filtering methods.
CO2	Design linear phase FIR filters and IIR filters of different specifications.
CO3	Realise the various FIR and IIR filter structures for a given system function.
CO4	Compute DFT efficiently using FFT method and to explain the architecture of a DSP processor.
CO5	Analyze predictive models through real-world applications (e.g., churn, risk scoring).

Text Books:

- Digital signal processing using MATLAB, Vinay K. Ingle and John G. Proakis, Cengage Learning, 3rd edition, 2011.
- Think DSP: Digital signal processing using Python, Allen B. Downey, Green Tea Press, 2nd edition, 2012.
- Discrete-time signal processing, Alan V. Oppenheim and Ronald W. Schaffer, Pearson Education, 3rd edition, 2014.

Reference Books:

- Digital signal processing, Shaila D. Apte, Wiley, 2nd edition, 2019.
- Digital signal processing: A computer-based approach, S. K. Mitra, McGraw Hill, 4th edition, 2014.

Mapping of Course Outcomes (CO's) with PO's & PSO's

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	2	1	0	0	0	0	0	0	2	3	2	1
CO2	3	3	2	3	2	0	0	0	0	0	0	2	3	3	2
CO3	3	3	2	3	2	0	0	0	0	0	0	2	3	3	2
CO4	3	2	2	3	2	0	0	0	0	0	0	2	3	2	2
CO5	2	3	2	3	3	0	0	0	0	0	0	3	3	3	2

3 – high, 2 – Average, 1 - Low , 0-Null

Programme	B.Tech ECE (AI & ML)	Programme Code	BTEM			
Course Code	25BTEM153	Number of Hours/Week	3			
Semester	V	Max. Marks	100			
Year	III	Credits	3			
Core Course						
Course Title	APPLIED ELECTROMAGNETIC THEORY			L	T	P
			3	0	0	
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students:						
<ul style="list-style-type: none"> • Understand the basic concepts of electromagnetic fields and waves. • Learn the application of Maxwell's equations in different media. • Analyze the behavior of electromagnetic wave propagation. • Study the principles of transmission lines and waveguides. • <input type="checkbox"/> Apply electromagnetic theory to real-world engineering problems. 						
UNIT	TOPICS				HOURS	
I	Introduction to Co-ordinate Systems – Rectangular, Cylindrical and Spherical Co- ordinate Systems – Co-ordinate transformation; Gradient of a Scalar field, Divergence of a Vector field and Curl of a Vector field- their physical interpretation; Divergence Theorem, Stokes' Theorem;				9	
II	Coulomb's Law, Electric field intensity, Field due to a line charge, surface charge distribution. Electric Flux and Flux Density; Gauss's law and its application to determine the field due to an infinite line charge, infinite sheet charge; Electric Potential-Potential Gradient, conservative property of electric field, Equipotential surfaces; Electric Dipole; Capacitance - capacitance of co-axial cable, two wire line; Poisson's and Laplace's equations;				9	
III	Biot-Savart's Law, Magnetic Field intensity due to a finite and infinite wire carrying current; Magnetic field intensity on the axis of a circular and rectangular loop carrying current; Magnetic flux Density; Magnetic Vector Potential; Ampere's circuital law and simple applications; Inductance and mutual inductance. Boundary conditions for electric fields and magnetic fields; Conduction current and displacement current densities; Continuity equation for current; Maxwell's Equation in Differential and Integral form from Modified form of Ampere's circuital law, Faraday's Law and Gauss's Law				8	
IV	Wave Equations from Maxwell's Equations; Uniform Plane Waves, Wave equations in Phasor form; Propagation of Uniform Plane waves in free space, loss-less and lossy dielectric medium, Uniform Plane waves in good conductor; Skin effect and skin depth, phase velocity and group velocity, Intrinsic Impedance, Attenuation constant and Propagation Constant in all medium; Poynting Vector and Poynting Theorem.				9	

V	Transmission line: Waves in transmission line, Line parameters, Transmission line equation & solutions, Propagation constants, Characteristic impedance, Wavelength, Velocity of propagation. Standing Wave Ratio(SWR), impedance matching. Solution of problems. Electromagnetic interference.	9
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COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1	Apply vector analysis and coordinate systems to solve static electric and magnetic field problems
CO2	Apply Gauss Law, Coulomb's law and Poisson's equation to determine electrostatic field parameters
CO3	Determine magnetic fields from current distributions by applying Biot-Savart's law and Amperes Circuital law.
CO4	Apply Maxwell Equations for the solution of timevarying fields
CO5	Analyse electromagnetic wave propagation in different media.

Text Books:

3. Matthew N.O. Sadiku, Principles of Electromagnetics, Oxford University Press, 6th Edition.
4. Hayt W. H. and J. A. Buck, Engineering Electromagnetics, McGraw-Hill, 8th Edition.
- 5.

Reference Books

- 1 Joseph A. Edminister, Electromagnetics, Schaum's Outline Series, Tata McGrawHill, Revised 2nd Edition.
- 2 John Kraus and Daniel Fleisch, Electromagnetics with Applications, McGraw-Hill, 5 th edition

Mapping of Course Outcomes (CO's) with PO's & PSO's

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	2	1	0	0	0	0	0	0	2	3	2	1
CO2	3	3	2	3	2	0	0	0	0	0	0	2	3	3	2
CO3	3	3	2	3	2	0	0	0	0	0	0	2	3	3	2
CO4	3	2	2	3	2	0	0	0	0	0	0	2	3	2	2
CO5	2	3	2	3	3	0	0	0	0	0	0	3	3	3	2

high, 2 – Average, 1 - Low , 0-Null

Programme	B.Tech ECE (AI & ML)	Programme Code	BTEM			
Course Code	25BTEM351	Number of Hours/Week	3			
Semester	V (PSEIII)	Max. Marks	100			
Year	III	Credits	3			
PROGRAMME SPECIFIC ELECTIVE						
Course Title	DEEP LEARNING			L	T	P
			3	0	0	
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students to:						
<ul style="list-style-type: none"> • Understand the principles of deep learning and neural network architecture. • Design, train, and evaluate deep learning models for various applications such as image classification, speech recognition, and NLP. • Implement advanced deep learning techniques like CNNs, RNNs, and GANs. • Optimize and regularize deep learning models to prevent overfitting and enhance generalization. • Apply deep learning methods to solve real-world problems in computer vision, NLP, and other domains. 						
UNIT	TOPICS				HOURS	
I	Introduction to Deep Learning Mathematical building blocks of neural network-neural network Introduction to Neural Networks-Overview of machine learning and deep learning-Perceptron model and neural networks-Activation functions. Deep Learning Frameworks-Overview of frameworks: TensorFlow, Keras, PyTorch-Setting up the environment and tools for deep learning				9	
II	Foundations of Deep Neural Networks (DNNs) Feedforward Neural Networks-Architecture of feedforward neural networks (FNNs)-Backpropagation and gradient descent-Loss functions and optimization algorithms. Training Neural Networks-Overfitting, underfitting, and regularization-Batch normalization and learning rate scheduling				9	
III	Convolutional Neural Networks (CNNs) Introduction to CNNs-Convolutional layers, pooling layers, and fully connected layers-CNN architectures. Applications of CNNs-Image classification, object detection, and segmentation-Transfer learning using pre-trained models. Advanced CNN Techniques-Data augmentation, fine-tuning, and model ensembling				9	

IV	Recurrent Neural Networks (RNNs) Introduction to RNNs-RNN architecture and vanishing gradient problem-Long Short-Term Memory and Gated Recurrent Units-Applications of RNNs-Sequence prediction, language modeling, and sentiment analysis-Time-series forecasting, speech recognition.	9
V	Generative Models (GANs, VAEs) Generative Adversarial Networks (GANs)-Architecture of GANs-Training GANs and applications. Variational Autoencoders (VAEs)-Introduction to VAEs and their use in unsupervised learning. Multi-modal Deep Learning-Combining vision, speech, and text in a unified model-Applications in autonomous driving, robotics, and healthcare	9

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1:	To introduce the foundational concepts of deep learning, including neural networks, activation functions, and optimization techniques.
CO2:	To explore various deep learning architectures such as feedforward neural networks, convolutional neural networks (CNNs), and recurrent neural networks (RNNs).
CO3:	To study advanced topics like generative adversarial networks (GANs), transfer learning, and deep reinforcement learning.
CO4:	To provide hands-on experience in implementing deep learning models for real-world applications in computer vision, natural language processing (NLP), and speech recognition.
CO5:	To emphasize model evaluation, regularization techniques, and strategies for improving the efficiency and scalability of deep learning models.

Text Books:

1. **"Deep Learning with Python"** by François Chollet, Publisher: Manning, ISBN: 978-1617294433
2. **"Deep Learning"** by Ian Goodfellow, Yoshua Bengio, and Aaron Courville, Publisher: MIT Press, ISBN: 978-0262035613
3. **"Neural Networks and Deep Learning: A Textbook"** by Charu Aggarwal, Publisher: Springer, ISBN: 978-3319944623

Reference Books:

1. **"Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow"** by Aurélien Géron, Publisher: O'Reilly Media, ISBN: 978-1492032649
2. **"Deep Learning for Computer Vision"** by Rajalingappaa Shanmugamani, Publisher: Apress, ISBN: 978-1484229577
3. **"Pattern Recognition and Machine Learning"** by Christopher Bishop, Publisher: Springer, ISBN: 978-0387310732

Mapping of Course Outcomes (CO's) with PO's & PSO's

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	2	-	-	-	-	-	-	2	3	2	-
CO2	3	3	3	3	3	-	-	-	-	-	-	2	3	2	2
CO3	3	3	3	3	3	-	-	-	-	-	-	2	3	3	2
CO4	3	3	3	3	3	-	-	-	-	-	-	3	3	3	3
CO5	3	3	3	3	3	-	-	-	-	-	-	3	3	3	3

3 – high, 2 – Average, 1 - Low , 0-Null

Programme	B.Tech ECE (AI & ML)	Programme Code	BTEM			
Course Code	25BTEM352	Number of Hours/Week	4			
Semester	V (PSE III)	Max. Marks	100			
Year	III	Credits	4			
PROGRAMME SPECIFIC ELECTIVE						
Course Title	OPERATIONAL RESEARCH AND OPTIMIZATION			L	T	P
				3	1	0
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students:						
<ul style="list-style-type: none"> • To give an overview of the theoretical foundations of computer science from the perspective of formal languages. • To illustrate finite state machines to solve problems in computing • To familiarize Regular grammars and Context Free Grammar. • To solve various problems by normal form techniques, Push Down Automata and Turing Machines. 						
UNIT	TOPICS				HOURS	
I	Introduction: Evolution of OR, Definitions of OR, Scope of OR, Applications of OR, Phases in OR study. Characteristics and limitations of OR, models used in OR, Linear Programming Problem (LPP), Generalized LPP- Formulation of problems as L.P.P. Solutions to LPP by graphical method (Two Variables).				10	
II	LPP: Simplex method, Canonical and Standard form of LP problem, slack, surplus and artificial variables, Solutions to LPP by Simplex method, Big-M Method and Two Phase Simplex Method, Degeneracy in LPP. Concept of Duality, writing Dual of given LPP. Solutions to L.P.P by Dual Simplex Method.				10	
III	Transportation Problem: Formulation of transportation problem, types, initial basic feasible solution using North-West Corner rule, Vogel's Approximation method. Optimality in Transportation problem by Modified Distribution (MODI) method. Unbalanced T.P. Maximization T.P. Degeneracy in transportation problems, application of transportation problem				12	
IV	Network analysis: Introduction, Construction of networks, Fulkerson's rule for numbering the nodes, AON and AOA diagrams; Critical path method to find the expected completion time of a project, determination of floats in networks, PERT networks, determining the probability of completing a project, predicting the completion time of project; Cost analysis in networks. Crashing of networks- Problems.				12	
V	Game Theory: Definition, Pure Strategy problems, Saddle point, Max-Min and Min-Max criteria, Principle of Dominance, Solution of games with Saddle point. Mixed Strategy problems. Solution of 2X2 games by Arithmetic method, Solution of 2Xn m				12	

	and mX2 games by graphical method. Formulation of games.	
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COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1 :	Design finite automata or regular expression for any tokenization task
CO2 :	Construct a context free grammar for parsing any language
CO3 :	Design Turing machine for any language
CO4 :	Conclude the decidable / undecidable nature of any language
CO5 :	Apply mathematical and formal techniques for solving real-world problems

Text Book:

1. Operations Research, P K Gupta and D S Hira, S. Chand and Company LTD. Publications, New Delhi – 2007
2. Operations Research, An Introduction, Seventh Edition, Hamdy A. Taha, PHI Private Limited, 2006.

Reference Books:

Operations Research, Theory and Applications, Sixth Edition, J K Sharma, Trinity Press, Laxmi Publications Pvt. Ltd. 2016. 2. Operations Research, Paneerselvan, PHI

Mapping of Course Outcomes (CO's) with PO's & PSO's

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	2	2	1	1	3	2	2	1	3	2	1
CO2	2	3	2	1	3	2	3	1	2	3	1	2	2	3	2
CO3	3	2	3	2	2	3	1	1	2	2	3	2	3	2	2
CO4	2	3	2	3	2	1	2	2	3	3	2	3	2	1	3
CO5	1	1	2	3	1	2	3	3	1	1	3	2	1	2	3

3 – high, 2 – Average, 1 - Low , 0-Null

Programme	B.Tech ECE (AI & ML)	Programme Code	BTEM			
Course Code	25BTEM353	Number of Hours/Week	3			
Semester	V (PSE III)	Max. Marks	100			
Year	III	Credits	3			
Programme Specific Elective						
Course Title	SATELLITE COMMUNICATION			L	T	P
				3	0	0
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students:						
<ol style="list-style-type: none"> 1. To introduce the basic principles of Satellite Communication systems, orbital mechanics, launchers. 2. To know the different subsystems of satellites. 3. To introduce the basic concepts and designing of Satellite links. 4. To introduce the basic concepts of earth station transceiver. 5. To know the basics of direct broadcast satellite television 						
UNIT	TOPICS				HOURS	
I	Communication Satellite: Orbit and Description: A Brief history of satellite Communication, satellite Frequency Bands, Satellite Systems, Applications, Orbital Period and Velocity, effects of orbital Inclination, Azimuth and Elevation, Coverage angle and slant Range, Eclipse, Orbital Perturbations, Placement of a Satellite in a Geo-Stationary orbit.				8	
II	Satellite Sub-Systems: Attitude and Orbit Control system, TT&C subsystem, Attitude Control subsystem, Power systems, Communication subsystems, Satellite Antenna Equipment. Satellite Link: Basic Transmission Theory, System Noise Temperature and G/T ratio, Basic Link Analysis, Interference Analysis, Design of satellite Links for a specified C/N, (With and without frequency Re-use), Link Budget.				7	
III	Propagation Effects: Introduction, Atmospheric Absorption, Cloud Attenuation, Tropospheric and Ionospheric Scintillation and Low angle fading, Rain induced attenuation, rain induced cross polarization interference. Multiple Access: Frequency Division Multiple Access (FDMA) - Intermodulation, Calculation of C/N, Time Division Multiple Access (TDMA) -Frame Structure, Burst Structure, Satellite switched TDMA, On-board Processing, Demand Assignment Multiple Access (DAMA) –Types of Demand Assignment, Characteristics, CDMA Spread Spectrum Transmission and Reception.				8	
IV	Earth Station Technology: Transmitters, Receivers, Antennas, Tracking Systems, Terrestrial Interface, Power Test Methods, Lower Orbit Considerations. Satellite Navigation and Global Positioning Systems: Radio and Satellite Navigation, GPS Position Location Principles, GPS Receivers, GPS C/A Code Accuracy, Differential GPS.				6	

V	Satellite Packet Communications: Message Transmission by FDMA: M/G/1 Queue, Message Transmission by TDMA, PURE ALOHA-Satellite Packet Switching, Slotted Aloha, Packet Reservation, Tree Algorithm.	6
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COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1	Understand the working and classification of optical fibers in terms of propagation modes
CO2	Solve problems of transmission characteristics and losses in optical fiber
CO3	Explain the constructional features and the characteristics of optical sources and detectors
CO4	Describe the operations of optical amplifiers
CO5	Understand the concept of WDM, FSO and LiFi

Text Book

- 1.Satellite Communications –Timothy Pratt, Charles Bostian, Jeremy Allnutt, 2ndEdition, 2003, John Wiley & Sons.
- 2.Satellite Communications Engineering –Wilbur, L. Pritchard, Robert A. Nelson and Heuri G.Suyderhoud, 2ndEd., Pearson Publications.

Reference Books

Digital Satellite Communications-Tri.T.Ha, 2ndEdition, 1990, Mc.Graw Hill

Mapping of Course Outcomes (CO's) with PO's & PSO's

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	1	0	1	1	0	0	0	2	3	2	2
CO2	3	3	1	2	1	0	1	1	0	0	0	2	3	2	2
CO3	3	2	1	2	1	0	1	1	0	0	0	2	3	3	2
CO4	3	2	1	2	1	0	1	1	0	0	0	2	3	3	2
CO5	3	2	1	1	1	0	1	1	0	0	0	2	3	3	3

3 – high, 2 – Average, 1 - Low , 0-Null

Programme	B.Tech ECE (AI & ML)	Programme Code	BTEM			
Course Code	25BTEM354	Number of Hours/Week	3			
Semester	V (PSE IV)	Max. Marks	100			
Year	III	Credits	3			
Programme Specific Elective						
Course Title	Quantum Machine Learning			L	T	P
				3	0	0
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students:						
<ul style="list-style-type: none"> • Understand the basics of quantum computing and machine learning. • Learn the principles of quantum algorithms used in machine learning. • Analyze how quantum systems can improve data processing and computation. • Develop skills to implement simple quantum machine learning models. • Explore real-world applications of quantum machine learning. 						
UNIT	TOPICS				HOURS	
I	Need for Quantum Computing and fundamental concepts, Vector spaces, Probability, Complex numbers and mathematical preliminaries, Postulates of quantum mechanics, Bra-ket notations, Measurements, Composite systems, Bells state, Entanglement, Bloch sphere, Pure and Mixed states				8	
II	Geometry of quantum states, Complexity classes, Turing machine, Turing machine concepts, Quantum gates, Quantum circuits, Quantum circuits design,				7	
III	Quantitative measures of circuit, Analysis of quality of Circuits, Circuit optimization, Introduction to quantum parallelism, Deutsch Algorithm, Deutsch Jozsa algorithm,				8	
IV	Introduction to Grover algorithm, Detailed walk through on Grovers algorithm, geometric visualization of Grovers iterations, grovers search applied to unstructured database, quantum Teleportation, shor algorithm, quantum fourier transform				6	
V	Introduction to quantum applications, Research challenges of quantum, Introduction to QC Models, Physical Realization of Models, Variational quantum eigen solver, quantum cryptograpy-bb84 protocol, discussion of different use cases in quantum finance and quantum optimization. (QAOA)				6	

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1	Understand the fundamentals of quantum computing and machine learning concepts.
CO2	Explain and analyze basic quantum algorithms used in machine learning.
CO3	Apply quantum principles to solve simple machine learning problems.
CO4	Implement basic quantum machine learning models using appropriate tools.
CO5	Evaluate the performance and potential of quantum machine learning in real-world applications.

Text Book

1. Quantum Computation and Quantum Information. M. A. Nielsen and I. L. Chuang, Cambridge University Press
2. Quantum Computing, Vishal Sahni, Tata McGraw-Hill Publishing Company Limited, 2007.

Reference Books

Quantum Computer Science. N. David Mermin:, Cambridge University Press

Mapping of Course Outcomes (CO's) with PO's & PSO's

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	1	0	1	1	0	0	0	2	3	2	2
CO2	3	3	1	2	1	0	1	1	0	0	0	2	3	2	2
CO3	3	2	1	2	1	0	1	1	0	0	0	2	3	3	2
CO4	3	2	1	2	1	0	1	1	0	0	0	2	3	3	2
CO5	3	2	1	1	1	0	1	1	0	0	0	2	3	3	3

3 – high, 2 – Average, 1 - Low , 0-Null

Programme	B.Tech ECE (AI & ML)	Programme Code	BTEM			
Course Code	25BTEM355	Number of Hours/Week	3			
Semester	V (PSE IV)	Max. Marks	100			
Year	III	Credits	3			
Programme Specific Elective						
Course Title	BIOMEDICAL SIGNAL PROCESSING			L	T	P
				3	0	0
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students:						
<ul style="list-style-type: none"> • Understand the origin, characteristics, and physiological significance of biomedical signals such as ECG, EEG, EMG, and PCG. • Analyze the challenges involved in biomedical signal acquisition, including noise and artifacts. • Apply time-domain and frequency-domain signal processing techniques for biomedical signal analysis. • Understand and apply adaptive filtering, wavelet-based detection, and event detection techniques to biomedical signals. • Analyze nonstationary biomedical signals for diagnostic and clinical decision-making applications 						
UNIT	TOPICS				HOURS	
I	Introduction to Biomedical Signals Action Potential and Its Generation, Origin and Waveform Characteristics of Basic Biomedical Signals Like: Electrocardiogram (ECG), Electroencephalogram (EEG), Electromyogram (EMG), Phonocardiogram (PCG), Electroneurogram (ENG), Event-Related Potentials (ERPS), Electrogastrogram (EGG), Objectives of Biomedical Signal Analysis, Difficulties in Biomedical Signal Analysis, Computer-Aided Diagnosis.				9	
II	Removal of Noise and Artifacts from Biomedical Signal Random and Structured Noise, Physiological Interference, Stationary and Nonstationary Processes, Noises and Artifacts Present in ECG, Time and Frequency Domain Filtering.				9	
III	EEG Signal Processing and Event Detection in Biomedical Signals EEG Signal and Its Characteristics, EEG Analysis, Linear Prediction Theory, Autoregressive Method, Sleep EEG, Application of Adaptive Filter for Noise Cancellation in ECG and EEG Signals; Detection of P, Q, R, S and T Waves in ECG, EEG Rhythms, Waves and Transients, Detection of Waves and Transients, Correlation Analysis And Coherence Analysis of EEG Channels.				9	

IV	EP Estimation: Signal Averaging, Adaptive Filtering: General structures, LMS adaptive filter, Adaptive noise cancelling, Wavelet Detection: Introduction, Detection by structural features, Matched filtering, Adaptive Wavelet Detection, Detection of Overlapping Wavelets	8
V	Analysis of Nonstationary Signals Heart Sounds and Murmurs, Characterization of Nonstationary Signals and Dynamic Systems, Short-Time Fourier Transform, Considerations in Short-Time Analysis and Adaptive Segmentation	7

COURSE OUTCOMES:

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

CO1	Explain the origin, characteristics, and physiological significance of major biomedical signals such as ECG, EEG, EMG, and PCG.
CO2	Identify and analyze various noise sources and artifacts in biomedical signals and apply filtering techniques for noise removal.
CO3	Apply signal processing techniques for event detection and feature extraction in ECG and EEG signals.
CO4	Analyze biomedical signals using adaptive filtering, signal averaging, and wavelet-based detection methods.
CO5	Analyze nonstationary biomedical signals using time–frequency techniques for clinical and diagnostic interpretation.

Text book:

- Willis J. Tompkin, “Biomedical Digital Signal Processing”, Prentice Hall of India / Pearson Education

References:

- Rangayyan, R.M., 2015. Biomedical signal analysis (Vol. 33). John Wiley & Sons.
- Reddy, D.C., 2005. Biomedical signal processing: principles and techniques. McGraw-Hill

Mapping of Course Outcomes (CO's) with PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	2	1	2	0	1	0	0	0	2	3	2	1
CO2	3	3	2	3	2	2	0	1	0	0	0	2	3	3	2
CO3	3	3	2	3	2	2	0	1	0	0	0	2	3	3	2
CO4	3	3	2	3	3	2	0	1	0	0	0	2	3	3	2
CO5	2	2	2	3	3	3	0	2	0	0	0	3	3	3	2

Programme	B.Tech ECE (AI & ML)	Programme Code	BTEM			
Course Code	25BTEM356	Number of Hours/Week	3			
Semester	V (PSE IV)	Max. Marks	100			
Year	III	Credits	3			
Programme Specific Elective						
Course Title	COMPUTER NETWORK			L	T	P
				3	0	0
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students:						
<ul style="list-style-type: none"> • To understand the concept of layering in networks. • To know the functions of protocols of each layer of TCP/IP protocol suite. • To visualize the end-to-end flow of information. • To learn the functions of network layer and the various routing protocols. • To familiarize the functions and protocols of the Transport layer. 						
UNIT	TOPICS				HOURS	
I	INTRODUCTION TO NETWORK MODELS Data Communication - Networks - Network Types: WAN, MAN, LAN - Protocol Layering – TCP/IP Protocol suite - OSI Model - Introduction to Sockets. Physical Layer: Transmission techniques - Guided - Un-Guided - Multiplexing: TDM, FDM, and WDM.				7	
II	DATA LINK LAYER Framing - Error Detection - Error Correction - Hamming Distance, Cyclic Redundancy Check, Flow Control and Error Control Protocol - Stop and Wait, Go-Back-N ARQ - Selective Repeat ARQ - Sliding Window - Piggybacking - Multiple Access Protocols - ALOHA, CSMA/CD, CSMA/CA.				12	
III	NETWORK LAYER Switching Techniques: Circuit Switching, Message Switching, Packet Switching - Internet protocol - IPv4 and IPv6 - Address Resolution Protocol (ARP), RARP – Internet Control Message Protocol (ICMP) - DHCP - Routing and protocols: Unicast routing - Distance Vector Routing - RIP - Link State Routing - OSPF - Path-vector routing - BGP - Multicast Routing: DVMRP – PIM.				10	
IV	TRANSPORT LAYER User Datagram Protocol (UDP), Transmission Control Protocol (TCP), Flow control - Congestion Control Algorithms: Leaky Bucket and Token Bucket Algorithm - Quality of Service.				9	
V	APPLICATION LAYER Application Layer protocols: HTTP - FTP - Email protocols (SMTP - POP3 - IMAP - MIME) – DNS – SNMP.				7	

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1:	Explain the basic layers and its functions in computer networks.
CO2:	Design and implement simple models to simulate how data flows between nodes in a network.
CO3:	Evaluate and compare different routing algorithms.
CO4:	Design custom protocols to address specific network functions.
CO5:	Demonstrate various application-layer protocols in achieving end-to-end communication.

Text Books:

1. Data Communications and Networking, 5th Edition, Behrouz Forouzan, Mc Graw Hill, 2017.
2. A. S. Tanenbaum (2003), Computer Networks, 4th edition, Pearson Education/ PHI, New Delhi, India.

Reference Books:

1. Larry L. Peterson, Bruce S. Davie, Computer Networks: A Systems Approach, Fifth Edition, Morgan Kaufmann Publishers Inc., 2012.
2. William Stallings, Data and Computer Communications, Tenth Edition, Pearson Education, 2013.
3. Nader F. Mir, Computer and Communication Networks, Second Edition, Prentice Hall, 2014.
4. Ying-Dar Lin, Ren-Hung Hwang, Fred Baker, "Computer Networks: An Open-Source Approach", McGraw Hill, 2012.

Mapping of Course Outcomes (CO's) with PO's & PSO's

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	2	2	3	2	2	2	2	2	3	3	2	2
CO2	3	3	3	2	3	2	2	3	2	2	3	3	3	3	3
CO3	3	2	3	3	3	3	3	2	2	3	2	2	2	3	3
CO4	3	2	3	2	2	3	2	3	2	2	3	3	2	2	2
CO5	2	3	3	3	3	3	2	3	2	2	3	3	3	3	3

3 – high, 2 – Average, 1 - Low , 0-Null

Programme	B.Tech ECE (AI & ML)	Programme Code	BTEM			
Course Code	25BTEM251	Number of Hours/Week	2			
Semester	V	Max. Marks	100			
Year	III	Credits	1			
Core Course						
Course Title	DIGITAL SIGNAL PROCESSING LAB			L	T	P
			0	0	2	
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
<p>The main learning objective of this course is to prepare the students for:</p> <ul style="list-style-type: none"> • Understand and generate basic discrete-time and continuous-time signals used in DSP applications. • Apply mathematical operations such as convolution, sampling, and spectral analysis to real-time signals. • Design and implement FIR and IIR digital filters using simulation and real-time signal inputs. • Analyze time-domain and frequency-domain characteristics of LTI systems. • Implement basic DSP algorithms for audio, image, and communication signal processing applications. 						
LIST OF EXPERIMENTS						
<ol style="list-style-type: none"> 1. Generation of sine wave and standard test signals. 2. Convolution: Linear and Circular 3. Real Time FIR Filter implementation (Low-pass, High-pass and Band-pass) by 4. inputting a signal from the signal generator 5. Real Time IIR Filter implementation (Low-pass, High-pass and Band-pass) by inputting a signal from the signal generator 6. Sampling of analog signal and study of aliasing. 7. Generation of Waveforms (Continuous and Discrete) 8. Verification of Sampling Theorem. 9. Time and Frequency Response of LTI systems (First and second order). 10. Linear Convolution, Circular Convolution and Linear Convolution using Circular Convolution. 11. To find the DFT and IDFT for the given input sequence. 12. Linear convolution using DFT (Overlap-add and Overlap-Save methods). 13. To find the DCT and IDCT for the given input sequence. 14. To find FFT and IFFT for the given input sequence. 						

15. FIR and IIR filter design using Filter Design Toolbox.
16. FIR Filter (Low-pass, High-pass and Band-pass) design (Window method).
17. IIR Filter (Low-pass, High-pass and Band-pass) design (Butterworth and Chebychev).
18. Generation of AM, FM & PWM waveforms and their spectrum.
19. Generation of DTMF signal.
20. Study of sampling rate conversion (Decimation, Interpolation, Rational factor).
21. Filtering of noisy signals
22. Implementation of simple algorithms in audio processing (delay, reverb, flange etc.).
23. Implementation of simple algorithms in image processing (detection, de-noising, filtering etc.)

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1	Generate and analyze standard continuous-time and discrete-time signals and verify sampling theorem and aliasing effects.
CO2	Perform linear and circular convolution using time-domain methods, DFT, FFT, overlap-add and overlap-save techniques.
CO3	Design and implement FIR and IIR digital filters using window methods, analog-to-digital transformations, and filter design tools.
CO4	Analyze the time and frequency response of LTI systems and compute DFT, IDFT, DCT, FFT, and IFFT for given signals.
CO5	Implement real-time DSP applications including modulation, DTMF generation, sampling rate conversion, noise filtering, and basic audio and image processing algorithms.

Mapping of Course Outcomes (CO's) with PO's & PSO's

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	2	–	2	2	1	1	0	3	2	1	1
CO2	3	3	2	2	2	–	2	3	2	1	0	3	3	2	2
CO3	3	3	3	2	3	1	2	3	3	2	0	3	3	3	2
CO4	3	3	2	3	3	–	2	3	2	2	0	3	3	2	3
CO5	3	3	3	3	3	2	3	3	3	3	0	3	3	3	3

3 – high, 2 – Average, 1 - Low , 0-Null

Programme	B.Tech ECE (AI & ML)	Programme Code	BTEM			
Course Code	25BTEM252	Number of Hours/Week	2			
Semester	V	Max. Marks	100			
Year	III	Credits	1			
Core Course						
Course Title	EMBEDDED SYSTEM AND IOT LAB			L	T	P
			0	0	2	
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
<p>The main learning objective of this course is to prepare the students for:</p> <ul style="list-style-type: none"> • To learn the internal architecture and programming of an embedded processor. • To introduce interfacing, I/O devices to the processor. • To introduce the evolution of the Internet of Things (IoT). • To build a small low-cost embedded IoT system using Arduino/Raspberry Pi/ open platform. • To apply the concept of the Internet of Things in real-world scenario. 						
LIST OF EXPERIMENTS						
<ol style="list-style-type: none"> 1. Write 8051 Assembly Language experiments using simulator. 2. Test data transfer between registers and memory. 3. Perform ALU operations. 4. Write Basic and arithmetic Programs Using Embedded C. 5. Introduction to Arduino platform and programming 6. Explore different communication methods with IoT devices (Zigbee, GSM, Bluetooth) 7. Introduction to Raspberry PI platform and python programming 8. Interfacing sensors with Raspberry PI 9. Communicate between Arduino and Raspberry PI using any wireless medium 10. Setup a cloud platform to log the data 11. Log Data using Raspberry PI and upload to the cloud platform 12. Design an IOT based system 						

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1	Explain the architecture of embedded processors
CO2	Write embedded C programs.

CO3	Design simple embedded applications.
CO4	Compare the communication models in IOT
CO5	Design IoT applications using Arduino/Raspberry Pi /open platform.

Mapping of Course Outcomes (CO's) with PO's & PSO's

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	2	–	2	2	1	1	0	3	2	1	1
CO2	3	3	2	2	2	–	2	3	2	1	0	3	3	2	2
CO3	3	3	3	2	3	1	2	3	3	2	0	3	3	3	2
CO4	3	3	2	3	3	–	2	3	2	2	0	3	3	2	3
CO5	3	3	3	3	3	2	3	3	3	3	0	3	3	3	3

3 – high, 2 – Average, 1 - Low , 0-Null

Programme	B.Tech ECE (AI & ML)	Programme Code	BTEM			
Course Code	25BTEM851	Number of Hours/Week	3			
Semester	V	Max. Marks	100			
Year	III	Credits	3			
Skill Enhancement Course						
Course Title	PRINCIPLES OF MANAGEMENT			L	T	P
				3	0	0
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students:						
<ul style="list-style-type: none"> • Understand the basic concepts and importance of management and its early thinkers. • Learn the purpose, steps, and methods of planning and decision making. • Know how organizations are structured and how authority is managed. • Understand how managers direct, lead, motivate, and communicate with teams. • Learn how controlling helps managers check progress and improve performance. 						
UNIT	TOPICS				HOURS	
I	Fundamentals of Management: Introduction Concepts, Objectives, Nature Scope and Significance of management Evolution of management thought-Contribution of Taylor, Weber and Fayol management.				12	
II	Planning: Concept, Objectives, Nature, Limitation, Process of planning, Importance, Forms, Techniques and Process of decision making.				10	
III	Organizing: Concept, Objectives, Nature of organizing, Types of Organization, delegation of authority, Authority and responsibilities, Centralization and Decentralization, Span of control.				12	
IV	Directing: Concept, Principles & Techniques of directing and Coordination Concept of leadership-Style. Importance, Styles, Supervision, Motivation, Importance Theory of Motivation, Communication.				12	
V	Controlling: Concept, Principles, Process and Techniques of Controlling, Relationship between planning and controlling.				14	

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1	Discuss the management concepts, objectives, nature, scope, significance and evolution, with contributions from Taylor, Weber, and Fayol.
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CO2	Illustrate the process of planning, including its objectives, forms, techniques and decision-making processes, explaining its importance and limitations in a management context.
CO3	Apply the principles of organizing by evaluating different organizational structures, analyzing delegation of authority, and assessing the impact of centralization and decentralization on business operations.
CO4	Examine the principles and techniques of directing, leadership styles and motivational theories, and analyze their significance in managing teams, ensuring effective communication, supervision and coordination within organizations.
CO5	Estimate the effectiveness of controlling processes and techniques and assess the relationship between planning and controlling to improve organizational performance.

Text Book:

1. D. Pagare, Principles of Management, 6th ed. New Delhi, India: Sultan Chand & Sons, 2018.

Reference Books:

1. L. M. Prasad, Principles and Practice of Management, 9th ed. New Delhi, India: Sultan Chand & Sons, 2016.
2. V. S. P. Rao and P. S. Narayana, Principles and Practice of Management. New Delhi, India: Konark Publishers Pvt. Ltd., 1987.
3. R. Srinivasan and S. A. Chunawalla, Management Principles and Practice, 1st ed. Mumbai, India: Himalaya Publishing House, 2014.

Mapping of Course Outcomes (CO's) with PO's & PSO's

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	0	2	2	0	2	2	0	1	2	1	2	2	2	2
CO2	1	1	1	2	2	2	2	1	1	2	1	1	2	3	2
CO3	3	1	1	2	2	2	2	1	1	2	1	1	2	3	2
CO4	3	3	2	3	2	2	2	1	2	3	2	2	3	3	2
CO5	3	3	2	3	2	2	2	1	2	3	2	2	3	3	2

3 – high, 2 – Average, 1 - Low , 0-Null

Semester VI

Programme	B.Tech ECE (AI & ML)	Programme Code	BTEM			
Course Code	25BTEM161	Number of Hours/Week	3			
Semester	VI	Max. Marks	100			
Year	III	Credits	3			
Core Course						
Course Title	WIRELESS SENSOR TECHNOLOGY			L	T	P
			3	0	0	
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students:						
<ul style="list-style-type: none"> • To understand the characteristics, basic concepts in Wireless sensor networks • To understand the architecture framework and goals of WSN • To understand the Medium Access control and its protocols • To understand the routing metrics and network layer protocols • To understand the QoS based routing protocols 						
UNIT	TOPICS				HOURS	
I	Introduction: Components of a wireless sensor node, Motivation for a Network of Wireless Sensor Nodes, Classification of sensor networks, Characteristics of wireless sensor networks, Challenges of wireless sensor networks, Comparison between wireless sensor networks and wireless mesh networks, Limitations in wireless sensor networks, Design challenges, Hardware architecture.				9	
II	Basic Architectural Frame-work :-Physical Layer, Basic Components, Source Encoding, Channel Encoding, Modulation. Network Architecture - Sensor Network Scenarios, Optimization Goals and Figures of Merit, Gateway Concepts.				9	
III	Medium Access Control: Wireless MAC Protocols, Characteristics of MAC Protocols in Sensor Networks, Contention-Free MAC Protocols, Contention-Based MAC Protocols, and Hybrid MAC Protocols. Location discovery, quality, other issues, S-MAC, IEEE 802.15.4.				9	
IV	Network Layer: Routing Metrics, Flooding and Gossiping, Data Centric Routing, Proactive Routing, On-Demand Routing, Hierarchical Routing, Location-Based Routing				9	
V	QoS-Based Routing Protocols: Node and Network Management: Power Management, Local Power Management aspects, Dynamic Power Management, Conceptual Architecture				9	

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1	Understand the challenges, design goals and architecture of Wireless sensor networks
CO2	Understand the channel encoding and modulation mechanism.
CO3	Understand the contention free and contention-based MAC protocols.
CO4	Understand the routing metrics and protocols of Network layer
CO5	Understand the QoS based routing protocols

Text Book:

1. WaltenegusDargie, Christian Poellabauer, –Fundamentals of Wireless Sensor Networks: Theory and Practicel, Wiley 2010
2. Mohammad S. Obaidat, Sudip Misra, –Principles of Wireless Sensor Networksl, Cambridge, 2014

Reference Books:

1. Ian F. Akyildiz, Mehmet Can Vuran , –Wireless Sensor Networksl, Wiley 2010
2. C S Raghavendra, K M Sivalingam, TaiebZnati, –Wireless Sensor Networksl, Springer, 2010 Keith D Cooper and Linda Torczon, Engineering a Compilerl, Morgan Kaufmann Publishers Elsevier Science, 2004.

Mapping of Course Outcomes (CO's) with PO's & PSO's

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	2	2	1	1	3	2	2	1	3	2	1
CO2	2	3	2	1	3	2	3	1	2	3	1	2	2	3	2
CO3	3	2	3	2	2	3	1	1	2	2	3	2	3	2	2
CO4	2	3	2	3	2	1	2	2	3	3	2	3	2	1	3
CO5	1	1	2	3	1	2	3	3	1	1	3	2	1	2	3

3 – high, 2 – Average, 1 - Low , 0-Null

Programme	B.Tech ECE (AI & ML)	Programme Code	BTEM			
Course Code	25BTEM162	Number of Hours/Week	3			
Semester	VI	Max. Marks	100			
Year	III	Credits	3			
Core Course						
Course Title	DIGITAL IMAGE PROCESSING			L	T	P
			3	0	0	
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students:						
<ul style="list-style-type: none"> • Distinguish / Analyse the various concepts and mathematical transforms necessary for image processing • Differentiate and interpret the various image enhancement technique • Illustrate image segmentation algorithm • Understand the basic image compression techniques 						
UNIT	TOPICS				HOURS	
I	Digital Image Fundamentals: Image representation, basic relationship between pixels, elements of DIP system, elements of visual perception-simple image formation model. Vidicon and Digital Camera working principles Brightness, contrast, hue, saturation, Mach band effect Colour image fundamentals-RGB, CMY, HIS models, 2D sampling, quantization				9	
II	Review of matrix theory: row and column ordering- Toeplitz, Circulant and block matrix 2D Image transforms: DFT, its properties, Walsh transform, Hadamard transform, Haar transform, DCT, KL transform and Singular Value Decomposition. Image Compression: Need for compression, Basics of lossless compression – bit plane coding, run length encoding and predictive coding, Basics of lossy compression – uniform and non-uniform quantization techniques used in image compression, Concept of transform coding, JPEG Image compression standard				9	
III	Image Enhancement: Spatial domain methods: point processing-intensity transformations, histogram processing, image subtraction, image averaging. Spatial filtering- smoothing filters, sharpening filters.Frequency domain methods: low pass filtering, high pass filtering, homomorphic filter				9	
IV	Image Restoration: Degradation model, Unconstraint restoration-Lagrange multiplier and constraint restoration. Inverse filtering-removal of blur caused by uniform linear motion, Weiner filtering, Geometric transformations-spatial transformations				9	

V	Image segmentation: Classification of Image segmentation techniques, region approach, clustering techniques. Segmentation based on thresholding, edge-based segmentation. Classification of edges, edge detection, Hough transform, active contour	9
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COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1	Understand the challenges, design goals and architecture of Wireless sensor networks
CO2	Understand the channel encoding and modulation mechanism.
CO3	Understand the contention free and contention-based MAC protocols.
CO4	Understand the routing metrics and protocols of Network layer
CO5	Understand the QoS based routing protocols

Text Book:

1. Gonzalez Rafel C, Digital Image Processing, Pearson Education, 2009
2. S Jayaraman, S Esakkirajan, T Veerakumar, Digital image processing, Tata Mc Graw Hill, 2015

Reference Books:

1. Jain Anil K , Fundamentals of digital image processing: , PHI,1988
2. Kenneth R Castleman , Digital image processing:, Pearson Education,2/e,2003
3. Pratt William K , Digital Image Processing: , John Wiley,4/e,2007

Mapping of Course Outcomes (CO's) with PO's & PSO's

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	2	2	1	1	3	2	2	1	3	2	1
CO2	2	3	2	1	3	2	3	1	2	3	1	2	2	3	2
CO3	3	2	3	2	2	3	1	1	2	2	3	2	3	2	2
CO4	2	3	2	3	2	1	2	2	3	3	2	3	2	1	3
CO5	1	1	2	3	1	2	3	3	1	1	3	2	1	2	3

3 – high, 2 – Average, 1 - Low , 0-Null

Programme	B.Tech ECE (AI & ML)	Programme Code	BTEM			
Course Code	25BTEM163	Number of Hours/Week	3			
Semester	VI	Max. Marks	100			
Year	III	Credits	3			
Core Course						
Course Title	CRYPTOGRAPHY AND NETWORK SECURITY			L	T	P
				3	0	0
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students:						
<ul style="list-style-type: none"> • To gain insights into security principles, legal aspects, and threat mitigation strategies. • To explore encryption techniques and their role in ensuring data confidentiality. • To understand cryptographic algorithms and key management in secure communication. • To analyze authentication protocols and digital security measures for integrity. • To study real-world cybersecurity practices, including intrusion detection and firewall defense. 						
UNIT	TOPICS				HOURS	
I	INTRODUCTION Security trends - Legal, Ethical and Professional Aspects of Security, Need for Security at Multiple levels, Security Policies - Model of network security – Security attacks, services and mechanisms – OSI security architecture – Classical encryption techniques: substitution techniques, transposition techniques, steganography) - Foundations of modern cryptography: perfect security – information theory – product cryptosystem – cryptanalysis.				9	
II	SYMMETRIC CRYPTOGRAPHY Mathematics Of Symmetric Key Cryptography: Algebraic structures - Modular arithmetic- Euclids algorithm- Congruence and matrices - Groups, Rings, Fields- Finite fields- SYMMETRIC KEY CIPHERS: SDES – Block cipher Principles of DES – Strength of DES – Differential and linear cryptanalysis - Block cipher design principles – Block cipher mode of operation – Evaluation criteria for AES – Advanced Encryption Standard - RC4 – Key distribution				9	
III	PUBLIC KEY CRYPTOGRAPHY Mathematics Of Asymmetric Key Cryptography: Primes – Primarily Testing –Factorization – Euler ‘s totient function, Fermat ‘s and Euler ‘s Theorem - Chinese Remainder Theorem – Exponentiation and logarithm - Asymmetric Key Ciphers: RSA cryptosystem – Key distribution – Key management – Diffie Hellman key exchange - ElGamal cryptosystem – Elliptic curve arithmetic-Elliptic curve cryptography.				9	
IV	MESSAGE AUTHENTICATION AND INTEGRITY Authentication requirement – Authentication function – MAC – Hash function – Security of hash function and MAC – SHA –Digital signature and authentication protocols – DSS- Entity Authentication: Biometrics, Passwords, Challenge Response protocols- Authentication applications - Kerberos, X.509				9	

V	SECURITY PRACTICE AND SYSTEM SECURITY Electronic Mail security – PGP, S/MIME – IP security – Web Security – SYSTEM SECURITY: Intruders – Malicious software – viruses – Firewalls	9
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COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1	Understand fundamental security concepts, threats, and classical encryption techniques
CO2	Apply symmetric and asymmetric cryptographic algorithms for secure communication
CO3	Implement authentication mechanisms, digital signatures, and hash functions for data integrity
CO4	Analyze network and system security threats, including malware, intrusion detection, and firewalls.
CO5	Explore security applications in email, web, and IP communication, ensuring end-to-end protection.

Text Book

1. William Stallings, Cryptography and Network Security: Principles and Practice, PHI 3rd Edition, 2006.
2. Cryptography and Network Security: Atul Kahate, Mc Graw Hill, 3rd Edition

Reference Books

1. Cryptography and Network Security: C K Shyamala, N Harini, Dr T R Padmanabhan, Wiley India, 1st Edition.
2. Cryptography and Network Security: Forouzan Mukhopadhyay, Mc Graw Hill, 3rd Edition
3. Information Security, Principles, and Practice: Mark Stamp, Wiley India.
4. Principles of Computer Security: WM. Arthur Conklin, Greg White, TMH
5. Introduction to Network Security: Neal Krawetz, CENGAGE Learning

Mapping of Course Outcomes (CO's) with PO's & PSO's

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	2	2	1	2	2	1	3	3	2	2
CO2	3	3	3	3	3	2	2	2	2	2	2	3	3	3	2
CO3	3	2	3	3	3	2	2	2	3	2	2	3	3	3	2
CO4	3	3	3	3	3	3	3	3	2	2	2	3	3	3	3
CO5	2	2	2	3	3	3	2	2	2	3	2	3	3	2	2

3 – high, 2 – Average, 1 - Low , 0-Null

Programme	B.Tech ECE (AI & ML)	Programme Code	BTEM			
Course Code	25BTEM364	Number of Hours/Week	3			
Semester	VI (PSE V)	Max. Marks	100			
Year	III	Credits	3			
Programme Specific Elective						
Course Title	APPLIED ARTIFICIAL INTELLIGENCE			L	T	P
			3	0	0	
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students:						
<ul style="list-style-type: none"> • To understand advanced concepts in artificial intelligence • To formulate artificial intelligence model with knowledge representation • To learn problem solving approaches through decision processes • To develop an AI model with the help of concepts such as searches, knowledge representation etc. 						
UNIT	TOPICS				HOURS	
I	Introduction to AI and searches Introducing the structure and scope of the course; Brief introduction and history of AI; state space searches; informed and uninformed searches; local searches; adversarial searches;				8	
II	Logic in AI Different knowledge representation systems; syntax; semantics; forward chaining; Resolution; Reduction in satisfiability problems; SAT solvers; DPLL algorithms; Walk SAT algorithms				8	
III	Uncertainty in AI Basics of probability; conditional independence and bayes rule; Bayesian networks – syntax, factorization, conditional independence and d-separation; inference using variable elimination; reducing 3-SAT to Bayes net; rejection sampling; likelihood weighing; MCMC with Gibbs sampling; maximum likelihood learning;				8	
IV	Decision Theory Steps in decision theory; non-deterministic uncertainty; probabilistic uncertainty and value of perfect information; expected utility and expected value; Markov decision process – policy evaluation using system of linear equations, iterative policy evaluation, value iteration, policy iteration and applications, extensions of MDPs				8	

V	Reinforcement Learning Background; Model based learning for policy evaluation; model free learning for policy evaluation; TD learning and computational neuroscience; Q Learning; Exploration vs Exploitation tradeoff; generalization in RL	8
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COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1	Describe the history behind artificial intelligence
CO2	Illustrate fundamental AI concepts
CO3	Demonstrate problem formulation in state space search
CO4	Infers adversarial search with alpha-beta pruning
CO5	Develop an AI model for existing problems

Text Books:

1. Stuart Russell and Peter Norvig. Artificial Intelligence: A Modern Approach. Prentice Hall Press, USA, 3rd edition, 2009

Mapping of Course Outcomes (CO's) with PO's & PSO's

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	1	0	0	1	0	3	0	1	0	3	2	0	0
CO2	3	2	3	3	0	2	0	0	0	2	0	1	0	3	3
CO3	3	1	2	2	0	2	0	0	0	2	1	1	1	1	3
CO4	3	1	2	2	0	2	0	0	0	2	1	1	0	1	2
CO5	2	2	3	3	3	1	3	3	3	2	2	1	3	3	3

3 – high, 2 – Average, 1 - Low , 0-Null

Programme	B.Tech ECE (AI & ML)	Programme Code	BTEM			
Course Code	25BTEM362	Number of Hours/Week	3			
Semester	VI (PSE V)	Max. Marks	100			
Year	III	Credits	3			
Programme Specific Elective						
Course Title	COMPUTER VISION			L	T	P
				3	0	0
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students:						
<ul style="list-style-type: none"> • To introduce the fundamental concepts of computer vision, including image formation, feature extraction, and camera models. • To develop an understanding of image processing techniques such as edge detection, image segmentation, and feature extraction. • To study various algorithms for object detection, recognition, and tracking. • To explore advanced topics in computer vision, including 3D vision, motion analysis, and image stitching. • To apply computer vision methods to real-world applications, including robotics, augmented reality, and autonomous vehicles. 						
UNIT	TOPICS				HOURS	
I	Introduction to Computer Vision Overview of Computer Vision-History, scope, and applications of computer vision-Computer vision vs. image processing-Basic concepts: image formation, camera models, and projection-Image Representation and Properties-Color models -Image transformations.				9	
II	Image Processing for Computer Vision Image Preprocessing-Image enhancement -Image smoothing and filtering-Edge-Detection and Feature Extraction-Sobel, Canny, and Laplacian edge detection-Corner detection (Harris, FAST, SIFT, SURF)-Image Segmentation-Thresholding-Region-based segmentation -region growing, watershed-Clustering-based segmentation.				9	
III	Geometric Transformations and Camera Models Geometric Transformations-Affine and projective transformations-Homography and its applications in image stitching.Camera Models and Calibration-Pinhole camera model-Camera calibration techniques-intrinsic and extrinsic parameters-Depth estimation using stereo vision				9	
IV	Object Detection and Recognition Object Detection-Sliding window, Haar cascades, Histogram of Oriented Gradients features-Modern approaches -YOLO, SSD, Faster R-CNN-Object Recognition-Template matching, feature				9	

	matching-Machine learning for object recognition -Deep learning-based recognition (CNNs)-Face Recognition-Eigenfaces, Fisherfaces-Deep learning approaches	
V	Motion Analysis and Tracking Optical Flow-Horn-Schunck and Lucas-Kanade methods for optical flow estimation-Motion Segmentation-Object Tracking-Tracking algorithms -Kalman filter, Mean-shift, and CAMShift-multi-object tracking-Visual odometry and motion capture	9

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1:	Understand the core principles and techniques used in computer vision.
CO2:	Apply image processing algorithms for feature extraction, edge detection, and image segmentation.
CO3:	Implement object detection and recognition algorithms.
CO4:	Analyze motion in images and videos using optical flow and tracking techniques.
CO5:	Develop computer vision solutions for practical applications in robotics, augmented reality, and autonomous systems.

Text Books:

1. **"Computer Vision: Algorithms and Applications"** by Richard Szeliski
Publisher: Springer. ISBN: 978-1848829343
2. **"Computer Vision: A Modern Approach"** by David A. Forsyth and Jean Ponce,
Publisher: Pearson, ISBN: 978-0136085928
3. **"Multiple View Geometry in Computer Vision"** by Richard Hartley and Andrew Zisserman, Cambridge University Press, ISBN: 978-0521540513
4. **"Deep Learning for Computer Vision"** by Rajalingappaa Shanmugamani, Publisher: Apress, ISBN: 978-1484229577

Reference Books:

1. **"Learning OpenCV 3: Computer Vision in C++ with the OpenCV Library"** by Adrian Kaehler and Gary Bradski, Publisher: O'Reilly Media, ISBN: 978-1491937996
2. **"Programming Computer Vision with Python: Tools and algorithms for analyzing images"** by Jan Erik Solem, Publisher: O'Reilly Media, ISBN: 978-1449316434

Mapping of Course Outcomes (CO's) with PO's & PSO's

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	2	-	-	-	-	-	-	2	3	2	-

CO2	3	3	3	3	3	-	-	-	-	-	-	2	3	2	2
CO3	3	3	3	3	3	-	-	-	-	-	-	2	3	3	2
CO4	3	3	3	3	3	-	-	-	-	-	-	3	3	3	3
CO5	3	3	3	3	3	-	-	-	-	-	-	3	3	3	3

3 – high, 2 – Average, 1 - Low , 0-Null

Programme	B.Tech ECE (AI & ML)	Programme Code	BTEM			
Course Code	25BTEM363	Number of Hours/Week	3			
Semester	VI (PSE V)	Max. Marks	100			
Year	III	Credits	3			
Programme Specific Elective						
Course Title	PREDICTIVE ANALYSIS			L	T	P
				3	0	0
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students:						
<ul style="list-style-type: none"> • To introduce the fundamentals of predictive analytics and differentiate it from other forms of data analytics, including descriptive and prescriptive analytics. • To equip students with essential statistical and mathematical tools required to understand, build, and evaluate predictive models. • To provide a strong foundation in supervised machine learning techniques used for prediction tasks, including regression, classification, and ensemble methods. • To develop competency in time-series forecasting methods, enabling students to build models that can predict future values based on historical data. • To offer practical exposure through real-world case studies and applications, helping students to apply predictive modeling techniques in diverse domains such as finance, healthcare, and marketing. • To familiarize students with ethical considerations, model interpretability, and deployment strategies involved in the real-world use of predictive analytics systems. 						
UNIT	TOPICS				HOURS	
I	Introduction to Predictive Analytics: Introduction to Analytics: Descriptive, Predictive, and Prescriptive Analytics- Predictive Modeling Process: Problem formulation, Data understanding, Data preparation- Types of Predictive Models: Classification, Regression, Time-series- Model evaluation: Overfitting, Underfitting, Bias-Variance tradeoff- Tools and platforms for predictive analytics (e.g., R, Python, SAS, RapidMiner)				9	
II	Statistical Foundations for Prediction: Probability theory and distributions- Descriptive and inferential statistics- Hypothesis testing and confidence intervals- Correlation and causation- Feature selection techniques: Chi-square test, ANOVA, Mutual Information.				9	
III	Machine Learning for Predictive Modeling: Supervised learning: Linear Regression, Logistic Regression, k-NN- Decision Trees and Ensemble Methods: Random Forests, Gradient Boosting- Support Vector Machines (SVM)- Model evaluation metrics: Accuracy, Precision, Recall, F1-score, ROC-AUC- Cross-validation and Hyper-parameter tuning.				9	

IV	Time Series Forecasting: Time Series Components: Trend, Seasonality, Noise-Forecasting methods: Moving Average, Exponential Smoothing, ARIMA-Stationarity and Differencing-ACF and PACF plots-Introduction to advanced models: Prophet, LSTM (optional for advanced students)	9
V	Applications and Case Studies: Predictive analytics in real-world domains: Finance, Healthcare, Marketing, Supply Chain- Case study: Customer churn prediction /Credit scoring / Stock price forecasting-Ethics and Privacy in Predictive Modeling-Model deployment: Introduction to APIs and MLOps concepts- Project Work and Presentations.	9

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1:	Understand the role of predictive analytics in the broader data science ecosystem.
CO2:	Apply fundamental statistical techniques for data analysis and hypothesis testing.
CO3:	Build regression and classification models for structured data prediction.
CO4:	Understand the components of time-series data: trend, seasonality, and noise.
CO5:	Analyze predictive models through real-world applications (e.g., churn, risk scoring).

Text Books:

1. Max Kuhn, Kjell Johnson, Applied Predictive Modeling, Publisher: Springer, 1st Edition, 2013, ISBN: 978-1461468486.
2. Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, An Introduction to Statistical Learning: with Applications in R, Springer, 2nd Edition, 2021, ISBN: 978-1071614174.
3. Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, O'Reilly Media, 2nd Edition, 2019., ISBN: 978-1492032649.

Reference Books:

1. Francesca Lazzeri, Machine Learning for Time Series Forecasting with Python, Wiley, 1st Edition, July 2020, ISBN: 978-1119682363.
2. Foster Provost and Tom Fawcett, Data Science for Business: What You Need to Know about Data Mining and Data-Analytic Thinking, O'Reilly Media, Updated Paperback Edition, 2020 (Reprint with updates), ISBN: 978-1098104023.

Mapping of Course Outcomes (CO's) with PO's & PSO's

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	2	-	-	-	-	-	-	2	3	2	-
CO2	3	3	3	3	3	-	-	-	-	-	-	2	3	2	2
CO3	3	3	3	3	3	-	-	-	-	-	-	2	3	3	2
CO4	3	3	3	3	3	-	-	-	-	-	-	3	3	3	3
CO5	3	3	3	3	3	-	-	-	-	-	-	3	3	3	3

3 – high, 2 – Average, 1 - Low , 0-Null

Programme	B.Tech ECE (AI & ML)	Programme Code	BTEM			
Course Code	25BTEM364	Number of Hours/Week	3			
Semester	VI (PSE VI)	Max. Marks	100			
Year	III	Credits	3			
Programme Specific Elective						
Course Title	APPLIED MACHINE LEARNING			L	T	P
				3	0	0
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students:						
<ul style="list-style-type: none"> • To explore classical and advanced concepts in machine learning • To equip different optimization strategies in machine learning • To construct an existing problem into standard machine learning paradigm • To dealt with generative models for machine learning applications. 						
UNIT	TOPICS				HOURS	
I	Introduction and optimization Introduction and its history; basics of optimization problems; convex sets and convex functions; strictly and strongly convex functions; implications of strong convexity; primal and dual optimization problems; slaters condition; analysis of gradient descent algorithm; KKT conditions				8	
II	Classical Machine Learning Bias-variance tradeoff; regression; Bayesian decision theory; Bayesian belief networks; parameter estimation and maximum likelihood estimation; parameter estimation and Bayesian estimation; concepts of non-parametric techniques; density estimation by parzen window; parzen window and KNN algorithm				8	
III	Dimensionality reduction and Classification Dimensionality problem; principal component analysis; eigen decomposition and singular value decomposition; linear discriminant analysis; ensemble classifiers; gaussian mixture models and EM algorithm;				8	
IV	Deep Learning Neural networks; multilayer perceptron; backpropagation algorithm; autoencoder – deep autoencoder, sparse auto encoder, denoising autoencoder; large ML models and architectures; issues in training deep neural networks;				8	

V	Generative models Background; autoregressive models; maximum likelihood learning; variational auto encoders; normalizing flows; Generative adversarial networks; energy-based models; score-based models; diffusion models for discrete data;	8
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COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1	Infers basic optimizations in machine learning
CO2	Distinguish different ML concepts in terms of applications
CO3	Implement generative models for ML applications
CO4	Validate the ML models to improve the performance
CO5	Develop an innovative ML model for existing problems

Text Books:

1. Gauri Joshi, Optimization Algorithms for Distributed Machine Learning SpringerLink, 2022.
2. Andrew Ng., Machine Learning Yearning. deeplearning.ai, 2018.
3. Stefano Ermon, Deep Generative models CS236 Fall 2023

Reference Books:

1. Ian J. Goodfellow, Yoshua Bengio, and Aaron Courville. Deep Learning. MIT Press, Cambridge, MA, USA, 2016.

Mapping of Course Outcomes (CO's) with PO's & PSO's

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	3	0	1	0	0	0	1	0	3	0	1	2
CO2	3	2	1	3	1	0	2	0	0	1	0	2	1	2	3
CO3	3	2	2	3	3	2	3	0	0	2	0	2	2	2	3
CO4	2	3	1	2	3	1	2	1	1	1	1	2	2	1	3
CO5	3	2	3	3	3	2	3	3	3	2	2	2	3	3	3

3 – high, 2 – Average, 1 - Low , 0-Null

Programme	B.Tech ECE (AI & ML)	Programme Code	BTEM			
Course Code	25BTEM365	Number of Hours/Week	3			
Semester	VI (PSE VI)	Max. Marks	100			
Year	III	Credits	3			
Programme Specific Elective						
Course Title	INTERNET OF THINGS			L	T	P
				3	0	0
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students:						
<ul style="list-style-type: none"> • To understand the fundamentals, applications, and challenges of IoT. • To explore IoT system design, architecture, and embedded systems. • To analyze IoT communication protocols and networking techniques. • To study IoT data analytics, cloud integration, and machine learning applications. • To examine real-world IoT applications, security challenges, and future trends. 						
UNIT	TOPICS				HOURS	
I	Introduction to to IoT: Basics of IoT – IoT Characteristics – IoT Applications – Challenges in IoT – Smart Homes – Healthcare – Agriculture – Industrial IoT – Security and Privacy in IoT – Best Practices in IoT System Design.				9	
II	IoT Architecture & Design Methodology: IoT System Design – IoT Architecture Layers – Embedded Systems for IoT – Sensors & Actuators – Interfacing Techniques – Power Management in IoT Devices.				9	
III	IoT Communication & Networking: Wireless Communication Protocols – Bluetooth – Wi-Fi – Zigbee – LoRa – 5G – IoT Protocol Stack – MQTT – CoAP – Data Transmission in IoT – Designing Low-Power and Scalable IoT Networks – Edge and Fog Computing.				9	
IV	IoT Data Analytics & Cloud Integration: Data Collection & Storage – Cloud Computing for IoT – AWS IoT – IBM Watson – Google Cloud IoT – IoT Data Processing – AI & Machine Learning in IoT – Data Encryption & Secure Storage Methods.				9	
V	IoT Applications & Case Studies: IoT in Smart Cities – IoT in Healthcare – Predictive Maintenance – IoT-Based Automation – Security & Ethical Issues in IoT – Legal and Privacy Considerations – Future Trends in IoT.				9	

COURSE OUTCOMES:

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

CO1	Define IoT fundamentals, classify IoT characteristics, and analyze security aspects.
CO2	Develop IoT systems, integrate embedded components, and configure sensors and actuators.
CO3	Implement IoT communication protocols, analyze networking techniques, and demonstrate their applications.
CO4	Deploy IoT solutions on cloud platforms, process IoT data, and assess system performance.
CO5	Compare IoT applications, assess security risks, and justify ethical considerations.

Text book:

1. “Internet of Things for Architects”, Perry Lea, Packt Publishing, 2018.

References:

1. “Building the Internet of Things: Implement New Business Models, Disrupt Competitors, Transform Your Industry”, Maciej Kranz, Wiley, 2016.
2. “Designing the Internet of Things”, Adrian McEwen and Hakim Cassimally, Wiley, 2013.

Mapping of Course Outcomes (CO's) with PO's & PSO's

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	3	2	1	1	1	2	2	3	3	2	3
CO2	3	3	3	3	3	2	1	1	2	2	3	3	3	3	3
CO3	3	3	3	3	3	2	1	1	2	2	3	3	3	3	3
CO4	3	3	3	3	3	2	1	1	2	2	3	3	3	3	3
CO5	3	3	2	3	3	3	2	3	2	3	3	3	3	3	3

3 – high, 2 – Average, 1 - Low , 0-Null

Programme	B.Tech ECE (AI & ML)	Programme Code	BTEM			
Course Code	25BTEM366	Number of Hours/Week	3			
Semester	VI (PSE VI)	Max. Marks	100			
Year	III	Credits	3			
Programme Specific Elective						
Course Title	DATA VISUALIZATION			L	T	P
				3	0	0
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students:						
<ul style="list-style-type: none"> • To understand the various types of data, apply and evaluate the principles of data visualization • Acquire skills to apply visualization techniques to a problem and its associated dataset • To apply structured approach to create effective visualizations • To learn how to bring valuable insight from the massive dataset using visualization • To create interactive visualization for better insight using various visualization tools 						
UNIT	TOPICS				HOURS	
I	Introduction to Data Visualization Overview of data visualization, Data Abstraction, Task Abstraction, Analysis: Four Levels for Validation				9	
II	Visualization Techniques Scalar and point techniques, vector visualization techniques, multidimensional techniques, visualizing cluster analysis, matrix visualization in Bayesian data analysis				9	
III	Visual Analytics Networks and Trees, Heat Map, Map Color and Other channels, Manipulate View, Visual Attributes				9	
IV	Visualization Tools and Techniques Introduction to various data visualization tools, Visualization using R, Diverse Types of Visual Analysis, Time, Series data visualization, Text data visualization, Multivariate data visualization and case studies				9	
V	Integration of Data Visualization & Recent Trends Integration of visualization tools with Hadoop, Dashboard creation using visualization tools for the use cases: Finance, marketing-insurance-healthcare etc., Recent trends				9	

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1	Explain the concept of augmented intelligence and its distinction from traditional AI, along with its applications and ethical challenges.
CO2	Demonstrate the use of machine learning, natural language processing, and computer vision in the development of augmented intelligence systems.
CO3	Design human-centric AI solutions that enhance human decision-making through effective human-machine collaboration.
CO4	Evaluate the performance of augmented intelligence systems, focusing on model optimization, data integration, and system architecture.
CO5	Develop forward-thinking augmented intelligence solutions, incorporating emerging technologies and ethical practices to address future challenges.

Text Books:

1. Wilke CO. Fundamentals of data visualization: a primer on making informative and compelling figures. O'Reilly Media; 2019 Mar 18.

Reference Books:

1. Chen M, Hauser H, Rheingans P, Scheuermann G, editors. Foundations of data visualization. Cham, Switzerland: Springer International Publishing; 2020 Aug 11.
2. Healy K. Data visualization: a practical introduction. Princeton University Press; 2024 Sep 10.

Mapping of Course Outcomes (CO's) with PO's & PSO's

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO 1	1	0	2	0	2	0	0	0	0	0	0	0	0	1	0
CO 2	0	2	0	1	1	0	2	0	3	0	1	2	2	1	3
CO 3	0	0	0	1	0	0	2	0	0	0	0	0	2	3	1
CO 4	0	2	2	0	1	2	0	0	3	0	0	1	1	0	0
CO 5	3	0	2	0	0	0	0	0	1	1	0	0	1	2	3

3 – high, 2 – Average, 1 - Low , 0-Null

Programme	B.Tech ECE (AI & ML)	Programme Code	BTEM			
Course Code	25BTEM261	Number of Hours/Week	2			
Semester	VI	Max. Marks	100			
Year	III	Credits	1			
Core Course						
Course Title	DIGITAL IMAGE PROCESSING LAB			L	T	P
			0	0	2	
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
<p>The main learning objective of this course is to prepare the students for:</p> <ul style="list-style-type: none"> • Understand and implement basic image processing operations such as enhancement and filtering. • Analyze images using different transformation techniques. • Apply image processing methods for segmentation and feature extraction. • Develop programs for processing and analyzing digital images. • Evaluate and interpret the results of image processing techniques for real-world applications. 						
LIST OF EXPERIMENTS						
<ol style="list-style-type: none"> 1. Simulation and Display of an Image, Negative of an Image(Binary & Gray Scale) 2. Implementation of Relationships between Pixels 3. Implementation of Transformations of an Image 4. Contrast stretching of a low contrast image, Histogram, and Histogram Equalization 5. Display of bit planes of an Image 6. Display of FFT (1-D & 2-D) of an image 7. Computation of Mean, Standard Deviation, Correlation coefficient of the given Image 8. Implementation of Image Smoothing Filters (Mean and Median filtering of an Image) 9. Implementation of image sharpening filters and Edge Detection using Gradient Filters 10. Image Compression by DCT, DPCM, HUFFMAN coding 11. Implementation of image restoring techniques 12. Implementation of Image Intensity slicing technique for image enhancement 13. Canny edge detection Algorithm 						

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1	Study the image fundamentals, mathematical transforms necessary for image processing
CO2	About the various techniques of image enhancement, reconstruction, compression and segmentation
CO3	Know sampling and reconstruction procedures
CO4	Design image processing systems
CO5	Apply image processing techniques using appropriate tools and software for solving real-world problems

Mapping of Course Outcomes (CO's) with PO's & PSO's

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	2	–	2	2	1	1	0	3	2	1	1
CO2	3	3	2	2	2	–	2	3	2	1	0	3	3	2	2
CO3	3	3	3	2	3	1	2	3	3	2	0	3	3	3	2
CO4	3	3	2	3	3	–	2	3	2	2	0	3	3	2	3
CO5	3	3	3	3	3	2	3	3	3	3	0	3	3	3	3

3 – high, 2 – Average, 1 - Low , 0-Null

Programme	B.Tech ECE (AI & ML)	Programme Code	BTEM			
Course Code	25BTEM262	Number of Hours/Week	2			
Semester	VI	Max. Marks	100			
Year	III	Credits	1			
Core Course						
Course Title	CRYPTOGRAPHY AND NETWORK SECURITY LAB			L	T	P
			0	0	2	
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
<p>The main learning objective of this course is to prepare the students for:</p> <ul style="list-style-type: none"> • Understand the fundamental concepts of cryptography and network security. • Learn and implement classical and modern encryption algorithms such as Caesar, DES, RSA, and Blowfish. • Develop programming skills in C, Java, and web technologies for implementing security algorithms. • Gain practical knowledge of key exchange mechanisms and secure communication techniques. • Analyze and apply cryptographic methods to ensure data confidentiality, integrity, and security. 						
LIST OF EXPERIMENTS						
<ol style="list-style-type: none"> 1. Write a C program that contains a string (char pointer) with a value \Hello World'. The programs should XOR each character in this string with 0 and display the result 2. Write a C program that contains a string (char pointer) with a value \Hello World'. The program should AND or and XOR each character in this string with 127 and display the result. 3. Write a Java program to perform encryption and decryption using the following algorithms: a. Ceaser Cipher b. Substitution Cipher c. Hill Cipher 4. Write a Java program to implement the DES algorithm logic 5. Write a C/JAVA program to implement the Blowfish algorithm logic 6. Write a C/JAVA program to implement the Rijndael algorithm logic 7. Write a Java program to implement RSA Algorithm 8. Implement the Diffie-Hellman Key Exchange mechanism using HTML and JavaScript. 						

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1	Explain security concepts, Ethics in Network Security. Identify and classify various Attacks and explain the same.
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CO2	Compare and contrast symmetric and asymmetric encryption systems and their vulnerability to various attacks
CO3	Explain the role of third-party agents in the provision of authentication services.
CO4	Comprehend and apply authentication, email security, web security services and mechanisms.
CO5	Distinguish and explain different protocol like SSL, TLS Vis-à-vis their applications

Mapping of Course Outcomes (CO's) with PO's & PSO's

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	2	–	2	2	1	1	0	3	2	1	1
CO2	3	3	2	2	2	–	2	3	2	1	0	3	3	2	2
CO3	3	3	3	2	3	1	2	3	3	2	0	3	3	3	2
CO4	3	3	2	3	3	–	2	3	2	2	0	3	3	2	3
CO5	3	3	3	3	3	2	3	3	3	3	0	3	3	3	3

3 – high, 2 – Average, 1 - Low , 0-Null

Semester VII

Programme	B.Tech ECE (AI & ML)	Programme Code	BTEM			
Course Code	25BTEM171	Number of Hours/Week	3			
Semester	VII	Max. Marks	100			
Year	IV	Credits	3			
CORE COURSE						
Course Title	MICROWAVE AND ANTENNA			L	T	P
			3	0	0	
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students to:						
<ul style="list-style-type: none"> • Understand basic terminology and concepts of Antennas. • To attain knowledge on the basic parameters those are considered in the antenna design process and the analysis while designing that. • Analyze the electric and magnetic field emission from various basic antennas and mathematical formulation of the analysis. • To have knowledge on antenna operation and types as well as their usage in real time field. • Aware of the wave spectrum and respective band-based antenna usage and also to know the propagation of the waves at different frequencies through different layers in the existing layered free space environment structure. 						
UNIT	TOPICS				HOURS	
I	Antennas Basics: Introduction, Basic Antenna Parameters – Patterns, Beam Area, Radiation Intensity, Beam Efficiency, Directivity-Gain-Resolution, Antenna Apertures, Illustrative Problems. Fields from Oscillating Dipole, Field Zones, Front - to-back Ratio, Antenna Theorems, Radiation, Retarded Potentials – Helmholtz Theorem. Thin Linear Wire Antennas – Radiation from Small Electric Dipole, Quarter Wave Monopole and Half Wave Dipole – Current Distributions, Field Components, Radiated Power, Radiation Resistance, Beam Width, Directivity, Effective Area, Effective Height, Natural Current Distributions, Far Fields and Patterns of Thin Linear Centre-fed Antennas of Different Lengths, Illustrative Problems.				8	
II	VHF, UHF and Microwave Antennas - I : Arrays with Parasitic Elements, Yagi-Uda Array, Folded Dipoles and their Characteristics, Helical Antennas – Helical Geometry, Helix Modes, Practical Design Considerations for Monofilar Helical Antenna in Axial and Normal Modes, Horn Antennas – Types, Optimum Horns, Design Considerations of Pyramidal Horns, Illustrative Problems.				7	
III	VHF, UHF and Microwave Antennas - II: Microstrip Antennas – Introduction, Features, Advantages and Limitations, Rectangular Patch Antennas – Geometry and Parameters, Characteristics of Microstrip Antennas. Impact of Different Parameters on Characteristics, Reflector Antennas – Introduction, Flat Sheet and Corner Reflectors, Paraboloidal Reflectors – Geometry, Pattern Characteristics, Feed Methods, Reflector Types – Related Features, Illustrative Problems. Lens Antennas – Introduction, Geometry of Non-metallic Dielectric Lenses, Zoning, Applications.				7	

IV	<p>Antenna Arrays: Point Sources – Definition, Patterns, arrays of 2 Isotropic Sources - Different Cases, Principle of Pattern Multiplication, Uniform Linear Arrays – Broadside Arrays, Endfire Arrays, EFA with Increased Directivity, Derivation of their Characteristics and Comparison, BSAs with Non-uniform Amplitude Distributions – General Considerations and Binomial Arrays, Illustrative Problems. Antenna Measurements: Introduction, Concepts - Reciprocity, Near and Far Fields, Coordinate System Patterns to be Measured, Pattern Measurement Arrangement, Directivity Measurement, Gain Measurements (by Comparison, Absolute and 3- Antenna Methods)</p>	8
V	<p>Wave Propagation: Ground Wave Propagation: Plane Earth Reflection, Space Wave and Surface Wave. Space Wave Propagation: Introduction, Field Strength Relation, Effects of Imperfect Earth, Effects of Curvature of Earth. Sky wave Propagation: Introduction structural Details of the ionosphere, Wave Propagation Mechanism, Refraction and Reflection of Sky Waves by ionosphere, Ray Path, Critical Frequency, MUF, LUF, OF, Virtual Height and Skip Distance, Relation Between MUF and the Skip Distance, Multi-Hop Propagation, Wave Characteristics</p>	8

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1	Explain fundamental antenna concepts, parameters, radiation mechanisms, and field regions.
CO2	Analyze radiation characteristics and performance of basic antennas such as dipoles, monopoles, arrays, and aperture antennas.
CO3	Design and analyze VHF, UHF, and microwave antennas including horn, helical, microstrip, reflector, and lens antennas.
CO4	Analyze antenna arrays and evaluate antenna characteristics using standard measurement techniques.
CO5	Explain electromagnetic wave propagation mechanisms and analyze ground wave, space wave, and sky wave propagation.

Text Books:

1. John D Krauss, Ronald J Marhefka and Ahmad S. Khan, “Antennas and Wave Propagation”, Fourth Edition, Tata McGraw Hill.

Reference Books:

1. A. R. Harish, M. Sachidananda, “Antennas and Wave Propagation”, Oxford University Press.
2. Edward Conrad Jordan and Keith George Balmain, “Electromagnetic Waves and Radiating Systems”, PHI.
3. R.L. Yadava, Electromagnetic Waves, Khanna Publishing House, Delhi.
4. A. Das, Sisir K. Das, “Microwave Engineering”, Tata McGraw Hill

Mapping of Course Outcomes (CO's) with PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	0	1	0	0	0	0	0	0	0	2	3	2	1
CO2	3	3	1	1	0	0	0	0	0	0	0	2	3	3	2
CO3	3	2	3	1	1	0	0	0	0	0	0	2	3	3	3
CO4	3	3	2	2	1	0	0	0	0	0	0	2	3	3	2
CO5	3	2	1	2	0	0	1	0	0	0	0	2	3	2	3

3 – High, 2 – Average, 1 – Low , 0-Null

Programme	B.Tech ECE (AI & ML)	Programme Code	BTEM			
Course Code	25BTEM172	Number of Hours/Week	3			
Semester	VII	Max. Marks	100			
Year	IV	Credits	3			
CORE COURSE						
Course Title	VLSI DESIGN			L	T	P
			3	0	0	
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students to:						
<ul style="list-style-type: none"> • To introduce System Verilog for design and verification of VLSI circuits. • To understand the fundamentals of IC technology, components and their characteristics. • To understand combinational logic circuits and design principles. • To understand sequential logic circuits and clocking strategies. • To understand Memory Architecture and arithmetic building blocks 						
UNIT	TOPICS				HOURS	
I	Introduction to System Verilog Components of System Verilog- Literal values- data Types – Arrays – Queues- Strings Composite Type – Expressions – Behavioral modeling, Structural modeling – Packages -Tasks and Functions – Verification using System Verilog: Clocking and Program block – Events - Random constraint generation – Assertions – Immediate assertions – Concurrent assertions.				9	
II	CMOS Logic CMOS Inverter, Logic Gates, Design of Compound Gates, Pass Transistor Gates and Transmission Gates, CMOS Fabrication Process, Layout Design Rules, Gate layout, Stick Diagrams, Propagation Delays, Elmore's constant, Logical Effort, Power Dissipation.				9	
III	COMBINATIONAL LOGIC CIRCUITS Circuit Families: Static CMOS, Ratioed Circuits, CVSL, Dynamic Circuits, Pass Transistor Circuits, Examples of combinational logic design, Circuit pitfalls, Low Power Design principles.				9	
IV	SEQUENTIAL LOGIC CIRCUITS AND CLOCKING STRATEGIES Static Latches and Registers, Dynamic Latches and Registers, Pipelines, Non-bistable Sequential Circuits, Timing classification of Digital Systems, Synchronous Design, Self Timed Circuit Design.				9	

V	ARITHMETIC CIRCUITS AND MEMORY ARCHITECTURE Adders-Binary adder, Ripple carry adder, Carry look ahead adder, Multiplier-array multiplier, Carry save multiplier, Booth Multiplier, Wallace tree multiplier, Shifters- Barrel shifter, Logarithmic shifter, Logic Implementation using Programmable Devices (PROM, PLA, PAL, FPGA), Memory Classification, Memory Architecture and Building Blocks	9
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Course Outcomes

Upon successful completion of this course, the student will be able to:

CO1	Develop HDL description for combinational and sequential circuits design and verification
CO2	In depth knowledge of CMOS technology
CO3	Understand Combinational Logic Circuits and Design Principles
CO4	Understand Sequential Logic Circuits and Clocking Strategies
CO5	Understand Memory architecture and building blocks

Text Books:

1. Jan D Rabaey, AnanthaChandrakasan, “Digital Integrated Circuits: A Design Perspective”, PHI, 2016.
2. Neil H E Weste, Kamran Eshranghian, “Principles of CMOS VLSI Design: A System Perspective,” Addison Wesley, 2009.
3. J.Bhasker, “A System Verilog: Primer”, 2001

References

1. D.A.Hodges and H.G.Jackson, Analysis and Design of Digital Integrated Circuits, International Student Edition, McGraw Hill 1983
2. M. Morris Mano and Michael D. Ciletti, ‘Digital Design’, Pearson, 5th Edition, 2013

Mapping of Course Outcomes (CO’s) with PO’s & PSO’s

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	2	0	0	0	0	0	3	3	2	2
CO2	3	3	3	3	2	3	0	0	2	1	2	3	3	3	3
CO3	3	2	3	3	3	0	0	0	2	2	0	3	3	3	3
CO4	3	3	3	3	2	0	0	3	0	0	0	2	2	2	2
CO5	0	0	0	0	2	2	2	2	0	0	0	0	1	1	1

3 – High, 2 – Average, 1 – Low , 0-Null

Programme	B.Tech ECE (AI & ML)	Programme Code	BTEM			
Course Code	25BTEM371	Number of Hours/Week	3			
Semester	VII (PSE VII)	Max. Marks	100			
Year	IV	Credits	3			
Programme Specific Elective						
Course Title	OPTO ELECTRONICS			L	T	P
			3	0	0	
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students to:						
<ul style="list-style-type: none"> • To know the physics of absorption, recombination and photoemission from semiconductors. • To analyse different types of photo detectors based on their performance parameters. • To discuss different LED structures with material properties and reliability aspects. • To explain optical modulators and optical components • To illustrate different types of lasers with distinct properties. 						
UNIT	TOPICS				HOURS	
I	Optical processes in semiconductors – electron hole recombination, absorption, Franz-Keldysh effect, Stark effect, quantum confined Stark effect, deep level transitions, Auger recombination heat generation and dissipation, heat sources.				7	
II	Lasers – threshold condition for lasing, line broadening mechanisms, axial and transverse laser modes, heterojunction lasers, distributed feedback lasers, DBR lasers, quantum well lasers, tunneling based lasers, modulation of lasers.				7	
III	Nitride light emitters, nitride material properties, InGaN/GaN LED, structure and working, performance parameters, InGaN/GaN Laser Diode, structure and working, performance parameters. White-light LEDs, generation of white light with LEDs, generation of white light by dichromatic sources, generation of white light by trichromatic sources, temperature dependence of trichromatic, 7generation of white light by tetrachromatic and pentachromatic sources, white-light sources based on wavelength converters.				9	

IV	Optical modulators using pn junction, electro-optical modulators, acousto-optical modulators, Raman-Nath modulators, Franz-Keldysh and Stark effect modulators, quantum well electro-absorption modulators, optical switching and logic devices, optical memory.	6
V	Introduction to optical components, directional couplers, multiplexers, attenuators, isolators, circulators, tunable filters, fixed filters, add drop multiplexers, optical cross connects, wavelength convertors, optical bistable devices.	7

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1	Explain optical processes in semiconductors such as absorption, recombination, and emission mechanisms.
CO2	Analyze laser principles, threshold conditions, modes of operation, and performance parameters of different laser structures.
CO3	Describe the structure, working principles, and performance characteristics of LEDs and laser diodes, including white-light generation techniques.
CO4	Explain the operation of optical modulators, switching devices, and optical memory systems.
CO5	Identify and apply optical components used in photonic and optical communication systems.

Text Book:

1. Pallab Bhattacharya: Semiconductor Optoelectronic Devices, Pearson, 2009
2. Yariv, Photonics Optical Electronics in modern communication, 6/e ,Oxford Univ Press,2006.

Reference Books:

1. Alastair Buckley, Organic Light-Emitting Diodes, Woodhead, 2013.
2. B E Saleh and M C Teich, Fundamentals of Photonics:, Wiley-Interscience, 1991
3. Bandyopadhyay, Optical communication and networks, PHI, 2014.

Mapping of Course Outcomes (CO's) with PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	2	1	–	–	–	–	–	–	2	3	2	1
CO2	3	3	2	3	2	–	–	–	–	–	–	2	3	3	1
CO3	3	2	2	3	2	–	–	–	–	–	–	2	3	3	2
CO4	2	3	2	3	3	–	–	–	–	–	–	2	3	2	1
CO5	2	2	2	2	3	–	–	–	–	–	–	3	3	3	2

3 – High, 2 – Average, 1 – Low , 0-Null

Programme	B.Tech ECE (AI & ML)	Programme Code	BTEM			
Course Code	25BTEM372	Number of Hours/Week	3			
Semester	VII (PSE VII)	Max. Marks	100			
Year	IV	Credits	3			
Programme Specific Elective						
Course Title	FUZZY LOGIC			L	T	P
			3	0	0	
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students to:						
<ul style="list-style-type: none"> • Understand the basic concepts of fuzzy sets and fuzzy logic. • Learn the principles of fuzzification and defuzzification. • Study different fuzzy inference systems and rules. • Analyze the application of fuzzy logic in control systems. • Apply fuzzy logic techniques to solve real-world problems. 						
UNIT	TOPICS				HOURS	
I	INTRODUCTION: Background, Uncertainty and imprecision, Statistics and random processes, Uncertainty in information, Fuzzy sets and membership, Chance versus ambiguity, Classical sets - operations on classical sets to functions, Fuzzy sets-fuzzy set operations, Properties of fuzzy sets. Sets as points in hypercubes.				7	
II	CLASSICAL RELATIONS AND FUZZY RELATIONS: Cartesian product, Crisp relations-cardinality of crisp relations, Operations on crisp relations, Properties of crisp relations, Compositions, Fuzzy relations-cardinality of fuzzy relations, Operations on fuzzy relations, Properties of fuzzy relations, Fuzzy Cartesian product and composition, Non interactive fuzzy sets, Tolerance and equivalence relations-crisp equivalence relation, Crisp tolerance relation, Fuzzy tolerance, Max-min Method, other similarity methods				7	
III	MEMBERSHIP FUNCTIONS: Features of the membership function, Standards forms and boundaries, fuzzification, Membership value assignments-intuition, Inference, Rank ordering, Angular fuzzy sets. Neural networks, Genetic algorithms, Inductive reasoning.				9	
IV	FUZZY-TO-CRISP CONVERSIONS AND FUZZY ARITHMETIC: Lambda-cuts for fuzzy sets, Lambda-cuts for fuzzy relations, Defuzzification methods. Extension principle-crisp functions, Mapping and relations, Functions of fuzzy sets-extension principle, Fuzzy transform (Mapping), Practical considerations, and Fuzzy numbers Interval analysis in Arithmetic, Approximate methods of extension-				6	

	vertex method, DSW algorithm, Restricted DSW algorithm, Comparisons, Fuzzy vectors	
V	CLASSICAL LOGIC AND FUZZY LOGIC: Classical predicate logic-tautologies, Contradictions, Equivalence, Exclusive or and exclusive nor, Logical proofs, Deductive Inferences, Fuzzy logic, Approximate reasoning, Fuzzy tautologies, Contradictions, Equivalence and logical proofs, Other forms of the implication operation, Other forms of the composition operation.	7

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1	Understand and explain fuzzy set theory and fuzzy logic concepts.
CO2	Apply fuzzification and defuzzification techniques.
CO3	Design and analyze fuzzy inference systems.
CO4	Implement fuzzy logic in control and decision-making systems.
CO5	Evaluate the effectiveness of fuzzy logic solutions in real-world applications.

Text Book:

Fuzzy logic with Engineering applications” , Timothy J. Ross, McGraw-Hill, 1997.

Reference Books:

Nural networks and fuzzy systems: A dynamical system approach , B. Kosko, Pearson Edu. 19

Mapping of Course Outcomes (CO's) with PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	2	1	–	–	–	–	–	–	2	3	2	1
CO2	3	3	2	3	2	–	–	–	–	–	–	2	3	3	1
CO3	3	2	2	3	2	–	–	–	–	–	–	2	3	3	2
CO4	2	3	2	3	3	–	–	–	–	–	–	2	3	2	1
CO5	2	2	2	2	3	–	–	–	–	–	–	3	3	3	2

3 – High, 2 – Average, 1 – Low , 0-Null

Programme	B.Tech ECE (AI & ML)	Programme Code	BTEM			
Course Code	25BTEM373	Number of Hours/Week	3			
Semester	VII (PSE VII)	Max. Marks	100			
Year	IV	Credits	3			
Programme Specific Elective						
Course Title	DIGITAL MARKETING			L	T	P
			3	0	0	
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students to:						
<ul style="list-style-type: none"> • Comprehend the Fundamentals of Digital Marketing. • Develop Effective Content Marketing Strategies and Email Marketing Campaigns. • Understand and Implement Social Media Marketing Techniques and Display Marketing. • Develop Expertise in Search Engine Marketing (SEM) and Utilize Mobile Marketing. • Apply Analytics to Optimize Digital Marketing Strategies. 						
UNIT	TOPICS				HOURS	
I	Introduction to Digital Marketing: Fundamentals of Digital marketing & Its Significance, Traditional marketing Vs Digital Marketing, Evolution of Digital Marketing. Opportunities for building Brand Website – Planning and Creation – Marketing strategies for the digital world-latest practices.				8	
II	Content and Email Marketing: Content Marketing: Step-by-step Content Marketing, Developing a content marketing strategy. Email Marketing: Types of Emails in email marketing- Email Automation-Integrating Email with social media and Mobile.				8	
III	Social Media Marketing and Display Marketing: Social Media Marketing- Social Media Marketing Channels-Leveraging media for brand conversations and buzz. Successful/benchmark social media campaigns. Display Advertising: Working of Display Advertising; Benefits and challenges; Overview of Display ad Process.				8	
IV	Search Engine and Mobile Marketing: Introduction of SEM: How Search Engine works - SEM components. Search Engine Optimization: Keyword Strategy- SEO Strategy- SEO success factors- On Page Techniques-Off Page Techniques -PPC advertising. Mobile Marketing- Mobile Inventory/channels- Location based; Context based; Coupons and offers, Mobile Apps, Mobile Commerce, SMS Campaigns- Profiling and targeting.				8	

v	Digital Innovation and Trends: The contemporary digital revolution, digital transformation and Channel Attribution, security and privatization issues with digital marketing. Analytics- Ad-words, Email, Mobile, social media, Web Analytics – Changing your strategy based on analysis- Recent trends in Digital marketing.	8
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COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1	Understand the Fundamentals and Evolution of Digital Marketing
CO2	Develop and Implement Content and Email Marketing Techniques.
CO3	Leverage Social Media Marketing for Brand Growth and Gain Expertise in Display Advertising.
CO4	Develop Skills in Search Engine Marketing (SEM) and Utilize Mobile Marketing Techniques.
CO5	Understand Digital Innovation and Emerging Trends

Text Books:

1. Mouty Maiti: Internet Marketing, Oxford University Press India
2. Vandana, Ahuja; Digital Marketing, Oxford University Press India (November, 2015).
3. Eric Greenberg, and Kates, Alexander; Strategic Digital Marketing: Top Digital Experts Share the Formula for Tangible Returns on Your Marketing Investment; McGraw-Hill Professional (October, 2013).

Reference Books:

1. Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran, Computer Algorithms/ C++, Second Edition, Universities Press, 2019.
2. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, Introduction to Algorithms, Third Edition, PHI Learning Private Limited, 2012.
3. S. Sridhar, Design and Analysis of Algorithms, Oxford university press, 2014.

Mapping of Course Outcomes (CO's) with PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	1	1	2	2	2	1	3	2	1	3	2	2	1
CO2	2	2	2	1	3	2	3	2	2	3	2	2	3	3	2
CO3	3	2	3	2	1	2	3	2	3	3	2	3	2	3	3
CO4	3	2	3	3	3	3	2	3	3	3	3	3	3	3	2
CO5	3	3	3	2	3	3	3	2	3	3	2	3	3	3	3

3 – High, 2 – Average, 1 – Low , 0-Null

Programme	B.Tech ECE (AI & ML)	Programme Code	BTEM			
Course Code	25BTEM374	Number of Hours/Week	3			
Semester	VII (PSE VIII)	Max. Marks	100			
Year	IV	Credits	3			
Programme Specific Elective						
Course Title	PATTERN RECOGNITION			L	T	P
				3	0	0
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students:						
<ul style="list-style-type: none"> • To introduce the fundamental concepts of pattern recognition and machine learning. • To explore various feature extraction, classification, and clustering techniques. • To understand probabilistic models and deep learning approaches in pattern recognition. • To apply pattern recognition techniques to real-world problems. 						
UNIT	TOPICS				HOURS	
I	Introduction to Pattern Recognition Definition and applications of Pattern Recognition-Design cycle of pattern recognition systems-Supervised vs. Unsupervised learning-Probability and statistical decision theory-Bayes Decision Theory and minimum error classification				6	
II	Feature Extraction and Dimensionality Reduction Feature types: Geometric, statistical, and symbolic features-Feature extraction techniques -PCA, LDA, ICA-Feature selection and ranking-Discriminant analysis and manifold learning-Introduction to Kernel methods				9	
III	Classification Techniques Nearest Neighbor Classifier (KNN)-Bayesian Classifiers -Naïve Bayes, Gaussian Bayes-Decision Trees and Random Forests-Support Vector Machines (SVM) Deep learning-based classification -CNNs, RNNs				9	
IV	Clustering and Unsupervised Learning Partition-based clustering: K-Means, K-Medoids-Hierarchical clustering: Agglomerative and Divisive-Density-based clustering: DBSCAN-Gaussian Mixture Models (GMM) and Expectation-Maximization (EM)-Self-Organizing Maps (SOM) and Fuzzy clustering				9	
V	Applications of Pattern Recognition Optical Character Recognition (OCR)-Speech and Face Recognition-Biometric Authentication -Fingerprint, Iris, Palm-print-Image-based object detection and recognition-Real-time applications in healthcare, finance, and security				7	

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1	Understand the fundamentals of pattern recognition and its real-world applications.
CO2	Perform feature extraction and dimensionality reduction techniques.
CO3	Implement classification techniques for supervised learning problems.
CO4	Apply clustering algorithms for unsupervised learning and pattern discovery.
CO5	Develop and evaluate pattern recognition models for industrial applications.

Text Books:

1. **"Pattern Recognition and Machine Learning"** – Christopher M. Bishop
2. **"Pattern Classification"** – Richard O. Duda, Peter E. Hart, and David G. Stork
3. **"Introduction to Machine Learning"** – Ethem Alpaydin

Reference Books:

1. **"Computer Vision: Algorithms and Applications"** – Richard Szeliski
2. **"Deep Learning"** – Ian Goodfellow, Yoshua Bengio, and Aaron Courville

Mapping of Course Outcomes (CO's) with PO's & PSO's

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	3	2	1	1	2	1	3	3	2	2	3
CO2	3	3	3	3	3	2	2	2	3	2	3	3	3	3	3
CO3	3	3	3	3	3	3	2	3	3	2	3	3	3	3	3
CO4	3	3	3	3	3	2	2	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

3 – high, 2 – Average, 1 - Low , 0-Null

Programme	B.Tech ECE (AI & ML)	Programme Code	BTEM			
Course Code	25BTEM375	Number of Hours/Week	3			
Semester	VI (PSE VIII)	Max. Marks	100			
Year	IV	Credits	3			
Programme Specific Elective						
Course Title	Wireless Communication			L	T	P
				3	0	0
L-Lecture Hours T-Tutorial Hours P-Practical Hours						

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students to:

- Understand the evolution, standards, and architecture of modern wireless communication systems.
- Analyze cellular system design principles including frequency reuse, handoff, interference, and capacity enhancement techniques.
- Study wireless channel characteristics, propagation models, fading, and capacity limits of wireless channels.
- Apply digital modulation, multicarrier transmission, diversity, and equalization techniques in wireless environments.
- Gain knowledge of multiple access techniques and radio wave propagation mechanisms used in practical wireless systems.

UNIT	TOPICS	HOURS
I	<p>Introduction to Wireless Communication Systems: Generations: 2G, 3G, 4G, 5G. Wireless LAN, Bluetooth and Personal Area networks, Broadband Wireless Access -- WiMAX Technology. Wireless Spectrum allocation, Standards.</p> <p>Cellular System Design Fundamentals: Frequency Reuse, channel assignment strategies, Handoff strategies, Interference and system capacity, trunking and grade off service, improving coverage and capacity – cell splitting, sectoring, microcells.</p>	8
II	<p>Path loss and shadowing: Free space path loss, Two-Ray model, Shadowing, Statistical Multipath Channel Models: Time-varying channel impulse response, Narrowband fading, Wideband fading models, Delay spread and Coherence bandwidth, Doppler spread and Coherence time, Flat fading versus frequency selective fading, Slow fading versus fast fading, Discrete-time model.</p> <p>Capacity of Wireless Channels: Review of Capacity in AWGN, Capacity of flat fading channel – Ergodic capacity, Capacity with Outage, Capacity with CSI-R. (Derivations of capacity formulae are not required; Only expressions, computations and significance required.)</p>	8

III	<p>Digital Signaling for Flat fading Channels: Analysis of Average Error Probability and Outage probability of BPSK in flat-fading channels.</p> <p>Multi-carrier Modulation: Data transmission using multicarrier modulation for frequency-selective fading channels. Overlapping subchannels, Mitigation of Subcarrier Fading, Discrete Implementation of multicarrier – OFDM. Cyclic prefix, Peak-to-average-power-ratio.</p>	7
IV	<p>Diversity: Receiver diversity – selection combining, maximal ratio combining. Transmitter diversity – Alamouti scheme for 2x2 MIMO. Equalization: Equalization – Linear and non-linear equalization, Zero forcing, MMSE equalizers. LMS algorithm. Adaptive Equalization.</p> <p>Multiuser Systems: Uplink and Downlink, Multiple Access, Frequency-Division Multiple Access (FDMA), Time-Division Multiple Access (TDMA), Code-Division Multiple Access (CDMA), Orthogonal Frequency-Division Multiple Access (OFDMA).</p>	7
V	<p>Ground wave propagation, Plane earth reflection, Space wave and surface wave, Spherical earth propagation, Tropospheric waves, Ionospheric propagation, Effects of earth's magnetic field, Critical frequency, Maximum usable Frequency, Virtual height.</p>	7

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1	Explain the fundamentals of wireless communication systems, standards, and cellular network design principles. (Remembering, Understanding)
CO2	Analyze wireless channel characteristics including path loss, shadowing, fading, and channel capacity. (<i>Understanding, Analyzing</i>)
CO3	Evaluate the performance of digital modulation and multicarrier transmission techniques such as OFDM in fading channels. (<i>Analyzing</i>)
CO4	Apply diversity techniques, equalization methods, and adaptive algorithms to mitigate channel impairments. (<i>Applying, Analyzing</i>)
CO5	Explain multiple access techniques and radio wave propagation mechanisms used in modern wireless communication systems. (<i>Understanding, Applying</i>)

Text Books:

1. Andrea Goldsmith, Wireless Communications, Cambridge University Press, 2005
2. Theodore S. Rappaport, Wireless communication: Principles and Practice, 2/e, Pearson Education, 1990
3. Aditya Jagannatham, Principles of Modern Wireless Communication Systems, Mc Graw Hill, 2017.
4. Robert Collin, Antennas and Radiowave Propagation, McGraw Hill, 2016.

Reference Books

1. David Tse and Pramod Viswanath, Fundamentals of Wireless Communication, Cambridge University Press, 2005
2. Jochen Schiller, Mobile Communications, Pearson, 2008
3. Andreas F Molish , Wireless Communications, 2nd Edition, Wiley India Publications, 2013
4. W. C. Y. Lee, Mobile Cellular Telecommunication, McGraw Hill,
5. Gordon L. Stuber, Principles of Mobile Communication, Springer,2017
6. Rahim Thafazoli, Technologies for The Wireless Future, Volume 2 , Wiley and Sons 2004

Mapping of Course Outcomes (CO's) with PO's & PSO's

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	1	–	–	–	–	–	–	2	2	1	1
CO2	3	3	1	2	1	–	–	–	–	–	–	2	3	1	1
CO3	3	3	2	2	2	–	–	–	–	–	–	2	3	2	2
CO4	3	3	2	3	2	–	–	–	–	–	–	2	3	2	2
CO5	3	2	1	1	1	1	–	–	–	–	–	2	2	2	1

3 – high, 2 – Average, 1 - Low , 0-Null

Programme	B.Tech ECE (AI & ML)	Programme Code	BTEM			
Course Code	25BTEM376	Number of Hours/Week	3			
Semester	VII (PSE VIII)	Max. Marks	100			
Year	IV	Credits	3			
Programme Specific Elective						
Course Title	COMPUTATIONAL AND SYSTEMS BIOLOGY			L	T	P
				3	0	0
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students to:						
<ul style="list-style-type: none"> • Explain fundamental concepts of computational and systems biology, including modeling, simulation, and analysis of biological systems. (Understanding) • Utilize computational tools and programming languages (e.g., Python, R, MATLAB) to analyze biological datasets and develop predictive models. (Applying) • Deconstruct complex biological networks and pathways to identify key components, interactions, and emergent behaviors. (Analyzing) • Critically assess computational models and algorithms used in systems biology, comparing their effectiveness and limitations in biological research. (Evaluating) • Design and implement a computational model to simulate a biological process, integrating experimental data for validation. (Creating). 						
UNIT	TOPICS				HOURS	
I	Introduction to Computational and Systems Biology Overview of Systems Biology- Definitions, scope, and importance, Computational Approaches in Biology- Bioinformatics vs. Systems Biology, Molecular Networks- Genetic, protein, and metabolic networks, Mathematical Foundations- Graph theory, probability, and dynamical systems, High-Throughput Data- Genomics, transcriptomics, and proteomics, Tools & Software- Introduction to MATLAB, Python (Biopython, NumPy, SciPy), and R				8	
II	Mathematical and Computational Modeling of Biological Systems Deterministic Models- Ordinary Differential Equations (ODEs) for gene regulation and metabolic pathways, Stochastic Models- Master equation, Gillespie algorithm for stochastic gene expression, Boolean Networks and Logical Models- Gene regulatory networks modeling, Parameter Estimation & Sensitivity Analysis- Optimization techniques (Gradient Descent, MCMC), Simulating Biological Systems- MATLAB/Python-based simulations				8	
III	Omics Data Analysis and Machine Learning in Biology Next-Generation Sequencing (NGS) Data Analysis- RNA-Seq, ChIP-Seq, and variant calling, Gene Expression Analysis- Microarrays, clustering, and PCA, Machine Learning in Biology- Classification and				8	

	clustering of biological data, Deep Learning Applications- Convolutional Neural Networks (CNNs) for bioimage analysis, Network Inference- Bayesian networks, correlation networks, and network reconstruction	
IV	Biological Networks and Systems Dynamics Types of Biological Networks- Protein-protein interaction (PPI), gene regulatory, metabolic pathways, Network Analysis Techniques- Degree distribution, centrality measures, clustering, Dynamic Network Models- Time-series analysis of networks, Systems Biology Applications- Drug-target interaction prediction, disease modeling, Case Studies- Cancer systems biology, metabolic network modeling	8
V	Synthetic Biology and Computational Drug Discovery Synthetic Biology Principles- Engineering biological circuits, CRISPR-based design, Computational Drug Discovery- Molecular docking, structure-based drug design, Pharmacokinetics and Pharmacodynamics (PK/PD) Modeling, Multi-Omics Integration- Combining genomics, transcriptomics, and metabolomics, Future Trends in Computational and Systems Biology- AI in biology, single-cell analysis, personalized medicine	8

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1	Understand fundamental concepts in computational and systems biology, including biological data analysis, modeling, and simulation.
CO2	Apply computational techniques and bioinformatics tools to analyze genomic, proteomic, and metabolomic data.
CO3	Analyze biological networks and systems dynamics using mathematical and computational models.
CO4	Evaluate different machine learning and statistical methods for biological data interpretation and decision-making.
CO5	Create computational models and simulations to study complex biological systems and predict biological behavior.

Text Books:

1. Raman K. An introduction to computational systems biology: systems-level modelling of cellular networks. Chapman and Hall/CRC; 2021 May 30.

Reference Books:

1. Huang T, MARTON, Computational Systems Biology. Huang T, editor. Springer Science+ Business Media, LLC, part of Springer Nature; 2018.

Mapping of Course Outcomes (CO's) with PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	3	0	0	0	0	0	0	0	0	0	3	2	3
CO2	0	2	0	0	0	0	1	0	0	0	0	2	2	1	3
CO3	3	1	2	0	0	0	0	0	0	0	0	0	1	2	1
CO4	0	0	2	0	1	0	0	0	3	0	0	0	1	1	0
CO5	0	0	1	0	0	0	0	0	0	1	0	1	2	2	0

3 – High, 2 – Average, 1 – Low , 0-Null

Programme	B.Tech ECE (AI & ML)	Programme Code	BTEM			
Course Code	25BTEM271	Number of Hours/Week	2			
Semester	VII	Max. Marks	100			
Year	IV	Credits	1			
Core Course						
Course Title	MICROWAVE AND ANTENNA LAB			L	T	P
			0	0	2	
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
<ul style="list-style-type: none"> • Understand the basic concepts of microwave components and antenna systems. • Learn to measure and analyze microwave parameters such as frequency, wavelength, and impedance. • Gain practical knowledge of waveguides, transmission lines, and microwave devices. • Study the characteristics and performance of different types of antennas. • Develop skills to conduct experiments and interpret results in microwave and antenna systems. 						
LIST OF EXPERIMENTS						
<ol style="list-style-type: none"> 1. Gunn Diode Characteristics. 2. Reflex Klystron Mode Characteristics. 3. Measurement of VSWR 4. Verification of the relation between guide wavelength cut off wavelength and free space wavelength 5. Antenna Pattern Measurement. 6. Measurement of E-Plane and H-Plane Characteristics. 7. Directional Coupler Characteristics. 8. Unknown load impedance measurement using smith chart and verification using transmission line equation. 9. Measurement of dielectric constant for given solid dielectric cell. 10. Study of Vector Network Analyzer. 						

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1	Understand and analyze the characteristics of microwave components and devices.
CO2	Measure and evaluate microwave parameters using laboratory instruments.
CO3	Analyze the performance of transmission lines and waveguides.

CO4	Test and evaluate antenna parameters such as radiation pattern, gain, and bandwidth.
CO5	Interpret and troubleshoot experimental results in microwave and antenna systems.

Mapping of Course Outcomes (CO's) with PO's & PSO's

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	3	2	3	2	3	1	3	2	1	3	2	3
CO2	2	3	1	2	3	2	3	1	3	2	3	2	1	3	2
CO3	1	2	3	2	1	3	2	3	2	3	1	3	2	3	1
CO4	3	2	1	3	2	1	3	2	3	1	2	3	3	1	2
CO5	2	3	2	1	3	2	1	3	2	3	2	1	3	2	3

3 – high, 2 – Average, 1 - Low , 0-Null

Semester VIII

Programme	B.Tech ECE (AI & ML)	Programme Code	BTEM			
Course Code	25BTEM381	Number of Hours/Week	3			
Semester	VIII (PSE IX)	Max. Marks	100			
Year	IV	Credits	3			
Programme Specific Elective						
Course Title	GAME THEORY FOR MACHINE LEARNING			L	T	P
				3	0	0
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students:						
<ul style="list-style-type: none"> • To explore fundamental concepts in machine learning • To equip different concepts in machine learning with mathematical intuition • To construct an existing problem into standard machine learning paradigm • To develop an innovative ML model for research problems using different ML tools and standard datasets 						
UNIT	TOPICS				HOURS	
I	Introduction to machine learning Introduction to machine learning; Mathematics behind machine learning; Linear algebra - Vector space, system of linear equations, projection, Solving $Ax=b$, projection, least square problem, eigen values and vectors, eigen decomposition, singular value decomposition; Probability – discrete and continuous random variable; expectation, variance, covariance; Multivariable calculus basics				8	
II	Optimization Unconstrained optimization; constrained optimization; numerical optimization; gradient descent; steepest descent numerical gradient calculation; stopping criteria; linear regression; least squares; generalized function for linear regression; bias-variance trade off;				8	
III	Game theory in AI Two player games; adversarial search; game tree; minimax search; utility function; search strategies; alpha-beta pruning in minimax search; types of games – cooperative and non-cooperative games, zero-sum and non-zero-sum games; simultaneous and sequential games; Nash equilibrium				8	
IV	Game theory in machine learning Adversarial learning; minimax search; generative adversarial networks (GANs); generator; discriminator; multi-agent systems; reinforcement learning; competitive or cooperative approaches; fairness and resource allocation; Stackelberg games; multi-agent reinforcement learning; auction algorithms`				8	

V	Generative models for Games Background; autoregressive models; maximum likelihood learning; variational auto encoders; normalizing flows; energy-based models; score-based models; diffusion models for discrete data; applications – autonomous vehicles and traffic systems, security systems and cyber security	8
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COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1	Infers mathematical concepts behind machine learning
CO2	Distinguish different ML concepts in terms of applications
CO3	Implement standard ML algorithms for applications
CO4	Validate the ML models to improve the performance
CO5	Develop an ML model for existing problems

Text Books:

1. Gilbert Strang. Introduction to Linear Algebra. Wellesley-Cambridge Press, USA, 5th edition, 2016.
2. Andrew Ng. Machine Learning Yearning. deeplearning.ai, 2018.
3. Eva Tardos, Noam Nisan, Tim Roughgarden, Vijay V. Vazirani. Algorithmic Game Theory. Cambridge University Press. 2007.

Reference Books:

1. Ian J. Goodfellow, Yoshua Bengio, and Aaron Courville. Deep Learning. MIT Press, Cambridge, MA, USA, 2016.

Mapping of Course Outcomes (CO's) with PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	3	0	1	0	0	0	1	0	3	1	2	1
CO2	3	2	1	3	1	0	2	0	0	1	0	2	1	3	1
CO3	3	2	2	3	3	2	3	0	0	2	0	2	3	2	2
CO4	2	3	1	2	3	1	2	1	1	1	1	2	2	3	3
CO5	3	2	3	3	3	2	3	3	3	2	2	2	3	3	3

3 – High, 2 – Average, 1 – Low , 0-Null

Programme	B.Tech ECE (AI & ML)	Programme Code	BTEM			
Course Code	25BTEM382	Number of Hours/Week	3			
Semester	VIII (PSE IX)	Max. Marks	100			
Year	IV	Credits	3			
Programme Specific Elective						
Course Title	ROBOTICS ENGINEERING			L	T	P
				3	0	0
L-Lecture Hours T-Tutorial Hours P-Practical Hours						

COURSE OBJECTIVES:
The main learning objective of this course is to prepare the students:

1. Understand and discuss the fundamental elementary concepts of Robotics.
2. Provide insight into different types of robots.
3. Explain intelligent module for robotic motion control.
4. Educate on various path planning techniques.
5. Illustrate the working of innovative robotic devices

UNIT	TOPICS	HOURS
I	Introduction to Robotic, History - Developments in Robotics, Robot anatomy, Definition and law of robotics, Terminology of Robotics, Accuracy and repeatability, dexterity, compliance, RCC device of Robotics-Simple problems. Specifications of Robot-Speed of Robot- Robot joints and links, Robot Drive systems-Hydraulic, Pneumatic and Electric system. End Effectors - Mechanical grippers-Slider crank mechanism, cam type, Screw type, Rotary actuators, Magnetic grippers, Vacuum grippers, Gripper force analysis, Gripper selection and design considerations	8
II	Control system for robot joint- Controllers, Control system analysis – Transient Response, Steady state, Trajectory planning of end effectors. Feedback devices-Encoder, Resolver, LVDT-Motion Interpolations, Adaptive control Sensors in robot, Characteristics of sensing devices, Selections and need of sensors, Touch sensors-Tactile sensor, Proximity and range sensors, Force sensor-Light sensors, Pressure sensors, Robotic vision sensor	6
III	Robot kinematics-Types- 2D, 3D Transformation, inverse kinematics, Scaling, Rotation, Translation, Homogeneous Transformations, multiple transformations. Kinematic equations using Homogeneous Transformations - Joints, frame assignment to links, Orientation, direct kinematics Solving Kinematic equations – Velocities and Static forces in manipulators:- Jacobians, singularities, static forces, Jacobian in force domain, Dynamics:- Introduction to Dynamics	7

IV	Robot work cell design - control-Sequence control Operator interface, Safety monitoring devices in Robot Mobile robot working principle, actuation using MATLAB, NXT Software Introduction to Artificial Intelligence, Need and application of AI/AI techniques, Artificial neural networks in manufacturing automation, Fuzzy decision and control, robots and application of robots using AI and FUZZY	9
V	Robotics Applications: Material Handling: pick and place, palletizing and depalletizing, machining loading and unloading, welding & assembly, Medical, agricultural and space applications, unmanned vehicles: ground, Ariel and underwater applications, robotic for computer integrated manufacturing. Types of robots: Manipulator, Legged robot, wheeled robot, aerial robots, Industrial robots, Humanoids, Robots, Autonomous robots, and Swarm robots	6

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1	Understand the significance, social impact and future prospects of robotics and automation in various engineering applications.
CO2	Identify and describe the components and anatomy of robotic system.
CO3	Know about various path planning techniques and analyze different motions of robotics system
CO4	Use the suitable drives and end-effectors for a given robotics application. CO5: Apply robotics concept to automate the monotonous and hazardous tasks and categorize various types of robots based on the design and applications in real world scenarios.
CO5	Apply robotics concept to automate the monotonous and hazardous tasks and categorize various types of robots based on the design and applications in real world scenarios.

Text Books:

1. S.R. Deb, Robotics Technology and flexible automation, Tata McGraw-Hill Education, 2009.
2. Mikell P. Groover et. al., "Industrial Robots - Technology, Programming and Applications", McGraw Hill, Special Edition, (2012).

Reference Books:

1. Richard D Klafter, Thomas A Chmielewski, Michael Negin, "Robotics Engineering

– An Integrated Approach", Eastern Economy Edition, Prentice Hall of India Pvt. Ltd., 2006.

2. Fu K S, Gonzalez R C, Lee C.S.G, "Robotics: Control, Sensing, Vision and Intelligence", McGraw Hill, 1987. <https://www.robots.com/applications>.

Mapping of Course Outcomes (CO's) with PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	2	0	0	0	0	0	0	2	3	2	2
CO2	3	3	2	1	2	0	0	0	0	0	0	2	3	2	3
CO3	3	2	1	2	2	0	0	0	0	0	0	2	2	2	2
CO4	3	3	3	1	2	0	0	0	0	0	0	2	3	3	2
CO5	3	2	1	1	2	1	0	1	0	0	0	2	3	2	3

3 – High, 2 – Average, 1 – Low , 0-Null

Programme	B.Tech ECE (AI & ML)	Programme Code	BTEM			
Course Code	25BTEM383	Number of Hours/Week	3			
Semester	VIII (PSE IX)	Max. Marks	100			
Year	IV	Credits	3			
Programme Specific Elective						
Course Title	GPU COMPUTING			L	T	P
				3	0	0
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students:						
<ul style="list-style-type: none"> • Understand the fundamentals of GPU architecture and parallel computing models. • Learn programming concepts using CUDA, OpenCL, and parallel programming techniques. • Analyze and utilize different memory hierarchies and optimization techniques in GPU computing. • Develop skills in synchronization, debugging, and performance profiling of parallel programs. • Apply advanced concepts such as streams, multi-GPU processing, and heterogeneous computing to solve real-world problems. 						
UNIT	TOPICS				HOURS	
I	Introduction: History, GPU Architecture, Clock speeds, CPU / GPU comparisons, Heterogeneity, Accelerators, Parallel Programming, CUDA OpenCL / OpenACC, Kernels Launch parameters, Thread hierarchy, Warps/Wavefronts, Threadblocks/Workgroups, Streaming multiprocessors, 1D/2D/3D thread mapping, Device properties, Simple Programs				8	
II	Memory: Memory hierarchy, DRAM / global, local / shared, private / local, textures, Constant Memory, Pointers, Parameter Passing, Arrays and dynamic Memory, Multi-dimensional Arrays, Memory Allocation, Memory copying across devices, Programs with matrices, Performance evaluation with different memories				6	
III	Synchronization: Memory Consistency, Barriers (local versus global), Atomics, Memory fence. Prefix sum, Reduction. Programs for concurrent Data Structures such as Worklists, Linked-lists. Synchronization across CPU and GPU Functions: Device functions, Host functions, Kernels functions, Using libraries (such as Thrust), and developing libraries.				7	

IV	Support: Debugging GPU Programs. Profiling, Profile tools, Performance aspects Streams: Asynchronous processing, tasks, Task-dependence, Overlapped data transfers, Default Stream, Synchronization with streams. Events, Event-based Synchronization - Overlapping data transfer and kernel execution, pitfalls.	9
V	Advanced topics: Dynamic parallelism, Unified Virtual Memory, Multi-GPU processing, Peer access, Heterogeneous processing	6

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1	Understand and explain GPU architecture and parallel computing concepts.
CO2	Develop and execute parallel programs using CUDA/OpenCL frameworks.
CO3	Apply memory management techniques and optimize performance using GPU memory hierarchy.
CO4	Implement synchronization mechanisms and handle concurrency in parallel programs.
CO5	Analyze and optimize GPU applications using debugging, profiling tools, and advanced techniques like streams and multi-GPU processing.

Text Books:

1. David Kirk and Wen-mei Hwu, Programming Massively Parallel Processors: A Hands-On Approach, 2nd Edition, Publisher: Morgan Kaufman, 2012, ISBN: 9780124159921.
2. Shane Cook, CUDA Programming: A Developer's Guide to Parallel Computing with GPUs, Morgan Kaufman; 2012 (ISBN: 978-0124159334)

Mapping of Course Outcomes (CO's) with PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	2	0	0	0	0	0	0	2	3	2	2
CO2	3	3	2	1	2	0	0	0	0	0	0	2	3	2	3
CO3	3	2	1	2	2	0	0	0	0	0	0	2	2	2	2
CO4	3	3	3	1	2	0	0	0	0	0	0	2	3	3	2
CO5	3	2	1	1	2	1	0	1	0	0	0	2	3	2	3

3 – High, 2 – Average, 1 – Low , 0-Null

Programme	B.Tech ECE (AI & ML)	Programme Code	BTEM			
Course Code	25BTEM384	Number of Hours/Week	3			
Semester	VIII (PSE X)	Max. Marks	100			
Year	IV	Credits	3			
Programme Specific Elective						
Course Title	NATURAL LANGUAGE PROCESSING			L	T	P
			3	0	0	
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students:						
<ul style="list-style-type: none"> • Understand the Fundamentals of Lexical Analysis • Explore Speech Processing Techniques • Learn Parsing Techniques and Algorithms • Develop Knowledge of Lexical Networks and Word Sense Disambiguation • Apply Natural Language Processing in Real-world Applications 						
UNIT	TOPICS				HOURS	
I	Lexical Analysis Lexical Analysis - Regular expression and Automata for string matching - Words and Word Forms - Morphology fundamentals - Morphological Diversity of Indian Languages - Morphology Paradigms - Finite State Machine / Transducers Based Morphology - Automatic Morphology Learning - Parts of Speech - N-gram Models - Hidden Markov Models.				9	
II	Speech Processing Biology of Speech Processing - Place and Manner of Articulation - Word Boundary Detection - Argmax based computations - HMM and Speech Recognition - Text to Speech Synthesis - Rule Based-Concatenative based approach.				9	
III	Parsing Theories of Parsing - Parsing Algorithms – Earley Parser - CYK Parser - Probabilistic Parsing - CYK - Resolving attachment and structural ambiguity - Shallow Parsing - Dependency Parsing - Named Entity Recognition - Maximum Entropy Models - Conditional Random Fields.				9	
IV	Lexical Knowledge Networks Meaning: Lexical Knowledge Networks - Wordnet Theory - Indian Language Wordnets and Multilingual Dictionaries - Semantic Roles - Word Sense Disambiguation - WSD and Multilingualism - Metaphors - Coreference and Anaphora Resolution.				9	

V	Applications Applications: Sentiment Analysis - Text Entailment - Machine Translation - Question Answering System - Information Retrieval - Information Extraction - Cross Lingual Information Retrieval (CLIR).	9
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COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1	Ability to Analyze Lexical Structures
CO2	Competence in Speech Processing Techniques
CO3	Proficiency in Parsing Algorithms
CO:	Understanding and Application of Lexical Knowledge Networks
CO5	Application of NLP Techniques in Various Domains

Text Book

1. Jurafsky Daniel, Martin James, “Speech and Language Processing”, Second Edition, Tenth Impression, Pearson Education, 2018.
2. Christopher Manning, Schutze Heinrich, “Foundations of Statistical Natural Language Processing”, MIT Press, 1999. Operating System Concepts, Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Wiley publishers, Nineth edition, 2013.

Reference Books

1. Allen James, “Natural Language Understanding”, Second Edition, Benjamin Cumming, 1995.
2. Charniack Eugene, “Statistical Language Learning”, MIT Press, 1993.
3. Foundations of Statistical Natural Language Processing, The MIT Press Cambridge, Massachusetts London, England,1999.

Mapping of Course Outcomes (CO’s) with PO’s & PSO’s

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	0	0	0	0	1	0	0	0	1	0	1	0	1
CO2	2	2	0	0	0	0	0	0	0	0	0	0	2	1	3
CO3	1	2	1	0	0	0	1	0	0	0	2	3	1	2	1
CO4	2	2	2	0	1	0	0	0	0	0	0	0	1	1	0
CO5	3	3	1	0	0	0	0	2	0	0	0	1	2	2	0

3 – High, 2 – Average, 1 – Low , 0-Null

Programme	B.Tech ECE (AI & ML)	Programme Code	BTEM			
Course Code	25BTEM385	Number of Hours/Week	3			
Semester	VIII (PSE X)	Max. Marks	100			
Year	IV	Credits	3			
Programme Specific Elective						
Course Title	WEB DATA MINING			L	T	P
				3	0	0
L-Lecture Hours T-Tutorial Hours P-Practical Hours						

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students to:

- **Understand Data Mining Concepts and Functionalities:** Learn the foundational principles of data mining, including pre-processing techniques like cleaning, integration, reduction, and discretization, along with the architecture and classification of data mining systems.
- **Explore Association Rule Mining:** Study efficient algorithms for frequent item set mining, discover various types of association rules, and perform correlation and constraint-based analysis for meaningful data insights.
- **Master Classification and Prediction Techniques:** Analyze methods like decision trees, Bayesian classifiers, backpropagation, support vector machines, and ensemble techniques to develop accurate classification and prediction models.
- **Analyze Clustering Techniques and Outlier Detection:** Examine clustering methods, such as partitioning, hierarchical, density-based, and model-based techniques, and apply these methods to high-dimensional data and outlier analysis.
- **Mine Complex Data Types:** Explore multidimensional analysis and mining techniques for complex data objects, including spatial, multimedia, text, and web data, for advanced data mining applications.

UNIT	TOPICS	HOURS
I	Introduction: Basic Data Mining Tasks – Data Mining Versus Knowledge Discovery in Data Bases – Data Mining Issues – Data Mining Matrices – Social Implications of Data Mining – Data Mining from Data Base Perspective.	9
II	Neural Networks: Data Mining Techniques – a Statistical Perspective on data mining – Similarity Measures – Decision Trees – Neural Networks – Genetic Algorithms.	9
III	Fuzzy Systems Classification: Introduction – Statistical – Based Algorithms – Distance Based Algorithms – Decision.	9
IV	Genetic Algorithm: Clustering Tree – Based Algorithms – Neural Network Based Algorithms – Rule Based Algorithms – Combining Techniques: Introduction – Similarity and Distance Measures – Outliers – Hierarchical Algorithms. Partitioned Algorithms.	9

V	Hybrid Systems: Association Rules: Introduction - Large Item Sets – Basic Algorithms – Parallel & Distributed Algorithms – Comparing Approaches – Incremental Rules – Advanced Association Rules Techniques – Measuring the Quality of Rules.	9
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Course Outcomes

Upon successful completion of this course, the student will be able to:

CO1	Understanding Data Mining Techniques and Their Applications
CO2	Mastery of Machine Learning Algorithms for Data Mining
CO3	Critical Analysis of Data Mining Issues and Social Implications
CO4	Expertise in Hybrid and Combined Data Mining Approaches
CO5	Application of Data Mining Techniques for Real-World Problems

Text Books:

1. Jiawei Han & Micheline Kamber, “Data Mining Concepts & Techniques”, 2011, 3rd Edition.

Reference Books:

1. Margaret H. Dunham, “Data Mining Introductory and Advanced Topics”, Pearson, Education 2003.

Mapping of Course Outcomes (CO's) with PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	3	2	2	1	3	2	2	1	3	2	2
CO2	3	3	3	2	3	3	2	2	3	3	3	2	3	3	3
CO3	2	2	3	3	2	3	3	2	3	2	3	2	2	3	2
CO4	3	3	2	3	3	3	3	3	3	3	2	2	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

3 – High, 2 – Average, 1 – Low, 0-Null

Programme	B.Tech ECE (AI & ML)	Programme Code	BTEM			
Course Code	25BTEM386	Number of Hours/Week	3			
Semester	VIII (PSE X)	Max. Marks	100			
Year	IV	Credits	3			
Programme Specific Elective						
Course Title	GENERATIVE AI			L	T	P
			3	0	0	
L-Lecture Hours T-Tutorial Hours P-Practical Hours						
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students:						
<ul style="list-style-type: none"> • To explore classical and advanced concepts in generative AI • To equip different generative models in modern AI • To construct an existing problem into standard machine learning paradigm • To dealt with generative models for scalable machine learning. 						
UNIT	TOPICS				HOURS	
I	Introduction Introduction – artificial intelligence, machine learning, deep learning; intelligent agent and its environment; state space searches; informed and informed searches; adversarial searches; supervised and unsupervised learning; discriminative AI – classification, regression, clustering, dimensionality reduction, reinforcement learning;				8	
II	Generative AI Data generation; data transformation; data enrichment; Boltzmann machines; Gibbs sampling; restricted Boltzmann machines; deep belief networks; deep Boltzmann machines; autoencoders; variational autoencoders; generative adversarial networks (GANs)				8	
III	Modern Generative AI Nash equilibrium; GANs applications – generating realistic images, image to image translation, super resolution, data augmentation, style transfer; contrastive language-image pretraining (CLIP); diffusion models; stable diffusion Tech; Midjourney; autoregression;				8	
IV	Large Language Models Markov chains; rule-based text generation; recurrent neural networks; long short-term memory networks; N-gram models; seq2seq; GAN for text generation; Transformers; tokenization; pretraining and fine tuning LLMs; prompt engineering; GPTs				8	

V	<p>Ethical concerns and social implications Bias and fairness in AI generated data; data privacy, safety, security; mis information and misuse of generative AI; generative AI's impact on jobs and industry; dependency on AI; environmental concerns; AI oversight and self-regulations; multi-tasking and multi-sensory generative AI</p>	8
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COURSE OUTCOMES:

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

CO1	Infers classical generative algorithms in AI
CO2	Execute classical ML approaches into generative machine learning
CO3	Implement generative models for ML applications
CO4	Validate the ML models to improve the performance
CO5	Develop an innovative generative AI model for existing problems

Text Books:

1. Stuart Russell and Peter Norvig. Artificial Intelligence: A Modern Approach. Prentice Hall Press, USA, 3rd edition, 2009
2. Martin musiol. Generative AI. Wiley publications. 2024.

Mapping of Course Outcomes (CO's) with PO's & PSO's

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	3	0	1	0	0	0	1	0	3	0	1	2
CO2	3	2	1	3	1	0	2	0	0	1	0	2	1	2	3
CO3	3	2	2	3	3	2	3	0	0	2	0	2	2	2	3
CO4	2	3	1	2	3	1	2	1	1	1	1	2	2	1	3
CO5	3	2	3	3	3	2	3	3	3	2	2	2	3	3	3

3 – high, 2 – Average, 1 - Low , 0-Null