Pimpri Chinchwad Education Trust's

Pimpri Chinchwad University

Sate, Pune – 412106

PCET's
Pimpri
Chinchwad
University

Learn | Grow | Achieve

Curriculum Structure

B. TECH

COMPUTER SCIENCE & ENGINEERING

ARTIFICIAL INTELLIGENCE & MACHINE LEARNING

(Batch:2025-2026)

School of Engineering and Technology

Effective from

Academic Year 2025-26 Program Structure

April Version R3

Preamble:

We, at Pimpri Chinchwad University, offer the Bachelor of Technology in Computer Science and Engineering (Artificial Intelligence and Machine Learning) program to provide students with a strong foundation in computing along with specialized knowledge in intelligent systems, data-driven technologies, and machine learning applications. Our mission is to prepare graduates who are technically competent, ethically responsible, innovative, and capable of addressing real-world challenges through advanced AI and ML solutions.

The B.Tech. in Computer Science and Engineering (Artificial Intelligence and Machine Learning) program integrates knowledge from mathematics, statistics, computer science, data science, and engineering principles to provide a comprehensive understanding of intelligent computing systems. The curriculum includes courses in programming, data structures, databases, computer networks, operating systems, artificial intelligence, machine learning, deep learning, natural language processing, computer vision, data analytics, and cloud-based intelligent applications. Students are also provided with opportunities to gain practical exposure through internships, mini and major projects, laboratory work, hackathons, technical events, and industry-oriented learning experiences.

Our program aims to develop students' analytical thinking, problem-solving ability, communication skills, and leadership qualities so that they can contribute effectively to the design, development, and deployment of AI-enabled systems. The program emphasizes sustainable and socially responsible innovation, enabling students to build intelligent solutions for emerging industrial, societal, and research challenges while maintaining professional ethics, integrity, and lifelong learning attitude. Graduates of this program will be equipped to pursue successful careers in industry, entrepreneurship, research, and higher education in the domains of Artificial Intelligence, Machine Learning, Data Science, and allied areas.

We are committed to providing a supportive and inclusive learning environment that values diversity, equity, creativity, and interdisciplinary collaboration. Our faculty members are dedicated to excellence in teaching, research, and innovation, and actively contribute to the advancement of Artificial Intelligence and Machine Learning through scholarly activities, funded projects, and professional engagements. We invite students who are passionate about intelligent technologies and their transformative impact on society to join our program and embark on a journey of learning, innovation, and growth that will prepare them for rewarding careers and responsible technological leadership.

Vision and Mission of Program:

Vision:

To develop engineers well versed with Critical Theory and Practical's (problem solving ability); and sensitive to National and Global challenges from Inter-disciplinary perspective. To create Industry ready; socially and ethically strong professionals.

Mission:

Our mission is

- To develop the Computer Professionals by imparting computer engineering knowledge with professional ethics
- To provide the service to the communities to which we belong at local and national levels, combined with a deep awareness of our ethical responsibilities to our profession and to society

Program Outcome

At the end of program, students should be able to

PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to solve complex engineering problems.
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems to arrive at substantiated conclusions using principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet specified needs, considering public health, safety, cultural, societal, and environmental factors.
PO 4	**Conduct investigations of complex problems:** Use research-based knowledge and research methods, including design of experiments, analysis and interpretation of data, and synthesis of information, to provide valid conclusions.
PO 5	**Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex engineering activities, with an understanding of limitations.
PO 6	**The engineer and the world:** Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to professional engineering practice.
PO 7	**Environment and sustainability:** Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of, and the need for, sustainable development.
PO 8	**Ethics & inclusive behavior:** Apply ethical principles and commit to professional ethics, responsibilities, and norms of engineering practice with inclusive behavior.

PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication skills:** Communicate effectively on complex engineering activities with the engineering community and with society at large, including writing effective reports, designing documentation, making presentations, and giving/receiving clear instructions.
PO 11	**Project management, finance & lifelong learning:** Demonstrate knowledge and understanding of engineering and management principles and apply them as a member and leader in a team to manage projects in multidisciplinary environments; recognize the need for lifelong learning and engage in independent and professional development.

Program Educational Objectives

Program Educational Objectives (PEOs) for a BTECH in Artificial Intelligence & Machine Learning program are as follows:

- **PEO 1:** To provide students with knowledge and skills to become leading experts in the field of computer science engineering.
- **PEO 2:** To provide an innovative and comprehensive curriculum that integrates theoretical knowledge with practical experience, research opportunities, and professional development
- **PEO 3:** To groom the student's overall personality for professional growth.
- **PEO 4:** To inculcate values and ethics among the students and making them aware about their social commitments.

Program Specific Outcomes

At the end of program, students should be able to

PSO 1	Apply knowledge of computer science, artificial intelligence, machine learning, mathematics, and statistical techniques to formulate, model, and solve complex problems in intelligent and data-centric domains.
PSO 2	Design and implement AI & ML solutions using appropriate tools, algorithms, and data analysis techniques to extract insights, evaluate performance, and address challenges in real-world applications.

INDEX

Sr. No.	Type of course	Abbreviations
1	Basic Science Course	BSC
2	Engineering Science Course	ESC
3	Programme Core Course	PCC
4	Programme Elective Course	PEC
5	Open Elective Course	OE
6	Multidisciplinary Minor	MIN
7	Vocational and Skill Enhancement Course	VSEC
8	Ability Enhancement Course	AEC
9	Entrepreneurship / Economics / Management Courses	MGMT
10	Indian Knowledge System	IKS
11	Value Education Course	VEC
12	Research Methodology	RM
13	Comm. Engg. Project / Field Project	CEP/FP
14	Project	PROJ
15	Internship / OJT	INT/OJT
16	Rural Immersion	RI
17	Co-curricular Courses	CC
18	Massive Open Online Courses	MOOC

Overall Course Count and Credit Distribution

Sr. No.	Type of course	No. of Courses	Total Credits	
			No.	%
1	Basic Science Course	4	16	9.30
2	Engineering Science Course	5	14	8.14
3	Programme Core Course	29	57	33.14
4	Programme Elective Course	10	19	11.05
5	Open Elective Course	4	8	4.65
6	Multidisciplinary Minor	5	10	5.81
7	Vocational and Skill Enhancement Course	3	6	3.49
8	Ability Enhancement Course	6	2	1.16
9	Entrepreneurship / Economics / Management Courses	2	4	2.33
10	Academic / Constitutional Course (AC)	2	–	–
11	Research Methodology	1	3	1.74
12	Comm. Engg. Project / Field Project	2	2	1.16
13	Project	3	13	7.56
14	Internship / OJT	1	6	3.49
15	Rural Immersion	2	2	1.16
16	Co-curricular Courses	0	–	–
17	Massive Open Online Courses	5	10	5.81
Total (Regular B.Tech. Curriculum)		**84**	**172**	**100**

Credit Distribution Per Semester by Course Type

Sr. No.	Course Type	No. of Credits / Semester								Total
		1	2	3	4	5	6	7	8	
1	Basic Science Course (BSC)	8	8	0	0	0	0	0	0	16
2	Engineering Science Course (ESC)	7	7	0	0	0	0	0	0	14
3	Programme Core Course (PCC)	3	3	13	11	11	8	4	4	57
4	Programme Elective Course (PEC)	0	0	0	0	3	8	4	4	19
5	Open Elective Course (OE)	0	0	4	4	0	0	0	0	8
6	Multidisciplinary Minor (MIN)	0	0	0	2	2	2	2	2	10
7	Vocational and Skill Enhancement Course (VSEC)	0	0	0	2	2	2	0	0	6
8	Ability Enhancement Course (AEC)	1	1	0	0	0	0	0	0	2
9	Entrepreneurship / Economics / Management Courses (MGMT)	2	2	0	0	0	0	0	0	4
10	Academic / Constitutional Course (AC)	0	0	0	0	0	0	0	0	0
11	Research Methodology (RM)	0	0	0	0	0	0	0	3	3
12	Comm. Engg. Project (CEP) / Field Project (FP)	0	0	1	1	0	0	0	0	2
13	Project (PROJ)	0	0	0	0	1	0	4	8	13
14	Internship / OJT (INT/OJT)	0	0	0	0	0	0	6	0	6
15	Rural Immersion (RI)	0	0	0	0	1	1	0	0	2
16	Co-curricular Courses (CC)	0	0	0	0	0	0	0	0	0
17	Massive Open Online Courses (MOOC)	0	0	2	2	2	2	2	0	10
Total		**21**	**21**	**20**	**22**	**22**	**23**	**22**	**21**	**172**

PCET's Pimpri Chinchwad University
Learn | Grow | Achieve

Pimpri Chinchwad University
Established under Govt. of Maharashtra Act No. V of 2023
Sate, Maval (PMRDA) Dist - Pune, Maharashtra - 412 106.
: info@pcu.edu.in : www.PCU.edu.in : +91 9552421225

PCET'S

PIMPRI CHINCHWAD UNIVERSITY

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING ARTIFICIAL INTELLIGENCE & MACHINE LEARNING

B.Tech CSE (AI&ML)

As per Guidelines of NEP-2020 to be implemented

w.e.f. from Academic Year 2025-26

Choice Based Credit System (CBCS)

(2026 Pattern)

SEMESTER - III

Course Code	Type	Course Name	TEACHING SCHEME					ASSESSMENT SCHEME			
			THY	PR	TU	Credits	Hrs	CIA	ESA	PR/ OR	Total
UBTML201	PCC	Data Structures and Algorithms	3	-	-	3	3	40	60	-	100
UBTML202	PCC	Data Structures and Algorithms Laboratory	-	1	-	1	2	25	-	25	50
UBTML203	PCC	Python Programming	3	-	-	3	3	40	60	-	100
UBTML204	PCC	Python Programming Laboratory	-	1	-	1	2	25	-	25	50
UBTMLOE201 & UBTM-LOE203	OE	Elective-I	3	-	-	3	3	40	60	-	100
UBTMLOE202 & UBTM-LOE204	OE	Elective-I Lab	-	1	-	1	2	25	-	25	50
UBTML205	PCC	Discrete Structures	3	-	-	3	3	40	60	-	100
UBTML206	PCC	Computer Organization and Architecture	2	-	-	2	2	20	30	-	50
MOOCML301	MOOC	Operating System	-	-	2	2	2	50	-	-	50
UBTML207	CEP	Community Engineering Project	-	1	-	1	2	25	-	25	50
UFL201	AEC	Foreign Language I	2	-	-	-	2	-	-	-	-
ACUHV201 / ACCOI 201	AC	UHV II: Understanding Harmony / Constitution of India	2	-	-	-	2	-	-	-	-
Total			18	4	2	20	28	330	270	100	700

List of Elective I: Semester-III

Course Code	Elective-A	Course Code	Elective-B
UBTMLEO201 & UBTMLOE203 Elective-I			
UBTMLOE201	Digital Logic and Microprocessor	UBTMLOE203	Signal System
UBTMLOE202 & UBTMLOE204 Elective-I Lab			
UBTMLOE202	Digital Logic and Microprocessor Lab	UBTMLOE204	Signal System Lab

Foreign Language –I for Semester-III

Course Code	Foreign Language I
UFL201 FL-I	
UFL201 A	Foreign Language-I: German
UFL201 B	Foreign Language-I: Japanese

SEMESTER - IV

Course Code	Type	Course Name	TEACHING SCHEME					ASSESSMENT SCHEME			
			THY	PR	TU	Credits	Hrs	CIA	ESA	PR/ OR	Total
UBTML208	PCC	Database Management System	3	-	-	3	3	40	60	-	100
UBTML209	PCC	Database Management System Laboratory	-	1	-	1	2	25	-	25	50
UBTML210	PCC	Java Programming	3	-	-	3	3	40	60	-	100
UBTML211	PCC	Java Programming Laboratory	-	1	-	1	2	25	-	25	50
UBTML212	CEP	Project Based on Digital and Technological Solutions	-	1	-	1	2	25	-	25	50
UBTML213	PCC	Applied Statistical Techniques	3	-	-	3	3	40	60	-	100
UBTMLOE205 /UBTM-LOE207	OE	Elective-II	3	-	-	3	3	40	60	-	100
UBTMLOE206 /UBTM-LOE208	OE	Elective-II Lab	-	1	-	1	2	25	-	25	50
MOOCML402	MOOC	Foundations of Cybersecurity in Linux	-	-	2	2	2	50	-	-	50
UFL202	AEC	Foreign Language II	2	-	-	-	2	-	-	-	-
MIN	MIN	Multidisciplinary Minor - I	2	-	-	2	2	20	30	-	50
ACUHV201 / ACCOI 201	AC	UHV: Understanding Harmony / Constitution of India	2	-	-	-	2	-	-	-	-
PSD401	VSEC	Professional Development Training-I	-	2	-	2	4	50	-	-	50
Total			18	6	2	22	32	380	270	100	750

List of Elective II: Semester-IV

Course Code	Elective-A	Course Code	Elective-B
ELECTIVE-II			
UBTMLOE205	Internet of Things	UBTMLOE207	Digital Image Processing
UBTMLOE222 ELECTIVE-II LAB			
UBTMLOE206	Internet of Things Lab	UBTMLOE208	Digital Image Processing Lab

Foreign Language –II for Semester-IV

Course Code	Foreign Language II
UFL201 FL-II	
UFL202 A	Foreign Language-II: German
UFL202 B	Foreign Language-II: Japanese

SEMESTER - V

Course Code	Type	Course Name	TEACHING SCHEME					ASSESSMENT SCHEME			
			THY	PR	TU	Credits	Hrs	CIA	ESA	PR/ OR	Total
UBTML321	PCC	Computational Theory	2	-	1	3	3	40	60	-	100
UBTML322	PCC	Fundamentals of Networking	3	-	-	3	3	40	60	-	100
UBTML323	PCC	Fundamentals of Networking Lab	-	1	-	1	2	25	-	25	50
UBTML324	PCC	Artificial Intelligence	3	-	-	3	3	40	60	-	100
UBTML325	PCC	Artificial Intelligence Lab	-	1	-	1	2	25	-	25	50
UBTML326/ UBTML328/ UBT-CEPE311	PEC	Elective-III	2	-	-	2	2	20	30	-	50
UBTML327/ UBTML329/ UBT-CEPE312	PEC	Elective-III Lab	-	1	-	1	2	25	-	25	50
MIN	MIN	Multidisciplinary Minor	2	-	-	2	2	20	30	-	50
MOOCML503	MOOC	Introduction to Blockchain Technology and Applications	-	-	2	2	2	50	-	-	50
UBTML330	PROJ	Technical Seminar on Sustainable Environmental Solutions	-	1	-	1	2	25	-	25	50
UFL301	AEC	Foreign Language III	2	-	-	-	2	-	-	-	-
PSD501 / ACCEVS301	VSEC	Professional Development Training-II / Environmental Studies	-	2	-	2	4	50	-	-	50
ACCRI301	RI	Rural Immersion-I	-	1	-	1	2	25	-	-	25
Total			14	7	3	22	31	385	240	100	725

List of Elective III: Semester-V

Course Code	Elective-A	Course Code	Elective-B	Course Code	Elective-C
UBTML326, UBTML328 & UBTCEPE311 – Elective-III					
UBTML326	Web Programming Techniques	UBTML328	Foundations of Data Science	UBTCEPE311	Real Time Operating System
UBTML327, UBTML329 & UBTCEPE312 – Program Elective-III Lab					
UBTML327	Web Programming Techniques Lab	UBTML329	Foundations of Data Science Lab	UBTCEPE312	Real Time Operating System Lab

Note: #Refer separate booklet for Multidisciplinary Minor (MDM Courses)

Foreign Language –III for Semester-V

Course Code	Foreign Language III
UFL301 FL-III	
UFL301 A	Foreign Language-III: German
UFL301 B	Foreign Language-III: Japanese

SEMESTER - VI

Course Code	Type	Course Name	TEACHING SCHEME					ASSESSMENT SCHEME			
			THY	PR	TU	Credits	Hrs	CIA	ESA	PR/ OR	Total
UBTML331	PCC	Machine Learning	3	-	-	3	3	40	60	-	100
UBTML332	PCC	Machine Learning Lab	-	1	-	1	2	25	-	25	50
UBTML333	PCC	Algorithmic Techniques and Strategies	3	-	-	3	3	40	60	-	100
UBTML334	PCC	Algorithmic Techniques and Strategies Lab	-	1	-	1	2	25	-	25	50
UBTML335/ UBTML337	PEC	Elective IV	3	-	-	3	3	40	60	-	100
UBTML336/ UBTML338	PEC	Elective IV Lab	-	1	-	1	2	25	-	25	50
UBTML339/ UBTML341	PEC	Elective V	3	-	-	3	3	40	60	-	100
UBTML340/ UBTML342	PEC	Elective V Lab	-	1	-	1	2	25	-	25	50
MOOCML602	MOOC	Data Visualization using Tableau and R Programming	-	-	2	2	2	50	-	-	50
MIN	MIN	Multidisciplinary Minor-3	2	-	-	2	2	20	30	-	50
UFL302	AEC	Foreign Language IV	2	-	-	-	2	-	-	-	-
ACLR301 / ACCEVS301	VSEC	Career Readiness and Placement Preparation/ Professional Ethics	-	2	-	2	4	50	-	-	50
ACCRI302	RI	Rural Immersion-II	-	1	-	1	2	25	-	-	25
Total			16	7	2	23	32	405	270	100	775

List of Elective IV & V: Semester-VI

Course Code	Elective-A	Course Code	Elective-B
UBTML335 & UBTML337 – Elective-IV			
UBTML335	Pattern Recognition and Optimization	UBTML337	Data Visualization Tools
UBTML336 & UBTML338 – Elective-IV Lab			
UBTML336	Pattern Recognition and Optimization Lab	UBTML338	Data Visualization Tools Lab
UBTML339 & UBTML341 – Elective-V			
UBTML339	Soft Computing	UBTML341	Foundation of Big Data
UBTML340 & UBTML342 – Elective-V Lab			
UBTML340	Soft Computing Lab	UBTML342	Foundation of Big Data Lab

Foreign Language –IV for Semester-VI

Course Code	Foreign Language IV
UFL302 FL-IV	
UFL302 A	Foreign Language-IV: German
UFL302 B	Foreign Language-IV: Japanese

Note: #Refer separate booklet for Multidisciplinary Minor (MDM Courses)

SEMESTER - VII

Course Code	Type	Course Name	TEACHING SCHEME					ASSESSMENT SCHEME			
			THY	PR	TU	Credits	Hrs	CIA	ESA	PR/ OR	Total
UBTML401	PCC	Deep Learning	3	-	-	3	3	40	60	-	100
UBTML402	PCC	Deep Learning Lab	-	1	-	1	2	25	-	25	50
UBTML403 / UBTML405	PEC	Elective VI	3	-	-	3	3	40	60	-	100
UBTML404 / UBTML406	PEC	Elective VI Lab	-	1	-	1	2	25	-	25	50
MIN	MIN	Multidisciplinary Minor - 4	2	-	-	2	2	20	30	-	50
MOOCML702	MOOC	Devops	-	-	2	2	2	50	-	-	50
UBTML407	INT/ OJT	Industry/ International/ Research Internship I	-	6	-	6	12	100	-	100	200
UBTML408	PROJ	Major Project - I AIML	-	4	-	4	4	40	-	60	100
Total			8	12	2	22	30	340	150	210	700

List of Elective VI: Semester-VII

Course Code	Elective-A	Course Code	Elective-B
UBTML403 & UBTML405: Elective-VI			
UBTML403	Natural Language Processing	UBTML405	Generative AI and Applications
UBTML404 & UBTML406: Program Elective-IV Lab			
UBTML404	Natural Language Processing Lab	UBTML406	Generative AI and Applications Lab

Note: #Refer separate booklet for Multidisciplinary Minor (MDM Courses)

INTERNSHIP SCHEMES

	Scheme A	Scheme B
Semester	7^{th} Semester	7^{th} Semester
Mode	Offline	Online and MOOC Courses
Duration	3–4 Months	3–4 Months

SEMESTER - VIII

Course Code	Type	Course Name	TEACHING SCHEME					ASSESSMENT SCHEME			
			THY	PR	TU	Credits	Hrs	CIA	ESA	PR/ OR	Total
UBTML409	PCC	Computer Vision and Video Processing	3	-	-	3	3	40	60	-	100
UBTML410	PCC	Computer Vision and Video Processing Lab	-	1	-	1	2	25	-	25	50
UBTML411	RM	Principles of Research & Intellectual Property	3	-	-	3	3	40	60	-	100
UBTML412 / UBTML414	PEC	Elective VII	3	-	-	3	3	40	60	-	100
UBTML413 / UBTML415	PEC	Elective VII Lab	-	1	-	1	2	25	-	25	50
MIN	MIN	Multidisciplinary Minor - 5	2	-	-	2	2	20	30	-	50
UBTML416	PROJ	Major Project-II	-	8	-	8	16	150	-	100	250
Total			11	10	0	21	31	340	210	150	700

List of Elective VII: Semester-VIII

Course Code	Elective-A	Course Code	Elective-B
UBTML412 & UBTML414: Elective VII			
UBTML412	Time Series Forecasting	UBTML414	Foundations of Business Analytics
UBTML413 & UBTML415: Elective VII Labs			
UBTML413	Time Series Forecasting Lab	UBTML415	Foundations of Business Analytics Lab

Note: #Refer separate booklet for Multidisciplinary Minor (MDM Courses)

Credit Distribution Per Semester by Course Type

Sr. No.	Course Type	No. of Credits / Semester								Total
		I	II	III	IV	V	VI	VII	VIII	
1	Basic Science Course (BSC)	8	8	0	0	0	0	0	0	16
2	Engineering Science Course (ESC)	7	7	0	0	0	0	0	0	14
3	Programme Core Course (PCC)	3	3	8	8	4	8	4	4	42
4	MOOC (PCU Online / NPTEL / SWAYAM)	0	0	4	4	4	4	2	2	20
5	Programme Elective Course (PEC)	0	0	0	0	4	8	4	4	20
6	Elective (OE) other than particular program	0	0	4	2	2	0	0	0	8
7	Multidisciplinary Courses (MDC)	0	0	3	3	3	0	0	0	9
8	Vocational and Skill Enhancement Course (VSEC) / Foreign Language	1	1	1	1	0	0	0	0	4
9	Ability Enhancement Course (AEC)	2	2	0	2	2	0	0	0	8
10	Entrepreneurship / Economics / Management Courses (MGMT)	0	0	2	0	0	0	0	0	2
11	Indian Knowledge System (IKS)	2	2	0	0	0	0	0	0	4
12	Value Education Course (VEC)	0	0	0	2	0	0	0	0	2
13	Research Methodology (RM)	0	0	0	0	0	0	0	4	4
14	Multidisciplinary Comm. Engg. Project (CEP) / Rural Immersion Program (RIP) / NCC / Field Project (FP)	0	0	2	0	0	0	0	0	2
15	Project	0	0	0	0	2	0	6	6	14
16	Multidisciplinary Internship / OJT	0	0	0	0	0	0	4	4	8
17	Co-curricular Courses (CC)	1	1	0	0	0	0	0	0	2
Total Credits (Major)		**24**	**24**	**24**	**22**	**21**	**20**	**20**	**24**	**179**

COURSE SYLLABUS

CSE - AI&ML

SEMESTER-III

Name of the Program:	BTECH CSE - AI&ML	Semester: 3	Level: UG
Course Name:	Data Structures and Algorithms	Course Code/ Course Type	UBTML201/PCC
Course Pattern:	2026	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical/ Oral
3	-	-	3	3	40	60	-

Pre-Requisite:

1. Knowledge of C Programming

Course Objectives (CO):	**The objectives of Data Structures and Algorithms are:** 1. To introduce fundamental problem-solving approaches and concepts of data structures and algorithm analysis. 2. To provide in-depth knowledge of linked list structures and their operations for dynamic memory management. 3. To develop understanding of stack and queue abstract data types along with their applications in expression handling and scheduling. 4. To enable learners to analyze and apply basic searching and sorting techniques along with their performance comparisons. 5. To impart knowledge about hierarchical and network data structures like trees and graphs, and explore their real-world applications.
Course Learning Outcomes (CLO):	**Students would be able to:** 1. Explain data structure types and analyze the efficiency of algorithms using time and space complexity metrics. 2. Demonstrate operations such as insertion, deletion, and traversal on different types of linked lists. 3. Apply stack and queue operations to solve computational problems like expression evaluation and process scheduling. 4. Compare various searching and sorting algorithms and analyze their performance in different scenarios. 5. Construct tree and graph-based solutions using traversal techniques and shortest path algorithms.

Course Contents/Syllabus:

Descriptors/Topics	CLO	Hours
UNIT I		
Introduction to Data Structures: General Problem-Solving Concepts, Types of Problems, Problem Solving Concepts for the Computer. Concept of data, Types of data structures: Concept of Primitive and non-primitive, linear and Nonlinear, static and dynamic, persistent and ephemeral data structures. Algorithm: Characteristics of algorithm, Pseudo code, Flowchart. Analysis of algorithm: Frequency count and its importance in analysis of an algorithm, Time complexity and Space complexity of an algorithm Big 'O', 'Ω' and 'θ' notations.	**CLO 1**	**9**
UNIT II		

Stack and Queue: Stack: Concept of stack, Operations on stack (push, pop and display) Applications of stack: recursion, converting expressions from infix to postfix, infix to prefix form, evaluating postfix or prefix form. Queue: Concept of queues as ADT, Implementation of queue using array. Concept of circular queue, double ended queue, Applications of queue: priority queue.	**CLO 2**	**9**
UNIT III		
Linked List: Understanding the basics of Linked List, Comparison between array and linked list. Types and basic operations of Linked Lists: 1. Single Linked List. 2. Double Linked List. 3. Circular Linked List. 4. Circular Double Linked List. Basic operations: Creation, Insertion, Deletion, Traversing.	**CLO 3**	**9**
UNIT IV		
Searching and Sorting: Need of searching and sorting, Concept of internal and external sorting, sort stability. Searching methods: Linear and binary search algorithms. Sorting methods: Bubble, Insertion, Quick, Merge. Comparison of all sorting methods. Analyze Bubble Sort, Insertion sort, Quick Sort, Binary for Best, Worst and Average case.	**CLO 4**	**9**
UNIT V		
Tree and Graph: Tree: Trees and binary trees-concept and terminology, Expression tree, Binary tree as an ADT, Binary search tree, Binary search tree as ADT (Insert Search Delete, level wise Display) Threaded binary tree: Concept of threaded binary tree (inorder, preorder and postorder), Applications of trees. Graph: Concept and terminologies, Breadth First Search traversal, Depth First Search traversal, Prim's and Kruskal's algorithms for minimum spanning tree, shortest path using Dijkstra's algorithm.	**CLO 5**	**9**
Total Hours		**45**

Learning Resources:

Text Books:

1. Herbert Schildt, *C++: The Complete Reference*, McGraw Hill Education, 2003.
2. John R. Hubbard, *Data Structures with C++*, Schaum's Outlines, Tata McGraw Hill Education, 2000.

Reference Books:

1. Michael T. Goodrich, Roberto Tamassia, and David Mount, *Data Structures and Algorithms in C++*, Wiley India Pvt. Ltd., 2004.
2. Seymour Lipschutz, *Data Structures*, Schaum's Outlines, Tata McGraw Hill Education, 2006.

Online Resources/E-learning Resources:

1. Data Structures and Algorithms, IIT Delhi Prof. Naveen Garg
   `https://nptel.ac.in/courses/106102064`
2. NPTEL Course Resource
   `https://nptel.ac.in/courses/106103069`

Name of the Program:	BTECH CSE - AI&ML	Semester: 3	Level: UG
Course Name:	Data Structures and Algorithms Laboratory	Course Code/ Course Type	UBTML202/PCC
Course Pattern:	2026	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical/ Oral
-	1	-	1	2	25	-	25

Pre-Requisite:

1. Basic knowledge of Programming in C and C++

Course Objectives (CO):	**The objectives of Data Structures and Algorithms Laboratory are:** 1. To develop programming skills for implementing fundamental data structures using C/C++. 2. To perform practical operations on linked lists, stacks, and queues for solving computational problems. 3. To apply searching and sorting algorithms and study their performance through implementation. 4. To construct tree and graph-based programs for traversal and problem solving. 5. To strengthen analytical and debugging skills through hands-on experimentation with data structure applications.
Course Learning Outcomes (CLO):	**Students would be able to:** 1. Implement basic data structures and evaluate algorithmic complexity using practical examples. 2. Develop programs for linked list operations, stack applications, and queue-based solutions. 3. Apply searching and sorting techniques to solve data organization problems. 4. Construct and test binary search trees and graph traversal algorithms. 5. Analyze program output, debug logical errors, and justify the suitability of data structures for specific applications.

Practical Plan:

Practical Number	Practical Title	Week Number	Details	CLO	Hours
1	Time Complexity and Frequency Count	1	Write a C++ program to find the sum of elements in an array. Analyze its time complexity using frequency count.	CLO1	2
2	Best-case, worst-case, and average-case scenarios	2	Write a C++ program to perform linear search on an array. Identify and display best-case, worst-case, and average-case scenarios.	CLO2	2
3	Stack Application	5	Write a C++ program to implement a Stack using an array and apply it to convert an infix expression to postfix.	CLO3	2
4	Circular Queue	6	Write a C++ program to implement a Queue using arrays and demonstrate circular queue functionality.	CLO4	2

5	Single Linked List	3	Write a C++ program to implement a Singly Linked List with insertion, deletion, and traversal operations.	CLO2	2
6	Doubly Linked List	4	Write a C++ program to implement a Doubly Linked List and perform all basic operations.	CLO3	2
7	Bubble Sort and Insertion Sort	7	Write a C++ program to implement and analyze Bubble Sort and Insertion Sort.	CLO4	2
8	Binary Search and Quick Sort	8	Write a C++ program to perform Binary Search and Quick Sort, analyzing best, worst, and average case complexity.	CLO5	2
9	Binary Search Tree (BST)	9	Write a C++ program to implement a Binary Search Tree (BST) with operations: insertion, search, deletion, level-wise display.	CLO5	2
10	BFS and DFS	10	Write a C++ program to perform Breadth First Search (BFS) and Depth First Search (DFS) on a graph using adjacency list.	CLO5	2
				Total Hours	**20**

Learning Resources:

Text Books:

1. Herbert Schildt, *C++: The Complete Reference*, McGraw Hill Education, 2003.
2. John R. Hubbard, *Data Structures with C++*, Schaum's Outlines, Tata McGraw Hill Education, 2000.

Reference Books:

1. Michael T. Goodrich, Roberto Tamassia, and David Mount, *Data Structures and Algorithms in C++*, Wiley India Pvt. Ltd., 2004.
2. Seymour Lipschutz, *Data Structures*, Schaum's Outlines, Tata McGraw Hill Education, 2006.

Online Resources/E-learning Resources:

1. Data Structures and Algorithms, IIT Delhi Prof. Naveen Garg
   `https://nptel.ac.in/courses/106102064`
2. NPTEL Course Resource
   `https://nptel.ac.in/courses/106103069`

Name of the Program:	BTECH CSE-AI&ML	Semester: 3	Level: UG
Course Name:	Python Programming	Course Code/ Course Type	UBTML203/PCC
Course Pattern:	2026	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical/ Oral
3	-	-	3	3	40	60	-

Pre-Requisite:

1. Basic knowledge of Programming in C

Course Objectives (CO):	**The objectives of Python Programming are:** 1. To learn the fundamentals of the Python programming language. 2. To create Python list tuple to represent compound data solving, and learning methods in solving engineering problems. 3. To write and execute simple as well as complex Python programs. 4. To analyze the concepts of procedural as well as object-oriented Python programs. 5. To perform files handling operations and handle exceptions using Python.
Course Learning Outcomes (CLO):	**Students would be able to:** 1. Elaborate the features of Python programming language. 2. Apply the conditional and looping constructs using Python. 3. Use the multidimensional array and string operations using Python. 4. Analyze and apply the object-oriented concepts using Python programming. 5. Apply the file handling and exception handling using Python programming.

Course Contents/Syllabus:

Descriptors/Topics	CLO	Hours
UNIT I		
Introduction to Python: Python Introduction - Features, Identifiers, Reserved words, Indentation, Comments, Built-in Data types and their Methods: Strings, List, Tuples, Dictionary, and Set - Type Conversion - Operators. Execution of a Python Program, Writing Our First Python Program, Statements, Precedence of Operators.	**CLO 1**	**9**
UNIT II		
Decision Making and Looping: Conditional (if), Alternative (if-else), Chained Conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Math and Random number functions.	**CLO 2**	**9**
UNIT III		
Array and String: Arrays in Python, Strings and Characters. Strings: String Slices, Immutability, String Functions and Methods, String Module; Lists as Arrays, Sum an Array of Numbers, Linear Search, Binary Search.	**CLO 3**	**9**
UNIT IV		
Function and OOPs concept: User defined functions - function arguments and its types, lambda functions and list comprehension, OOPs Concepts - Class and Objects, Constructors, Data hiding, Data Abstraction, Inheritance.	**CLO 4**	**9**

UNIT V		
Files, Exceptions, Modules and Packages: Text Files, Reading and Writing Files, Format Operator; Command Line Arguments, Errors and Exceptions, Handling Exceptions, Modules, Packages; Illustrative Programs: Word Count, Copy File.	**CLO 5**	**9**
Total Hours		**45**

Learning Resources:

Text Books:

1. Y. Daniel Liang, *Introduction to Programming using Python*, Pearson, 2012.
2. Wes McKinney, *Python for Data Analysis: Data Wrangling with Pandas, NumPy, and Python*, O'Reilly, 2nd Edition, 2018.

Reference Books:

1. Wesley J. Chun, *Core Python Programming*, Prentice Hall, 2006.
2. Mark Lutz, *Learning Python*, O'Reilly, 4th Edition, 2009.

Online Resources/E-learning Resources:

1. W3Schools Python Tutorial
   `https://www.w3schools.com/python/`
2. LearnPython.org
   `https://www.learnpython.org/`

Name of the Program:	BTECH CSE - AI&ML	Semester: 3	Level: UG
Course Name:	Python Programming Laboratory	Course Code/ Course Type	UBTML204/PCC
Course Pattern:	2026	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical/ Oral
-	1	-	1	2	25	-	25

Pre-Requisite:

1. Basic knowledge of Programming in C

Course Objectives (CO):	**The objectives of Python Programming Laboratory are:** 1. To develop practical skills in writing, executing, and debugging Python programs. 2. To apply Python data structures, control statements, and built-in functions in problem solving. 3. To implement searching, numerical operations, and functional constructs using Python. 4. To create modular and reusable programs using functions, modules, and packages. 5. To perform file handling, exception handling, and mini-project development using Python.
Course Learning Outcomes (CLO):	**Students would be able to:** 1. Write and execute Python programs using command-line arguments and built-in data structures. 2. Solve problems using decision-making and looping constructs in Python. 3. Implement numerical and searching operations using Python libraries and string/list handling. 4. Create user-defined functions, modules, and packages for modular programming. 5. Develop Python programs using file operations, exception handling, and mini-project implementation.

Practical Plan:

Practical Number	Practical Title	Week Number	Details	CLO	Hours
1	Command Line Argument	1	To write a Python program that accepts command line arguments as input and performs some operations.	CLO1	2
2	Data Structure	2	To write a Python program to perform creation, indexing, slicing, concatenation and repetition operations on Python built-in data types: Strings, List, Tuples, Dictionary, and Set.	CLO1	2
3	Control Statements	3	To write a Python program to solve problems using decision and looping statements.	CLO2	2

4	Linear Search / Numerical Operations	4	To write a Python program to handle numerical operations using math and random number functions.	CLO3	2
5	Binary Search	5	To write a Python program to perform linear search and binary search using strings.	CLO3	2
6	Lambda Functions and List Comprehension	6	To write a Python program to perform lambda functions and list comprehension.	CLO4	2
7	User Defined Functions	7	To write a Python program to create user-defined functions with different types of function arguments with examples.	CLO4	2
8	Packages and Modules	8, 9	To write a Python program to create packages and import modules from packages to solve real problems.	CLO4	4
9	File Handling Operations	10, 11	To write a Python program to perform file manipulations - open, close, read, write, append and copy from one file to another.	CLO5	4
10	Exception Handling Operations	12	To write a Python program to handle exceptions using Python built-in exceptions.	CLO5	2
11	Mini Project	13, 14, 15	Implement mini project in a group of 3 to 4 students.	CLO1, CLO2, CLO3, CLO4, CLO5	6
				Total Hours	**30**

Learning Resources:

Text Books:

1. Y. Daniel Liang, *Introduction to Programming using Python*, Pearson, 2012.
2. Wes McKinney, *Python for Data Analysis: Data Wrangling with Pandas, NumPy, and Python*, O'Reilly, 2nd Edition, 2018.

Reference Books:

1. Wesley J. Chun, *Core Python Programming*, Prentice Hall, 2006.
2. Mark Lutz, *Learning Python*, O'Reilly, 4th Edition, 2009.

Online Resources/E-learning Resources:

1. W3Schools Python Tutorial
   `https://www.w3schools.com/python/`
2. LearnPython.org
   `https://www.learnpython.org/`

Name of the Program:	BTECH CSE-AI&ML	Semester: 3	Level: UG
Course Name:	Digital Logic & Microprocessor	Course Code/ Course Type	UBTMLOE201/OE
Course Pattern:	2026	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical/ Oral
3	-	-	3	3	40	60	-

Pre-Requisite:

1. Basic knowledge of Programming in C

Course Objectives (CO):	**The objective of Digital Electronics & Logic Design are:** 1. To understand the basics of Digital fundamentals, Boolean algebra, its applications and combinational logic circuits in digital systems. 2. To study various combinational digital circuits using logic gates. 3. To study, analyze and design clocked sequential circuits. 4. To get acquaint students with the asynchronous sequential circuits and design of hazard free circuits. 5. To learn the architecture and pin configuration of 8086 Microprocessor.
Course Learning Outcomes (CLO):	**Students would be able to:** 1. Use digital electronics in the present contemporary world. 2. Design various combinational digital circuits using logic gates. 3. Do the analysis and design procedures for synchronous and asynchronous sequential circuits. 4. Use the semiconductor memories and related technology. 5. Identify the architecture and pin configuration of 8086 Microprocessor.

Course Contents/Syllabus:

Descriptors/Topics	CLO	Hours
UNIT I		
Digital Fundamentals: Number Systems – Decimal, Binary, Octal, Hexadecimal, 1's and 2's complements, Codes – Binary, BCD, Excess 3, Gray, Alphanumeric codes, Boolean theorems, Logic gates, Universal gates, Sum of products and product of sums, Minterms and Maxterms, Karnaugh map Minimization and Quine.	**CLO 1**	**9**
UNIT II		
Combinational Circuit Design: Design of Half and Full Adders, Half and Full Subtractors, Binary Parallel Adder – Carry look ahead Adder, BCD Adder, Multiplexer, Demultiplexer, Magnitude Comparator, Decoder, Encoder, Priority Encoder.	**CLO 2**	**9**
UNIT III		
Synchronous Sequential Circuits: Flip flops – SR, JK, T, D, Master/Slave FF – operation and excitation tables, Triggering of FF, Analysis and design of clocked sequential circuits – Design – Moore/Mealy models, state minimization, design of Counters – Ripple Counters, Shift registers, Universal Shift Register.	**CLO 3**	**9**
UNIT IV		

Memory Devices and Digital Integrated Circuits: Digital integrated circuits: logic families and their characteristics - RTL, TTL, ECL, CMOS. Basic memory structure – ROM, PROM, EPROM, EEPROM. Programmable Logic Devices – Programmable Logic Array (PLA), Programmable Array Logic (PAL), Field Programmable Gate Arrays (FPGA).	**CLO 4**	**9**
UNIT V		
8086 Microprocessor: Introduction to 8086 architecture, pin description, external memory interfacing, maximum mode bus cycle, memory interfacing, minimum mode system configuration, maximum mode system configuration, interrupts processing, instruction set.	**CLO 5**	**9**
Total Hours		**45**

Learning Resources:

Text Books:

1. M. Morris Mano, *Digital Logic and Computer Design*, 2nd Edition, PHI.
2. R. P. Jain, *Modern Digital Electronics*, McGraw Hill.
3. Malvino Leach, *Digital Electronics*, McGraw Hill.

Reference Books:

1. Thomas L. Floyd, *Digital Fundamentals*, Pearson, 11th Edition.
2. Ronald J. Tocci, *Digital Systems: Principles and Applications.*
3. Douglas V. Hall, *Microprocessors and Interfacing, Programming and Hardware*, TMH, 2012.

Online Resources/E-learning Resources:

1. Udemy: Digital Electronics
   `https://www.udemy.com/topic/digital-electronic/`
2. Class Central: Digital Electronics
   `https://www.classcentral.com/course/youtube-digital-electronics-48205`

Name of the Program:	BTECH CSE-AI&ML	Semester: 3	Level: UG
Course Name:	Digital Logic & Microprocessor Lab	Course Code/ Course Type	UBTMLOE202/OE
Course Pattern:	2026	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical/ Oral
-	1	-	1	1	25	-	25

Pre-Requisite:

1. Basic knowledge of Programming in C

Course Objectives (CO):	**The objectives of Digital Logic & Microprocessor Lab are:** 1. To verify the behavior of basic logic gates and Boolean expressions through practical experiments. 2. To design and implement combinational circuits using standard logic ICs. 3. To analyze and realize sequential circuits such as flip-flops, multiplexers, decoders, and comparators. 4. To understand the operation of digital ICs and memory-related components through laboratory implementation. 5. To gain hands-on exposure to 8086 microprocessor architecture and assembly language programming.
Course Learning Outcomes (CLO):	**Students would be able to:** 1. Perform logic design experiments and verify Boolean simplification using logic gates. 2. Implement combinational circuits such as adders, subtractors, converters, and comparators using digital ICs. 3. Demonstrate the working of sequential and selection circuits including flip-flops, MUX, DEMUX, and encoders. 4. Analyze the functioning of decoder/display interfaces and memory-related digital circuits. 5. Execute basic 8086 assembly language programs and justify the working of microprocessor-based systems.

Practical Plan:

Practical Number	Practical Title	Week Number	Details	CLO	Hours
1	Practical 1	1	Introduction: Study of logic gates.	CLO1	2
2	Practical 2	2	Simplification, realization of Boolean expressions using Logic gates / Universal gates. Realization of half/full adder using logic gates.	CLO1	2
3	Practical 3	3	Simplification, realization of Boolean expressions using Logic gates / Universal gates. Realization of half/full subtractor using logic gates.	CLO1	2
4	Practical 4	4	Realization of parallel adder / subtractor using 7483 chip.	CLO2	2

5	Practical 5	5	BCD to Ex-3 code conversion and vice versa. Realization of parallel adder / subtractor using 7483 chip.	CLO2	2
6	Practical 6	6	Realization of Binary to Gray code converter and vice versa.	CLO2	2
7	Practical 7	7	MUX using 74153 for arithmetic circuits.	CLO3	2
8	Practical 8	8	DEMUX using 74139 for code converter.	CLO3	2
9	Practical 9	9	Realization of one/two bit comparator and study of 7485 magnitude comparator.	CLO3	2
10	Practical 10	10	Use of decoder chip to drive LED/LCD display.	CLO3	2
11	Practical 11	11	Priority Encoder.	CLO3	2
12	Practical 12	12	Truth table verification of flip-flops: JK master slave.	CLO4	2
13	Practical 13	13	Truth table verification of flip-flops: T-type.	CLO4	2
14	Practical 14	14	To study 8086 microprocessor system.	CLO5	2
15	Practical 15	15	Assembly language program using 8086 MASM software and 8086 microprocessor kit – Addition, subtraction, multiplication, division.	CLO5	2
				Total Hours	**30**

Learning Resources:

Text Books:

1. M. Morris Mano, *Digital Logic and Computer Design*, 2nd Edition, PHI.
2. R. P. Jain, *Modern Digital Electronics*, McGraw Hill.
3. Malvino Leach, *Digital Electronics*, McGraw Hill.

Reference Books:

1. Thomas L. Floyd, *Digital Fundamentals*, Pearson, 11th Edition.
2. Ronald J. Tocci, *Digital Systems: Principles and Applications.*
3. Douglas V. Hall, *Microprocessors and Interfacing, Programming and Hardware*, TMH, 2012.

Online Resources/E-learning Resources:

1. Udemy: Digital Electronics
   `https://www.udemy.com/topic/digital-electronic/`
2. Class Central: Digital Electronics
   `https://www.classcentral.com/course/youtube-digital-electronics-48205`

Name of the Program:	BTECH CSE-AI&ML	Semester: 3	Level: UG
Course Name:	Signal System	Course Code/ Course Type	UBTMLOE203/OE
Course Pattern:	2026	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical/ Oral
3	-	-	3	3	40	60	-

Pre-Requisite:

1. Signal theory, Math

Course Objectives (CO):	**The objectives of Signal System are:** 1. To recall the basic knowledge about the different type of signals. 2. To recognize the system analysis in frequency domain. 3. To apply the knowledge of Fourier and Laplace transform. 4. To analyze correlation and spectral density. 5. To evaluate probability, random variables & signals.
Course Learning Outcomes (CLO):	**Students would be able to:** 1. Identify different type of signals. 2. Explain the system analysis in frequency domain. 3. Apply knowledge of Fourier and Laplace transform. 4. Analyze correlation and spectral density. 5. Evaluate the probability, random variables & signals.

Course Contents/Syllabus:

Descriptors/Topics	CLO	Hours
UNIT I		
Introduction to Signals and Systems: Definition of signals and systems, communication and control systems as examples. Classification of signals: Continuous time and discrete time, even, odd, periodic and non-periodic, deterministic and non-deterministic, energy and power. Operations on signals: Amplitude scaling, addition, multiplication, differentiation, integration (accumulator for DT), time scaling, time shifting and folding, precedence rule. Elementary signals: exponential, sine, step, impulse and its properties, ramp, rectangular, triangular, signum, sinc. Systems: Definition, Classification: linear and non linear, time variant and invariant, causal and non-causal, static and dynamic, stable and unstable, invertible.	**CLO 1**	**9**
UNIT II		
System Analysis: System modeling: Input output relation, impulse response, block diagram, integro-differential equation and state-space representation. Definition of impulse response, convolution integral, convolution sum, computation of convolution integral using graphical method for unit step to unit step, unit step to exponential, exponential to exponential and unit step to rectangular, rectangular to rectangular only. Computation of convolution sum by all methods.	**CLO 2**	**9**
UNIT III		

System Analysis in Frequency Domain using Fourier Transform & Laplace Transform: Definition and necessity of CT and DT Fourier series and Fourier transforms. Analogy between CTFS, DTFS and CTFT, DTFT. CT Fourier series, CT Fourier transform and its properties, problem solving using properties, amplitude spectrum, phase spectrum of the signal and system. Interplay between time and frequency domain using sinc and rectangular signals. Limitations of FT and need of LT and ZT, ROC and pole zero concept.	**CLO 3**	**9**
UNIT IV		
Correlation and Spectral Density: Definition of Correlation and Spectral Density, correlogram, analogy between correlation, covariance and convolution, conceptual basis, autocorrelation, cross correlation, energy/power spectral density, properties of correlation and spectral density, inter relation between correlation and spectral density.	**CLO 4**	**9**
UNIT V		
Probability, Random Variables and Random Signals: Experiment, sample space, event, probability, conditional probability and statistical independence. Random variables: Continuous and Discrete random variables, cumulative distributive function, Probability density function, properties of CDF and PDF. Statistical averages, mean, moments and expectations, standard deviation and variance. Probability models: Uniform, Gaussian, Binomial.	**CLO 5**	**9**
Total Hours		**45**

Learning Resources:

Text Books:

1. Simon Haykins and Barry Van Veen, *Signals and Systems*, 2nd Edition, Wiley India.
2. Simon Haykins, *Introduction to Analog and Digital Communications*, Wiley India.

Reference Books:

1. Simon Haykins, *Introduction to Analog and Digital Communications*, Wiley India.
2. Charles Phillips, *Signals, Systems and Transforms*, 3rd Edition, Pearson Education.
3. Peyton Peebles, *Probability, Random Variable, Random Processes*, 4th Edition, Tata McGraw-Hill.

Online Resources/E-learning Resources:

1. NPTEL Course on Signals and Systems
   `https://onlinecourses.nptel.ac.in/noc21_ee28/preview`

Name of the Program:	BTECH CSE-AI&ML	Semester: 3	Level: UG
Course Name:	Signal System Laboratory	Course Code/ Course Type	UBTMLOE204/OE
Course Pattern:	2026	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical/ Oral
-	1	-	1	1	25	-	25

Pre-Requisite:

1. Signal theory, Math

Course Objectives (CO):	**The objectives of Signal System Laboratory are:** 1. To develop practical understanding of continuous-time and discrete-time signals through computational tools. 2. To perform signal operations and examine system properties using mathematical and simulation-based approaches. 3. To apply Fourier and Laplace transform concepts for signal and system analysis. 4. To analyze correlation and spectral density characteristics of given signals. 5. To strengthen interpretation and problem-solving skills in signal processing using MATLAB or equivalent software.
Course Learning Outcomes (CLO):	**Students would be able to:** 1. Represent and generate basic CT and DT signals using computational tools. 2. Perform signal operations and determine system properties from mathematical models. 3. Demonstrate Fourier and Laplace transform properties for analysis of signals and systems. 4. Compute and interpret correlation functions and spectral density measures of signals. 5. Analyze and validate signal-system behavior through simulation, observation, and result interpretation.

Practical Plan:

Practical Number	Practical Title	Week Number	Details	CLO	Hours
1	Practical 1	1	Sketch and write defining mathematical expression for the following signals in CT and DT using MATLAB - Unit step, rectangular, exponential, signum, sine, sinc, triangular, unit impulse, unit ramp.	CLO1	2
2	Practical 2	2	Take any two CT and DT signals and perform the following operations: amplitude scaling, addition, multiplication, differentiation, integration (accumulator for DT), time scaling, time shifting and folding.	CLO2	2

3	Practical 3	3	Express any two system mathematical expressions in input output relation form and determine whether each one of them is memory less, causal, linear, stable, time invariant, invertible.	CLO3	2
4	Practical 4	4	Express any two system mathematical expressions in input output relation form and determine whether each one of them is memory less, causal, linear, stable, time invariant, invertible.	CLO3	2
5	Practical 5	5	Express any two system mathematical expressions in impulse response form and determine whether each one of them is memory less, causal, linear, stable, time invariant, invertible.	CLO3	2
6	Practical 6	6	State and prove the properties of Fourier Transform. Take rectangular and sinc signal as examples and demonstrate the applications of CTFT properties. Also demonstrate the interplay between the time and frequency domain.	CLO4	2
7	Practical 7	7	State and prove the properties of Fourier Transform. Take rectangular and sinc signal as examples and demonstrate the applications of CTFT properties. Also demonstrate the interplay between the time and frequency domain.	CLO4	2
8	Practical 8	8	State and prove the properties of Laplace Transform. Take any example of a system in time domain and demonstrate the application of LT in system analysis.	CLO4	2
9	Practical 9	9	State and prove the properties of Laplace Transform. Take any example of a system in time domain and demonstrate the application of LT in system analysis.	CLO4	2
10	Practical 10	10	Design and implement a complete solution for a selected signal-processing style problem or equivalent computational analysis task as per laboratory guidance.	CLO4	2
11	Practical 11	11	State and prove the properties of Laplace Transform. Take any example of a system in time domain and demonstrate the application of LT in system analysis.	CLO4	2
12	Practical 12	12	Find the following for the given energy signal - Autocorrelation, Energy from Autocorrelation, Energy from definition, Energy Spectral Density directly.	CLO5	2
13	Practical 13	13	Find the following for the given energy signal - Autocorrelation, Energy from Autocorrelation, Energy from definition, Energy Spectral Density directly.	CLO5	2

14	Practical 14	14	Find the following for the given energy signal - Autocorrelation, Energy from Autocorrelation, Energy from definition, Energy Spectral Density directly.	CLO5	2
				Total Hours	**28**

Learning Resources:

Text Books:

1. Simon Haykins and Barry Van Veen, *Signals and Systems*, 2nd Edition, Wiley India.
2. Simon Haykins, *Introduction to Analog and Digital Communications*, Wiley India.

Reference Books:

1. Simon Haykins, *Introduction to Analog and Digital Communications*, Wiley India.
2. Charles Phillips, *Signals, Systems and Transforms*, 3rd Edition, Pearson Education.
3. Peyton Peebles, *Probability, Random Variable, Random Processes*, 4th Edition, Tata McGraw-Hill.

Online Resources/E-learning Resources:

1. NPTEL Course on Signals and Systems
   `https://onlinecourses.nptel.ac.in/noc21_ee28/preview`

Name of the Program:	BTECH CSE-AI&ML	Semester: 3	Level: UG
Course Name:	Discrete Structures	Course Code/ Course Type	UBTML205/PCC
Course Pattern:	2026	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical/ Oral
3	-	-	3	3	40	60	-

Pre-Requisite:

1. Determinants, Matrices, Limits, continuity, Differentiation

Course Objectives (CO):	**The objectives of Discrete Mathematics are:** 1. To familiarize the students with the concepts and techniques of logics & sets. 2. To recognize relations and its real-life application. 3. To comprehend Algebraic structure and its application. 4. To acquire the knowledge of graph theory. 5. To acquire the knowledge of trees to understand the concepts of different types of algorithms and its applications that would enhance analytical thinking power.
Course Learning Outcomes (CLO):	**Students would be able to:** 1. Explain the logic, normal forms and its application. 2. Comprehend the relations & functions. 3. Comprehend the algebraic structures. 4. Comprehend & apply the knowledge of graph theory in data structure and other core subjects. 5. Solve traversing problems, searching by using the concept of Trees.

Course Contents/Syllabus:

Descriptors/Topics	CLO	Hours
UNIT I		
Logic: Propositions and Connectives, Truth table, laws of Propositions, Logical Equivalence, Normal Forms: DNF, CNF, PCNF & PDNF, Logical implication, Quantifiers, Application of Propositional logic.	**CLO 1**	**9**
UNIT II		
Relation and Functions: Relation, representation of relation, types, Equivalence relation, Equivalence class, Partitions, Partial ordering relation, Hasse diagram, Lattice, Function and types of Functions.	**CLO 2**	**9**
UNIT III		
Algebraic Structures: Algebraic structures, Semi group, Monoid, Group, abelian group, cyclic group, Coding Theory.	**CLO 3**	**9**
UNIT IV		
Graph and Applications: Introduction, Graph models, Hand shaking lemma, Types of graphs, Matrix representation of Graphs, adjacency and incidence Matrix, Isomorphism, Connectivity, Eulerian and Hamiltonian Graphs, Shortest path, Travelling Salesman Problem, Dijkstra's algorithm, Planar graph and Euler formula.	**CLO 4**	**9**
UNIT V		

Trees: Introduction, properties, Rooted tree, Tree Traversal, path length, weighted tree, prefix code, Huffman coding, spanning tree, Minimal spanning tree, Kruskal algorithm, Prim's algorithm, cut set, The Max flow- Min cut Theorem (Transport Network), Application of tree.	**CLO 5**	**9**
Total Hours		**45**

Learning Resources:

Text Books:

1. C. L. Liu, *Elements of Discrete Mathematics*, Tata McGraw-Hill, 4th Edition, 2017, ISBN 978-1259006395.

Reference Books:

1. Kenneth H. Rosen, *Discrete Mathematics and its Applications*, Tata McGraw Hill, 8th Edition, 2018, ISBN 978-1259676512.
2. Dr. K. D. Joshi, *Foundations of Discrete Mathematics*, New Age International Limited Publishers, 2nd Edition, January 2014, ISBN-13: 978-8122435986.

Online Resources/E-learning Resources:

1. Class Central: Discrete Mathematics
   `https://www.classcentral.com/subject/discrete-mathematics`
2. Coursera: Discrete Mathematics Courses
   `https://www.coursera.org/courses?query=discrete%20mathematics`

Name of the Program:	BTECH CSE-AI&ML	Semester: 3	Level: UG
Course Name:	Computer Organization and Architecture	Course Code/ Course Type	UBTML206/PCC
Course Pattern:	2026	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical/ Oral
2	-	-	2	2	20	30	-

Pre-Requisite:

1. NIL

Course Objectives (CO):	**The objective of Computer Organization are:** 1. To recognize the components of Computer. 2. To articulate the principles of computer organization and the basic architectural concepts. 3. To learn simple register transfer language to specify various computer operations. 4. To interpret and summarize the pipelining concept and multiprocessor systems. 5. To design, and program a simple digital computer ALU operation.
Course Learning Outcomes (CLO):	**Students would be able to:** 1. Student will learn the concepts of computer organization for several engineering applications. 2. Student will develop the ability and confidence to use the fundamentals of computer organization as a tool in the engineering of digital systems. 3. An ability to identify, formulate, and solve hardware and software computer engineering problems using sound computer engineering principle. 4. To impart the knowledge on micro programming. 5. Comprehend the concepts of advanced pipelining techniques.

Course Contents/Syllabus:

Descriptors/Topics	CLO	Hours
UNIT I		
Fundamentals of Computers: Basic Functional units of Computers: Types and generation of computers, Functional units, basic Operational concepts, Bus structures. Software, Performance, Architecture: Von Neumann and Harvard architecture. Data Representation: Signed number representation, fixed and floating-point representations. Booth's Algorithm, Restoring Algorithm, Non-Restoring algorithm.	**CLO 1**	**9**
UNIT II		
The Memory System: Basic concepts of semiconductor RAM memories, Memory Hierarchy, Primary memory, Secondary Memory and its types, Magnetic Tape, Magnetic Disk, Optical disk, magnetic-optical, and other modern disks etc, Cache memories and its types, Cache coherence and Virtual Memory, Paging Replacement algorithm, DMA, DMA Transfer modes, sequential access, and direct access storage device.	**CLO 2**	**6**
UNIT III		

Register Transfer Language and Micro-Operations: Introduction to RTL - Registers, Bus and memory transfers, Micro operations: Arithmetic, Logic, and Shift micro-operation, Arithmetic logic shift unit.	**CLO 3**	**6**
UNIT IV		
Central Processing Unit Organization: Basic Computer Organization: Computer Registers and types, Instructions, Instruction cycle, Types of Instructions: Memory Reference Instructions, Input & output, Timing and control, Interrupts, Central Processing Unit organization: General Register Organization, stack organization, Addressing modes and its types, Data Transfer and Manipulation, Program Control, CISC and RISC processors. Control unit design: Design approaches, Control memory, Address sequencing Parallelism, Throughput and Speedup.	**CLO 4**	**6**
UNIT V		
Multi-Processor Organization: Pipelining and Vector Processing: Basic concepts, Instruction level Parallelism, Pipeline hazards, Hazards, Time Space Diagram, instruction Pipelining, Arithmetic Pipelining, Multiprocessor and Multicore operation, Loosely-coupled (distributed memory) multiprocessor system, Tightly-coupled (shared memory) multiprocessor system, SISD, SIMD, MISD, MIMD.	**CLO 5**	**6**
Total Hours		**30**

Learning Resources:

Text Books:

1. Carl Hamacher, Zvonko Vranesic, and Safwat Zaky, *Computer Organization*, 5th Edition, McGraw Hill.
2. William Stallings, *Computer Organization and Architecture*, 6th Edition, Pearson/PHI.

Reference Books:

1. M. Morris Mano, *Computer Systems Architecture*, 3rd Edition, Pearson/PHI.
2. Andrew S. Tanenbaum, *Structured Computer Organization*, 4th Edition, PHI/Pearson.
3. Sivarama P. Dandamudi, *Fundamentals of Computer Organization and Design*, Springer International Edition.
4. John L. Hennessy and David A. Patterson, *Computer Architecture: A Quantitative Approach*, 4th Edition.

Online Resources/E-learning Resources:

1. Class Central Resource
   `https://www.classcentral.com/course/swayam-principles-of-communication-systems-i-7963`
2. NPTEL Course Resource
   `https://onlinecourses.nptel.ac.in/noc22-ee05/preview`

Name of the Program:	BTECH CSE-AI&ML	Semester: 3	Level: UG
Course Name:	Operating system	Course Code/ Course Type	MOOCCE301/PCC
Course Pattern:	2026	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical/ Oral
-	-	2	2	2	50	-	-

Pre-Requisite:

1. Knowledge of Computer Architecture and Digital Logic
2. Proficiency in C/C++ or Python

Course Objectives (CO):	**The objective of Operating system are:** 1. Understand the fundamental concepts and responsibilities of an operating system. 2. Explore how operating systems manage hardware resources such as CPU, memory, storage, and I/O devices. 3. Gain insights into process scheduling, synchronization, and deadlock prevention techniques. 4. Learn how file systems and memory management strategies are implemented in real-world OSs. 5. Develop hands-on skills by analyzing and building small components of an operating system using labs and simulations.
Course Learning Outcomes (CLO):	**Students would be able to:** 1. Explain the architecture and functions of modern operating systems. 2. Implement and simulate key OS concepts such as process scheduling and memory allocation. 3. Analyze and apply synchronization techniques for process and thread management. 4. Understand and evaluate file systems, I/O management, and protection mechanisms. 5. Demonstrate the ability to solve real-world OS problems using practical tools and test environments.

Course Contents/Syllabus:

Descriptors/Topics	CLO	Hours
UNIT I		
Introduction to Operating Systems & Processes: Evolution of OS and types (batch, multitasking, real-time), OS as a resource manager, Processes and threads, Context switching and states.	**CLO 1**	**9**
UNIT II		
CPU Scheduling and Concurrency: Process scheduling: FCFS, SJF, Round Robin, Multilevel. Multithreading and CPU burst prediction. Process synchronization: critical section, semaphores, mutexes. Deadlocks: detection, prevention, avoidance.	**CLO 2**	**6**
UNIT III		
Memory Management: Contiguous and non-contiguous memory allocation, Paging and segmentation, Virtual memory and page replacement algorithms (FIFO, LRU), Swapping and memory fragmentation.	**CLO 3**	**6**

UNIT IV		
File Systems and Storage Management: File concepts, file access methods, and directory structure, Disk scheduling algorithms (FCFS, SSTF, SCAN), File system implementation: FAT, i-nodes, Mounting, allocation methods, and protection.	**CLO 4**	**6**
UNIT V		
Security, I/O and Virtualization: I/O structure, polling vs. interrupt-driven I/O, DMA and device drivers, OS-level security: authentication, access control, Basics of virtualization and containers.	**CLO 5**	**6**
Total Hours		**30**

Learning Resources:

Text Books:

1. Brett Powel, *Mastering Microsoft Power BI.*

Reference Books:

1. Andrew S. Tanenbaum and Herbert Bos, *Modern Operating Systems.*
2. Remzi H. Arpaci-Dusseau and Andrea C. Arpaci-Dusseau, *Operating Systems: Three Easy Pieces.*
3. Robert Love, *Linux Kernel Development.*

Online Resources/E-learning Resources:

1. Introduction to Operating Systems Specialization (Duke University)

Name of the Program:	BTECH CSE-AI&ML	Semester: 3	Level: UG
Course Name:	Community Engineering Project	Course Code/ Course Type	UBTML207/CEP
Course Pattern:	2026	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical/ Oral
-	1	-	1	2	25	-	25

Pre-Requisite:

1. NIL

Course Objectives (CO):	**The objectives of Community Engineering Project are:** 1. Develop an understanding of the role of engineering in addressing community needs and promoting sustainable development. 2. Apply engineering design processes and methodologies to identify, analyze, and prioritize community challenges. 3. Collaborate with community stakeholders to co-create solutions that are culturally sensitive, socially equitable, and environmentally sustainable. 4. Gain practical experience in project management, budgeting, and resource allocation for community engineering projects. 5. Communicate effectively with diverse audiences through written reports, oral presentations, and multimedia platforms.
Course Learning Outcomes (CLO):	**Students would be able to:** 1. Develop an understanding of the role of engineering in addressing community needs and promoting sustainable development. 2. Apply engineering design processes and methodologies to identify, analyze, and prioritize community challenges. 3. Collaborate with community stakeholders to co-create solutions that are culturally sensitive, socially equitable, and environmentally sustainable. 4. Gain practical experience in project management, budgeting, and resource allocation for community engineering projects. 5. Communicate effectively with diverse audiences through written reports, oral presentations, and multimedia platforms.

Project Guidelines:

Guidelines / Activities	CLO	Hours
GUIDELINE I – Problem Identification and Community Need Assessment		
Students shall identify a relevant community-based problem through field visits, community interaction, surveys, observation, or stakeholder discussion. The selected problem should address real societal, environmental, civic, educational, healthcare, accessibility, or local infrastructure needs. The project team shall define the background, relevance, beneficiaries, and expected impact of the identified issue.	**CLO 1**	**6**
GUIDELINE II – Planning, Analysis, and Solution Design		

Students shall analyze the identified problem using suitable engineering and problem-solving approaches. They shall study existing practices or solutions, identify gaps, and prepare a feasible plan for implementation. The proposed solution may be in the form of a model, prototype, application, awareness activity, survey-based intervention, system design, or technical support mechanism. Proper planning, resource identification, and activity scheduling shall be carried out.	**CLO 2**	**6**
GUIDELINE III – Community Collaboration and Project Implementation		
Students shall work in coordination with community stakeholders, faculty mentors, and team members for execution of the project. The implementation may include field work, awareness programs, prototype development, data collection, technical demonstrations, surveys, digital solution deployment, or pilot execution depending on the nature of the selected problem. The project should reflect teamwork, social sensitivity, and practical applicability.	**CLO 3**	**6**
GUIDELINE IV – Documentation, Monitoring, and Outcome Evaluation		
Students shall maintain proper records of project progress in the form of activity logs, survey sheets, observation records, photographs, feedback forms, and technical notes wherever applicable. The project outcomes shall be evaluated based on feasibility, usefulness, innovation, sustainability, and social impact. Necessary modifications or improvements may be incorporated after review and feedback.	**CLO 4**	**6**
GUIDELINE V – Report, Presentation, and Reflection		
At the end of the course, students shall prepare a structured report containing title, problem statement, objectives, methodology, implementation details, observations, outcomes, conclusion, and future scope. The project shall be presented before the evaluation panel through oral presentation, demonstration, poster, or multimedia support as applicable. Reflection on learning, challenges faced, teamwork, and contribution to society shall also form part of the submission.	**CLO 5**	**6**
Total Hours		**30**

Assessment:

1. Project Proposal: Written proposal outlining the project scope, objectives, and methodology.
2. Project Implementation: Development and implementation of the digital solution, including documentation and code repository.
3. Final Report: Written report summarizing the project process, outcomes, and impact assessment.
4. Presentation: Oral presentation of project findings and demonstration of the digital solution.

Name of the Program:	B.TECH CSE-AI&ML	Semester: 3	Level: UG/PG
Course Name:	German A1.1	Course Code/ Course Type	UFL201A/AEC
Course Pattern:	2026	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical/ Oral
2	-	-	-	2	-	-	-

Pre-Requisite:

1. NIL

Course Objectives (CO):	**The objective of German A1.1 are:** 1. To remember new words and their spellings. 2. To analyze the new concepts. 3. To apply the basic vocab and grammar concepts. 4. To comprehend the German text. 5. To create basic sentences in German.
Course Learning Outcomes (CLO):	**Students would be able to:** 1. Spell simple words in German. 2. Understand everyday expressions. 3. Frame simple sentences in German language. 4. Introduce themselves and others. 5. Answer questions about themselves.

Course Contents/Syllabus:

Descriptors/Topics	CLO	Hours
UNIT I		
Guten Tag: Speak about yourself and others, speak about countries and languages. Grammar – Sentence formation and verbs usage.	**CLO 1**	**6**
UNIT II		
Freunde, Kollegen und Ich: Speak about your hobbies, fix a meeting, speak about work and profession, create a profile on Internet. Grammar – How to use 'The' in German, singular and plural forms of nouns.	**CLO 2**	**6**
UNIT III		
In der Stadt: To get to know about cities and places, how to find way and understand directions, learn international words. Grammar – Negations (how to use NO in German), definite articles, indefinite articles.	**CLO 3**	**6**
UNIT IV		
Kleidung und Mode: Speak about clothes and shopping, lead a discussion during clothes shopping, discussion in departmental store, understand and research information about Berlin. Grammar – Separable and non-separable verbs.	**CLO 4**	**6**
UNIT V		
Tag für Tag & Zeit mit Freunden: Clock timings, to speak about family and friends, daily routine, to speak about free time activity, to understand the specific information from the text, to order and to pay in a restaurant. Grammar – Possessivarticle, Modalverbs, use of on, at, from...till, separable verbs and past tense.	**CLO 5**	**6**

Total Hours	30

Learning Resources:

Text Books:

1. *Netzwerk A1*, Ernst Klett Verlag & Goyal Publishers & Distributors Pvt. Ltd.
2. *Studio d A1*, Cornelesen Verlag & Goyal Publishers & Distributors Pvt. Ltd.
3. *Netzwerk Neu A1*, Ernst Klett Verlag & Goyal Publishers & Distributors Pvt. Ltd.

Reference Books:

1. *Hallo Deutsch A1*, Ernst Klett Verlag, Goyal Publishers & Distributors Pvt. Ltd.
2. *Themen Aktuell 1*, Hueber Verlag.
3. *Maximal*, Ernst Klett Verlag & Goyal Publishers & Distributors Pvt. Ltd.

Online Resources/E-learning Resources:

1. Youtube: https://youtube.com/@LearnGermanwithAnja?si=BkJYDPi7TS0fT4lr
2. https://youtube.com/@deutschlernenmitheidi?si=TkICIabzioaU0roZ
3. Instagram: https://instagram.com/learngermanwithanja

Name of the Program:	B.TECH CSE-AI&ML	Semester: 3	Level: UG/PG
Course Name:	Basic Japanese language skill	Course Code/ Course Type	UFL201B/AEC
Course Pattern:	2026	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical/ Oral
2	-	-	-	2	-	-	-

Pre-Requisite:

1. Desire to get acquainted with the Japanese language.

Course Objectives (CO):	**The objective of Basic Japanese language skill are:** 1. To meet the needs of ever-growing industry, with respect to language support. 2. To get introduced to Japanese society and culture through language. 3. To acquire competitive edge in career choices. 4. To participate effectively & responsibly in a multi-cultural world. 5. To enable learners to communicate effectively in Japanese language.
Course Learning Outcomes (CLO):	**Students would be able to:** 1. Read and Write Hiragana script. 2. Write and Speak basic sentences. 3. Comprehend and speak about time, hobbies, likes and dislikes. 4. Write basic kanji dialogues indicating how they are used in actual conversation. 5. Use the Hiragana script in discussion.

Course Contents/Syllabus:

Descriptors/Topics	CLO	Hours
UNIT I		
Introduction to Japanese Language: Introduction of script, culture, history of script, speaking: self introduction, listening: short video skit on self-introduction.	**CLO 1**	**6**
UNIT II		
Introduction of Hiragana Script: Writing: Hiragana script, Speak: Basic sentences, General vocabulary: Months, Days of the week, Basic numbers, colours.	**CLO 2**	**6**
UNIT III		
Basic Sentence Formation: Basic sentence structure: Affirmative and Negative, General vocabulary: about family.	**CLO 3**	**6**
UNIT IV		
Time and Verbs: Speaking: Talking about routine, Writing: routine using verbs and time, Reading: A clock.	**CLO 4**	**6**
UNIT V		
Introduction of Katakana and Basic Kanji: Affirmative present, past & future, Reading: English words, country names, Writing: Basic Kanji.	**CLO 5**	**6**
Total Hours		**30**

Learning Resources:

Text Books:

1. *Minna no Nihongo I*, 2nd Edition, 3A Corporation
2. *Japanese for Busy People I*, Revised 4th Edition, AJALT, Kodansha International
3. *Nihongo Shoho / Elementary Japanese*, Bonjinsha / approved beginner-level Japanese learning text

Reference Books:

1. *Genki I: An Integrated Course in Elementary Japanese*, The Japan Times
2. *Japanese Kanji Book Vol. 1*, Bonjinsha
3. *A Dictionary of Basic Japanese Grammar*, The Japan Times

Online Resources/E-learning Resources:

1. NHK World: Easy Japanese
   `https://www.nhk.or.jp/lesson/english/`
2. Erin's Challenge! I Can Speak Japanese
   `https://www.erin.jpf.go.jp/en/`
3. Marugoto Japanese Online Course
   `https://www.marugoto.org/en/`
4. JF Japanese e-Learning Minato / TUFS Japanese Resources
   `https://jplang.tufs.ac.jp/en/`

Name of the Program:	BTECH CSE-AI&ML	Semester: 3	Level: UG
Course Name:	UHV-II: Understanding Harmony	Course Code/ Course Type	ACUHV201/AC
Course Pattern:	2026	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical/ Oral
2	-	-	-	2	-	-	-

Pre-Requisite:

1. NIL

Course Objectives (CO):	**The objectives of UHV-II: Understanding Harmony are:** 1. To help the students appreciate the essential complementarity between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity. 2. To facilitate the development of a Holistic perspective among students towards life, profession and happiness. 3. To help students understand harmony at various levels of human living. 4. To enable the students to understand and live in harmony with self, family, society, and nature. 5. To strengthen the commitment towards ethical conduct and responsible participation in life and profession.
Course Learning Outcomes (CLO):	**Students would be able to:** 1. Understand the importance of values and skills in achieving harmony. 2. Develop a holistic perception of life and profession. 3. Comprehend harmony in the self, family, society, nature and existence. 4. Apply the understanding of harmonious living in day-to-day life. 5. Practice ethical human conduct in personal and professional life.

Course Contents/Syllabus:

Descriptors/Topics	CLO	Hours
UNIT I		
Course Introduction - Need, Basic Guidelines, Content and Process for Value Education: Purpose and motivation for value education, self-exploration, process for understanding harmony, relationship between values and skills, continuous happiness and prosperity.	**CLO 1**	**6**
UNIT II		
Understanding Harmony in the Human Being - Harmony in Myself: Human being as coexistence of self and body, needs of self and body, physical facilities, right utilization of body, harmony in the self.	**CLO 2**	**6**
UNIT III		
Understanding Harmony in the Family and Society - Harmony in Human-Human Relationship: Trust, respect, affection, care, guidance, reverence, glory, gratitude and love, relationship with family, justice in human relationships, harmony in society.	**CLO 3**	**6**
UNIT IV		
Understanding Harmony in Nature and Existence - Whole Existence as Coexistence: Harmony in nature, interconnectedness, cyclical processes, mutual fulfillment among units in nature, coexistence and sustainable living.	**CLO 4**	**6**

UNIT V		
Implications of the Above Holistic Understanding of Harmony on Professional Ethics: Professional ethics, competence in professional work, ethical human conduct, holistic technologies, production systems, and responsibility in profession.	**CLO 5**	**6**
Total Hours		**30**

Learning Resources:

Text Books:

1. R. R. Gaur, R. Sangal, and G. P. Bagaria, *A Foundation Course in Human Values and Professional Ethics.*

Reference Books:

1. AICTE recommended material on Universal Human Values.

Name of the Program:	BTECH CSE-AI&ML	Semester: 3	Level: UG
Course Name:	Constitution of India	Course Code/ Course Type	ACCOI201/AC
Course Pattern:	2026	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical/ Oral
2	-	-	-	2	-	-	-

Pre-Requisite:

1. NIL

Course Objectives (CO):	**The objectives of Constitution of India are:** 1. To understand the historical background and framing of the Constitution of India. 2. To make students aware of the philosophy, features and structure of the Indian Constitution. 3. To familiarize students with Fundamental Rights, Duties and Directive Principles of State Policy. 4. To understand the structure and functioning of government institutions. 5. To develop constitutional values, civic responsibility and democratic participation.
Course Learning Outcomes (CLO):	**Students would be able to:** 1. Explain the historical background and salient features of the Constitution of India. 2. Understand the Preamble, citizenship, Fundamental Rights and Duties. 3. Comprehend the Directive Principles of State Policy and constitutional bodies. 4. Analyze the functioning of Union, State and Local governments. 5. Demonstrate awareness of constitutional values and responsibilities.

Course Contents/Syllabus:

Descriptors/Topics	CLO	Hours
UNIT I		
Introduction to Constitution: Meaning of constitution, constitutionalism, historical background, making of the Constitution, constituent assembly, philosophy of the Constitution.	**CLO 1**	**6**
UNIT II		
Preamble, Citizenship, Fundamental Rights and Duties: Preamble, citizenship, Fundamental Rights, Fundamental Duties, significance and interpretation.	**CLO 2**	**6**
UNIT III		
Directive Principles and Constitutional Bodies: Directive Principles of State Policy, significance, relation with rights, constitutional bodies and institutions.	**CLO 3**	**6**
UNIT IV		
Union, State and Local Government: Parliament, President, Prime Minister and Council of Ministers, Governor, Chief Minister, State Legislature, Panchayati Raj and Municipal bodies.	**CLO 4**	**6**

UNIT V		
Democracy, Elections and Constitutional Values: Election system, judiciary overview, rule of law, constitutional morality, citizenship values and civic responsibility.	**CLO 5**	**6**
Total Hours		**30**

Learning Resources:

Text Books:

1. The Constitution of India (Bare Act).
2. D. D. Basu, *Introduction to the Constitution of India*.

Reference Books:

1. Subhash C. Kashyap, *Our Constitution*.

COURSE SYLLABUS

CSE - AI&ML

SEMESTER-IV

Name of the Program:	BTECH CSE-AI&ML	Semester: 4	Level: UG
Course Name:	Database Management System	Course Code/ Course Type	UBTML208/PCC
Course Pattern:	2026	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical/ Oral
3	-	-	3	3	40	60	-

Pre-Requisite:

1. Knowledge of C Programming and DSA

Course Objectives (CO):	**The objective of Database Management System are:** 1. Ability to design entity relationship and convert entity relationship diagrams into RDBMS and ability to identify the data models for relevant problems. 2. Apply normalization for the development of application software's. 3. Develop understanding concepts of Relational Database design and query languages. 4. Demonstrate effective Query processing and Transaction Processing. 5. Summarize concurrency control protocols and recovery algorithms.
Course Learning Outcomes (CLO):	**Students would be able to:** 1. An ability to design ER Model for any application. 2. To Decompose any Schema by applying normal forms. 3. To construct SQL queries for any requirement. 4. To Understand the Query Evaluation and Execution processes. 5. To write Trigger, Cursor, PL/SQL Programs and to design object oriented, extended relational schemas.

Course Contents/Syllabus:

Descriptors/Topics	CLO	Hours
UNIT I		
Introduction: Database System Applications, Database Systems versus File Systems, View of Data, Data Models, Database Languages, Database Users and Administrators, Transaction Management, Database System Structure, Application architectures, History of Database Systems. **Entity-Relationship Model:** Basic Concepts, Constraints, Keys, Design Issues, Entity-Relationship Diagram, Weak Entity Sets, Extended E-R Features, Design of an E-R Database Schema, Reduction of an E-R Schema to Tables.	**CLO 1**	**9**
UNIT II		
Relational Model: Structure of Relational Databases, The Relational Algebra, Extended Relational-Algebra Operations, Modification of the Database, Views, The Tuple Relational Calculus, The Domain Relational Calculus. **Relational-Database Design:** First Normal Form, Pitfalls in Relational-Database Design, Functional Dependencies, Decomposition, BCNF, Third, Fourth and more Normal Forms, Overall Database Design Process.	**CLO 2**	**9**
UNIT III		
Structured Query Language: Basic Structure, Set Operations, Aggregate Functions, Null Values, Nested Sub queries, Views, Integrity and Security, Domain Constraints, Referential Integrity, Assertions, Triggers, Security and Authorization, Authorization in SQL, Encryption and Authentication.	**CLO 3**	**9**

UNIT IV		
Transaction Management: Transaction Concept, Transaction State, Implementation of Atomicity and Durability, Concurrent Execution, Serializability, Recoverability, Implementation of Isolation, Transaction Definition in SQL, Testing for Serializability.	**CLO 4**	**9**
UNIT V		
Concurrency Control: Lock-Based Protocols, Timestamp-Based Protocols, Validation-Based Protocols, Multiple Granularities, Multiversion Schemes, Deadlock Handling, Insert and Delete Operations, Weak Levels of Consistency, Concurrency in Index Structures. **Recovery System:** issues and solutions.	**CLO 5**	**9**
Total Hours		**45**

Learning Resources:

Text Books:

1. Hector Garcia-Molina, Jeff Ullman, and Jennifer Widom, *Database Systems: The Complete Book*, Pearson Education, 2002.

Reference Books:

1. Silberschatz, H. Korth and S. Sudarshan, *Database System Concepts*, 4th Edition, McGraw-Hill International, 2002.
2. R. Elmasri and Shamakant B. Navathe, *Fundamentals of Database Systems*, 3rd Edition, Addison-Wesley, 2000.

Online Resources/E-learning Resources:

1. Database resource
   `http://www.cs.helsinki.fi/u/laine/tikape/k03/material03.html`
2. Stanford database resource
   `http://infolab.stanford.edu/~ullman/dscb.html`
3. NYU database course resource
   `http://cs.nyu.edu/courses/spring06/G22.2433-001/`

Name of the Program:	BTECH CSE-AI&ML	Semester: 4	Level: UG
Course Name:	Database Management System Laboratory	Course Code/ Course Type	UBTML209/PCC
Course Pattern:	2026	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical/ Oral
-	1	-	1	1	25	-	25

Pre-Requisite:

1. Basic knowledge of Programming in C

Course Objectives (CO):	**The objective of Database Management System Laboratory are:** 1. Develop understanding concepts of Relational Database design and query languages. 2. Demonstrate effective Query processing and Transaction Processing. 3. Apply normalization for the development of application software's. 4. Ability to design entity relationship diagrams into RDBMS and formulate SQL queries on the respect data. 5. Ability to identify the data models for relevant problems.
Course Learning Outcomes (CLO):	**Students would be able to:** 1. An ability to design ER Model for any application. 2. To Decompose any Schema by applying normal forms. 3. To construct SQL queries for any requirement. 4. To Understand the Query Evaluation and Execution processes. 5. To write Trigger, Cursor, PL/SQL Programs and to design object oriented, extended relational schemas.

Practical Plan:

Practical Number	Practical Title	Week Number	Details	CLO	Hours
1	Practical 1	1	Analyze the problem and come with the entities in it. Identify what data has to be persisted in the databases.	CLO1	2
2	Practical 2	2	Installation of MySQL and practicing DDL.	CLO1	2
3	Practical 3	3	Practice queries using ANY, ALL, IN, EXISTS, UNION, INTERSECT. Union: The union operator returns all distinct rows selected by two or more queries.	CLO2	2
4	Practical 4	4	Practice queries using Aggregate functions, Group By, Having Clause and Order Clause.	CLO2	2
5	Practical 5	5	Practice queries using Aggregate functions, Group By, Having Clause and Order Clause.	CLO2	2
6	Practical 6	6	Implement Indexes: An index is an ordered list of the contents of a column, or a group of columns, of a table.	CLO3	2
7	Practical 7	7	Implement Exception handling.	CLO3	2
8	Practical 8	8	Practice PL/SQL Programs using Cursor.	CLO4	2

9	Practical 9	9	Write Triggers for database operations.	CLO5	2
10	Practical 10	10	Mini project / case study based database design and SQL implementation.	CLO1, CLO2, CLO3, CLO4, CLO5	2
				Total Hours	**20**

Learning Resources:

Text Books:

1. Hector Garcia-Molina, Jeff Ullman, and Jennifer Widom, *Database Systems: The Complete Book*, Pearson Education, 2002.

Reference Books:

1. Silberschatz, H. Korth and S. Sudarshan, *Database System Concepts*, 4th Edition, McGraw-Hill International, 2002.
2. R. Elmasri and Shamakant B. Navathe, *Fundamentals of Database Systems*, 3rd Edition, Addison-Wesley, 2000.

Online Resources/E-learning Resources:

1. Database resource
   `http://www.cs.helsinki.fi/u/laine/tikape/k03/material03.html`
2. Stanford database resource
   `http://infolab.stanford.edu/~ullman/dscb.html`
3. NYU database course resource
   `http://cs.nyu.edu/courses/spring06/G22.2433-001/`

Name of the Program:	BTECH CSE-AI&ML	Semester: 4	Level: UG
Course Name:	Java Programming	Course Code/ Course Type	UBTML210/PCC
Course Pattern:	2026	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical/ Oral
3	-	-	3	3	40	60	-

Pre-Requisite:

1. Basic knowledge of Programming in C and C++

Course Objectives (CO):	**The objective of Java Programming are:** 1. To learn the fundamentals of the Java programming language. 2. To learn object-oriented principles like abstraction, encapsulation, inheritance, and polymorphism and apply them in solving problems using Java. 3. To apply the concepts of exception handling, multithreading and collection classes using Java. 4. To develop software applications using JDBC connectivity. 5. To design the Graphical User Interface using applets and swing controls.
Course Learning Outcomes (CLO):	**Students would be able to:** 1. To grasp the fundamentals programming concepts of Java programming language. 2. To apply object-oriented principles like abstraction, encapsulation, inheritance, polymorphism in solving problems using Java. 3. To perform exception handling, multithreading code using Java. 4. To develop software applications using JDBC connectivity. 5. To design the Graphical User Interface using event handling.

Course Contents/Syllabus:

Descriptors/Topics	CLO	Hours
UNIT I		
Introduction to Java Programming: Java Programming - History of Java, comments, Java buzz words, Data types, Variables, Constants, Scope and Lifetime of variables, Operators, Type conversion and casting, Enumerated types, Control flow - block scope, conditional statements, loops, break and continue statements, arrays, simple Java standalone programs, class, object, and its methods, constructors, methods, static fields and methods, access control, this reference, overloading constructors, recursion, exploring string class, garbage collection.	**CLO 1**	**9**
UNIT II		
Inheritance: Inheritance – Inheritance types, super keyword, preventing inheritance: final classes and methods. Polymorphism – method overloading and method overriding, abstract classes and methods. Interfaces - Interfaces Vs Abstract classes, defining an interface, implement interfaces, accessing implementations through interface references, extending interface, inner class. Packages - Defining, creating and accessing a package, importing packages.	**CLO 2**	**9**
UNIT III		

Exception Handling and Multithreading: Exception handling - Benefits of exception handling, the classification of exceptions - exception hierarchy, checked exceptions and unchecked exceptions, usage of try, catch, throw, throws and finally, creating own exception subclasses. Multithreading – Differences between multiple processes and multiple threads, thread life cycle, creating threads, interrupting threads, thread priorities, synchronizing threads, inter-thread communication, producer consumer problem.	**CLO 3**	**9**
UNIT IV		
Database Management and Collection Framework: Collection Framework in Java – Introduction to Java collections, overview of Java collection framework, commonly used collection classes - ArrayList, Vector, Hashtable, Stack, Lambda Expressions. Files - Streams - Byte streams, Character streams, Text input/output, Binary input/output, File management using File class. Connecting to Database – JDBC Type 1 to 4 drivers, connecting to a database, querying a database and processing the results, updating data with JDBC, Data Access Object (DAO).	**CLO 4**	**9**
UNIT V		
Event Handling: GUI Programming with Swing - The AWT class hierarchy, Introduction to Swing, Swing Vs AWT, Hierarchy for Swing components, Overview of some Swing components – JButton, JLabel, JTextField, JTextArea, simple Swing applications, Layout management – Layout manager types – border, grid and flow. Event Handling - Events, Event sources, Event classes, Event handling.	**CLO 5**	**9**
Total Hours		**45**

Learning Resources:

Text Books:

1. *Java Fundamentals: A Comprehensive Introduction*, Herbert Schildt and Dale Skrien, TMH.
2. *Head First Java: Your Brain on Java - A Learner's Guide*, 1st Edition, Bert Bates and Kathy Sierra.

Reference Books:

1. *Java: The Complete Reference*, Herbert Schildt and Dale Skrien, TMH.
2. *Java For Dummies*, 8th Edition, Barry Burd.

Online Resources/E-learning Resources:

1. Programming in Java by Prof. Debasis Samanta
   `https://onlinecourses.nptel.ac.in/noc20-cs58/preview`
2. NPTEL Java Course Resource
   `https://onlinecourses.nptel.ac.in/noc22-cs47/preview`

Name of the Program:	BTECH CSE-AI&ML	Semester: 4	Level: UG
Course Name:	Java Programming Laboratory	Course Code/ Course Type	UBTML211/PCC
Course Pattern:	2026	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical/ Oral
-	1	-	1	2	25	-	25

Pre-Requisite:

1. Basic knowledge of Programming in C and C++

Course Objectives (CO):	**The objectives of Java Programming Laboratory are:** 1. To learn the fundamentals of the Java programming language. 2. To learn object-oriented principles like abstraction, encapsulation, inheritance, and polymorphism and apply them in solving problems using Java. 3. To apply the concepts of exception handling, multithreading and collection classes using Java. 4. To develop software applications using JDBC connectivity. 5. To design the Graphical User Interface using applets and swing controls.
Course Learning Outcomes (CLO):	**Students would be able to:** 1. Grasp the fundamentals of the Java programming language. 2. Apply object-oriented principles like abstraction, encapsulation, inheritance, and polymorphism in solving problems using Java. 3. Create exception handling and multithreading code using Java. 4. Develop software applications using JDBC connectivity. 5. Design the Graphical User Interface using event handling.

Practical Plan:

Practical Number	Practical Title	Week Number	Details	CLO	Hours
1	Practical 1	1	Write a Java program to define the data types, variables, operators, arrays and control structures.	CLO1	2
2	Practical 2	2	Develop a program to define class and constructors. Demonstrate constructors with method overloading.	CLO1	2
3	Practical 3	3, 4	Develop a program to define inheritance and show method overriding.	CLO2	4
4	Practical 4	5	Develop a program to demonstrate Exception Handling.	CLO3	2
5	Practical 5	6, 7	Develop a program to demonstrate Multithreading.	CLO3	4
6	Practical 6	8	Develop a program to demonstrate I/O operations.	CLO4	2
7	Practical 7	9	Develop a program to demonstrate Database handling.	CLO4	2

8	Practical 8	10	Develop a program to demonstrate Network Programming.	CLO5	2
9	Practical 9	11	Develop a program to demonstrate Applet structure and event handling.	CLO5	2
10	Practical 10	12	Develop a program to demonstrate Layout managers.	CLO5	2
11	Mini Project	13, 14, 15	Develop a project using Java.	CLO5	6
				Total Hours	**30**

Learning Resources:

Text Books:

1. *Java Fundamentals: A Comprehensive Introduction*, Herbert Schildt and Dale Skrien, TMH.
2. *Head First Java: Your Brain on Java - A Learner's Guide*, 1st Edition, Bert Bates and Kathy Sierra.

Reference Books:

1. *Java: The Complete Reference*, Herbert Schildt and Dale Skrien, TMH.
2. *Java For Dummies*, 8th Edition, Barry Burd.

Online Resources/E-learning Resources:

1. Programming in Java by Prof. Debasis Samanta
   `https://onlinecourses.nptel.ac.in/noc20-cs58/preview`
2. NPTEL Java Course Resource
   `https://onlinecourses.nptel.ac.in/noc22-cs47/preview`

Name of the Program:	BTECH CSE-AI&ML	Semester: 4	Level: UG
Course Name:	Project Based on Digital and Technological Solutions	Course Code/ Course Type	UBTML212/CEP
Course Pattern:	2026	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical/ Oral
-	1	-	1	2	25	-	25

Pre-Requisite:

1. NIL

Course Objectives (CO):	**The objectives of Community Engineering Project are:** 1. Develop an understanding of the role of engineering in addressing community needs and promoting sustainable development. 2. Apply engineering design processes and methodologies to identify, analyze, and prioritize community challenges. 3. Collaborate with community stakeholders to co-create solutions that are culturally sensitive, socially equitable, and environmentally sustainable. 4. Gain practical experience in project management, budgeting, and resource allocation for community engineering projects. 5. Communicate effectively with diverse audiences through written reports, oral presentations, and multimedia platforms.
Course Learning Outcomes (CLO):	**Students would be able to:** 1. Develop an understanding of the role of engineering in addressing community needs and promoting sustainable development. 2. Apply engineering design processes and methodologies to identify, analyze, and prioritize community challenges. 3. Collaborate with community stakeholders to co-create solutions that are culturally sensitive, socially equitable, and environmentally sustainable. 4. Gain practical experience in project management, budgeting, and resource allocation for community engineering projects. 5. Communicate effectively with diverse audiences through written reports, oral presentations, and multimedia platforms.

Project Guidelines:

Guidelines / Activities	CLO	Hours
GUIDELINE I		
Problem Identification and Community Need Assessment: Students shall identify a relevant community-based problem through field visit, observation, survey, stakeholder interaction, or local need analysis. The selected problem shall be socially relevant and should address a practical challenge of the community. The team shall define the problem background, beneficiaries, objectives, and expected social impact.	**CLO 1**	**6**
GUIDELINE II		
Stakeholder Engagement and Requirement Analysis: Students shall conduct discussions with community members, beneficiaries, institutional representatives, or local bodies to understand the real need. They shall collect primary inputs, document constraints, and analyze the problem from technical, social, cultural, and sustainability perspectives.	**CLO 2**	**6**

GUIDELINE III		
Project Planning and Solution Design: Students shall prepare a feasible implementation plan by defining goals, methodology, deliverables, tools, resources, and timelines. The proposed solution may be in the form of a digital solution, prototype, awareness model, survey-based intervention, low-cost engineering solution, or technical support activity depending on the nature of the selected problem.	**CLO 3**	**6**
GUIDELINE IV		
Implementation, Monitoring, and Documentation: Students shall execute the planned activities in coordination with community stakeholders and faculty mentor. They shall maintain proper documentation such as progress log, field records, survey sheets, photographs, observations, technical notes, and implementation outcomes. Monitoring and mid-course correction shall be carried out wherever required.	**CLO 4**	**6**
GUIDELINE V		
Evaluation, Reporting, and Presentation: At the end of the course, students shall prepare a structured project report including title, problem statement, objectives, methodology, implementation details, observations, outcomes, conclusion, and future scope. The work shall be presented through oral presentation, demonstration, poster, or multimedia mode. Reflection on learning, teamwork, and social contribution shall also be included.	**CLO 5**	**6**
Total Hours		**30**

Assessment:

1. Project Proposal: Written proposal outlining the project scope, objectives, and methodology.
2. Project Implementation: Development and implementation of the digital / technical solution, including documentation and execution record.
3. Final Report: Written report summarizing the project process, outcomes, and impact assessment.
4. Presentation: Oral presentation of project findings and demonstration of the developed solution / intervention.

Learning Resources:

Text Books:

1. Erwin Kreyszig, *Advanced Engineering Mathematics*, 10th Edition, John Wiley & Sons, 2014.
2. Hugh Neill, *Trigonometry: A Complete Introduction*, John Murray Learning, 2018.
3. George B. Thomas, Jr. and Ross L. Finney, *Calculus and Analytical Geometry*, 9th Edition, 1998.

Reference Books:

1. B. S. Grewal, *Higher Engineering Mathematics*, Khanna Publishers, 44th Edition, 2010.
2. Ron Larson, *Trigonometry*, Brooks/Cole, 9th Edition, 2013.
3. Robert E. Moyer, *Trigonometry*, McGraw Hill / Addison-Wesley, 4th Edition, 2009.

Name of the Program:	BTECH CSE-AI&ML	Semester: 4	Level: UG
Course Name:	Applied Statistical Techniques	Course Code/ Course Type	UBTML213/PCC
Course Pattern:	2026	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical/ Oral
3	-	-	3	3	40	60	-

Pre-Requisite:

1. Basic statistical concepts

Course Objectives (CO):	**The objective of Applied Statistical Techniques are:** 1. To familiarize the students with advanced techniques in Statistics 2. To acquire knowledge of techniques of advanced level of sampling & estimation 3. To apply tests of hypothetical techniques and its applications that would enhance analytical thinking power 4. To learn the where and how to apply parametric & non-parametric tests with applications 5. Compare parametric and non-parametric inference
Course Learning Outcomes (CLO):	**Students would be able to:** 1. Identify the advanced terms in statistics 2. Explain the estimation & its techniques 3. Apply knowledge of hypothesis techniques to test large and small samples 4. Apply non-parametric tests on practical situations 5. Analyze parametric and non-parametric inference

Course Contents/Syllabus:

Descriptors/Topics	CLO	Hours
UNIT I		
Sampling Techniques: Random sampling, Sampling from finite and infinite populations, with and without replacement, central limit theorem, Standard error of sampling, Sampling distribution of sample mean and proportion	**CLO 1**	**9**
UNIT II		
Estimation: Introduction, Types of estimation, Interval estimation, Point estimation: Maximum likelihood function, Method of moments, Criteria for good estimates: Unbiasedness, Consistency, Sufficiency by Neyman factorization theorem	**CLO 2**	**9**
UNIT III		
Test of Hypothesis: Introduction, Hypothesis, Simple and composite hypothesis, Type I and Type II errors, Level of significance, Critical region, Student's-t test, Z-test	**CLO 3**	**9**
UNIT IV		
Test of Hypothesis-II: Test of hypothesis for small & large sample by Chi-Square distribution, Student's-t distributions, F-distributions. Degree of freedom, Analysis of variance (ANOVA): one-way, two-way (without interactions), P-Value.	**CLO 4**	**9**
UNIT V		

Nonparametric Inference: Non-parametric Inference, order statistics, Tolerance region, Sign test, Mann-Whitney test, Wilcoxon signed rank test, Spearman's rank correlation test, Chi-square test.	**CLO 5**	**9**
Total Hours		**45**

Learning Resources:

Text Books:

1. Erwin Kreyszig, *Advanced Engineering Mathematics*, 10th Edition, John Wiley & Sons, 2014.
2. Hugh Neill, *Trigonometry: A Complete Introduction*, John Murray Learning, 2018.
3. George B. Thomas, Jr. and Ross L. Finney, *Calculus and Analytical Geometry*, 9th Edition, 1998.

Reference Books:

1. B. S. Grewal, *Higher Engineering Mathematics*, Khanna Publishers, 44th Edition, 2010.
2. Ron Larson, *Trigonometry*, Brooks/Cole, 9th Edition, 2013.
3. Robert E. Moyer, *Trigonometry*, McGraw Hill, 4th Edition, 2009.

Name of the Program:	BTECH CSE-AI&ML	Semester: 4	Level: UG
Course Name:	Internet of Things	Course Code/ Course Type	UBTMLOE205/OE
Course Pattern:	2026	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical/ Oral
3	-	-	3	3	40	60	-

Pre-Requisite:

1. Computer Networks and Security

Course Objectives (CO):	**The objective of Internet of Things are:** 1. To comprehend fundamentals of Internet of Things (IoT) 2. To learn advances in IoT 3. To learn methodologies for IoT application development 4. To learn the IoT protocols, cloud platforms and security issues in IoT 5. To learn real world application scenarios of IoT along with its societal and economic impact using case studies and real time examples
Course Learning Outcomes (CLO):	**Students would be able to:** 1. Comprehend the fundamentals and need of IoT. 2. Apply IoT enabling technologies for developing IoT systems 3. Apply design methodology for designing and implementing IoT applications 4. Analyze IoT protocols for making IoT devices communication 5. Design cloud based IoT systems

Course Contents/Syllabus:

Descriptors/Topics	CLO	Hours
UNIT I		
Internet of Things: Concepts Introduction to Internet of Things (IoT): Definition, Characteristics of IoT, Vision, Trends in Adoption of IoT, IoT Devices, IoT Devices Vs Computers, Societal Benefits of IoT, Technical Building Blocks. Physical Design of IoT: Sensors and Actuators, Need of Analog / Digital Conversion. Logical Design of IoT: IoT functional blocks, Applications in IoT.	**CLO 1**	**10**
UNIT II		
IoT: Design Methodology IoT Design Methodology: Steps, Basics of IoT Networking, Internet Structure, Connectivity Technologies, IoT Communication Models, Four pillars of IoT: M2M, SCADA, WSN, RFID.	**CLO 2**	**9**
UNIT III		
IoT Protocols: Sensor Networks, Protocol Standardization for IoT, M2M and WSN Protocols, RFID Protocol, Modbus Protocol, Zigbee Architecture. IP based Protocols: MQTT (Secure), 6LoWPAN, LoRa.	**CLO 3**	**9**
UNIT IV		
Cloud Platforms for IoT: Software Defined Networking, Introduction to Cloud Storage Models, Communication API. WAMP: AutoBahn for IoT, Xively Cloud for IoT. Python Web Application, Amazon Web Services for IoT, SkyNet IoT Messaging Platform, RESTful Web Service, GRPC, SOAP.	**CLO 4**	**9**

UNIT V		
Security in IoT: Introduction, Vulnerabilities of IoT, Security Requirements, Challenges for Secure IoT, Threat Modeling. Key elements of IoT Security: Identity establishment, Access control, Data and message security, Non-repudiation and availability, Security model for IoT, Challenges in designing IoT applications.	**CLO 5**	**8**
Total Hours		**45**

Learning Resources:

Text Books:

1. Arshdeep Bahga, Vijay Madisetti, *Internet of Things – A hands-on approach*, Universities Press, ISBN: 0: 0996025510, 13: 978-0996025515
2. Olivier Hersent, David Boswarthick, Omar Elloumi, *The Internet of Things: Key Applications and Protocols*, 2nd Edition, Wiley Publication, ISBN: 978-1-119-99435-0

Reference Books:

1. Dawoud Shenouda Dawoud, Peter Dawoud, *Microcontroller and Smart Home Networks*, ISBN: 9788770221566, e-ISBN: 9788770221559
2. Charles Crowell, *IoT-Internet of Things for Beginners: An Easy-to-Understand Introduction to IoT*, ISBN-13: 979-8613100194
3. David Hanes, Gonzalo Salgueiro, Robert Barton, Jerome Henry, *IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things*, Cisco Press, ISBN-13: 978-1-58714-456-1, ISBN-10: 1-58714-456-5

Online Resources/E-learning Resources:

1. NPTEL IoT Course
   `https://nptel.ac.in/courses/106/105/106105166/`
2. NPTEL IoT Resource
   `https://nptel.ac.in/courses/108/108/108108098/`

Name of the Program:	BTECH CSE-AI&ML	Semester: 4	Level: UG
Course Name:	Internet of Things Laboratory	Course Code/ Course Type	UBTMLOE206/OE
Course Pattern:	2026	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical/ Oral
-	1	-	1	2	25	-	25

Pre-Requisite:

1. Computer Networks and Security lab

Course Objectives (CO):	**The objectives of Internet of Things Laboratory are:** 1. To understand fundamentals of Internet of Things (IoT) 2. To learn advances in IoT. 3. To learn methodologies for IoT application development 4. To learn the IoT protocols, cloud platforms and security issues in IoT 5. To learn real world application scenarios of IoT along with its societal and economic impact using case studies and real time examples
Course Learning Outcomes (CLO):	**Students would be able to:** 1. Understand the fundamentals and need of IoT. 2. Apply IoT enabling technologies for developing IoT systems 3. Apply design methodology for designing and implementing IoT applications 4. Analyze IoT protocols for making IoT devices communication 5. Design cloud based IoT systems

Practical Plan:

Practical Number	Practical Title	Week Number	Details	CLO	Hours
1	Practical 1	1	Connection of an Arduino board with ESP8266 wifi module.	CLO1	2
2	Practical 2	2	IoT based control of an LED using Arduino.	CLO2	2
3	Practical 3	3	IoT based control of an LED using Arduino.	CLO2	2
4	Practical 4	4	IoT and cloud based data logger using LM35 and Arduino.	CLO3	2
5	Practical 5	5	IoT and cloud based data logger using LM35 and Arduino.	CLO3	2
6	Practical 6	6	IoT and cloud based data logger using LM35 and Arduino.	CLO3	2
7	Practical 7	7	IoT based home automation using Arduino.	CLO4	2
8	Practical 8	8	IoT based home automation using Arduino.	CLO4	2
9	Practical 9	9	IoT based home automation using Arduino.	CLO4	2
10	Practical 10	10	IoT based street light control using Arduino.	CLO5	2
11	Practical 11	11	IoT based street light control using Arduino.	CLO5	2
12	Practical 12	12	IoT based street light control using Arduino.	CLO5	2

13	Practical 13	13	IoT based DC motor speed control using Arduino.	CLO5	2
14	Practical 14	14	IoT based DC motor speed control using Arduino.	CLO5	2
15	Practical 15	15	IoT based DC motor speed control using Arduino.	CLO5	2
				Total Hours	**30**

Learning Resources:

Text Books:

1. Arshdeep Bahga, Vijay Madisetti, *Internet of Things – A hands-on approach*, Universities Press, ISBN: 0: 0996025510, 13: 978-0996025515
2. Olivier Hersent, David Boswarthick, Omar Elloumi, *The Internet of Things: Key Applications and Protocols*, 2nd Edition, Wiley Publication, ISBN: 978-1-119-99435-0

Reference Books:

1. Dawoud Shenouda Dawoud, Peter Dawoud, *Microcontroller and Smart Home Networks*, ISBN: 9788770221566, e-ISBN: 9788770221559
2. Charles Crowell, *IoT-Internet of Things for Beginners: An Easy-to-Understand Introduction to IoT*, ISBN-13: 979-8613100194
3. David Hanes, Gonzalo Salgueiro, Robert Barton, Jerome Henry, *IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things*, Cisco Press, ISBN-13: 978-1-58714-456-1, ISBN-10: 1-58714-456-5

Online Resources/E-learning Resources:

1. NPTEL IoT Course
   `https://nptel.ac.in/courses/106/105/106105166/`
2. NPTEL IoT Resource
   `https://nptel.ac.in/courses/108/108/108108098/`

Name of the Program:	BTECH CSE-AI&ML	Semester: 4	Level: UG
Course Name:	Digital Image Processing	Course Code/ Course Type	UBTMLOE207/OE
Course Pattern:	2026	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical/ Oral
3	-	-	3	3	40	60	-

Pre-Requisite:

1. Digital Signal Processing

Course Objectives (CO):	**The objective of Digital Image Processing are:** 1. To become familiar with digital image fundamentals 2. To get exposed to simple image enhancement techniques in Spatial and Frequency domain 3. To learn concepts of degradation function and restoration techniques 4. To study the image segmentation and representation techniques 5. To become familiar with image compression and recognition methods
Course Learning Outcomes (CLO):	**Students would be able to:** 1. Learn the basics and fundamentals of digital image processing, such as Digitization, sampling, quantization, and 2D-transforms 2. Operate on images using the techniques of smoothing, sharpening and enhancement in spatial Domain 3. Learn the basics of compression digital image and their different types 4. Analyze the restoration concepts and filtering techniques 5. Explore the basics of segmentation & features extraction techniques

Course Contents/Syllabus:

Descriptors/Topics	CLO	Hours
UNIT I		
Introduction to Digital Image Processing: Introduction, Fundamental Steps in Digital Image Processing, Components of an Image Processing System, Sampling and Quantization, Representing Digital Images (Data structure), Some Basic Relations, Human visual system, Sampling and quantization, Representing digital images, Spatial and gray level resolution, Image file formats, Basic relationships between pixels, Distance Measures. Basic operations on images - image addition, subtraction, logical operations, scaling, translation, rotation. Image Histogram. Color fundamentals and models – RGB, HSI, YIQ.	**CLO 1**	**9**
UNIT II		
Image Enhancement in Spatial Domain: Some Basic Gray Level Transformations, Histogram Processing, Enhancement Using Arithmetic / Logic Operations. Spatial domain enhancement: Point operations - Log transformation, Power-law transformation, Piecewise linear transformations, Histogram equalization. Filtering operations - Image smoothing, Image sharpening. Frequency domain enhancement: 2D DFT, Smoothing and Sharpening in frequency domain, Homomorphic filtering. Restoration: Noise models, Restoration using inverse filtering and Wiener filtering.	**CLO 2**	**9**
UNIT III		

Image Compression: Types of redundancy, Fidelity criteria, Lossless compression – Run length coding, Huffman coding, Bitplane coding, Arithmetic coding. Introduction to DCT, Wavelet transform. Lossy compression – DCT based compression, Wavelet based compression. Image and Video Compression Standards – JPEG, MPEG.	**CLO 3**	**9**
UNIT IV		
Image Segmentation and Morphological Operations: Image Segmentation: Point Detections, Line detection, Edge Detection - First order derivative - Prewitt and Sobel. Second order derivative – LoG, DoG, Canny. Edge linking, Hough Transform, Thresholding - Global, Adaptive, Otsu's Method. Region Growing, Region Splitting and Merging. Morphological Operations: Dilation, Erosion, Opening, Closing, Hit-or-Miss transform, Boundary Detection, Thinning, Thickening, Skeleton.	**CLO 4**	**9**
UNIT V		
Image Restoration and Description: Image Restoration, degradation model, Properties, Noise models, Mean Filters, Order Statistics, Adaptive filters, Band reject Filters, Band pass Filters, Notch Filters, Optimum Notch Filtering, Inverse Filtering, Wiener filtering. Representation, Chain codes, Polygonal approximation, Signatures. Boundary Descriptors, Shape numbers, Fourier Descriptors, Statistical moments. Regional Descriptors, Topological, Texture. Principal Components for Description.	**CLO 5**	**9**
Total Hours		**45**

Learning Resources:

Text Books:

1. Rafael C. Gonzalez and Richard E. Woods, *Digital Image Processing*, Pearson, Third Edition, 2010.
2. Anil K. Jain, *Fundamentals of Digital Image Processing*, Pearson, 2002.

Reference Books:

1. Kenneth R. Castleman, *Digital Image Processing*, Pearson, 2006.
2. Rafael C. Gonzalez, Richard E. Woods, and Steven Eddins, *Digital Image Processing using MATLAB*, Pearson Education, Inc., 2011.

Online Resources/E-learning Resources:

1. Digital Image Processing, IIT Kharagpur, Prof. P. K. Biswas
   `https://nptel.ac.in/courses/117105079`
2. NPTEL Video Course: Digital Image Processing
   `https://www.digimat.in/nptel/courses/video/117105135/L02.html`

Name of the Program:	BTECH CSE-AI&ML	Semester: 4	Level: UG
Course Name:	Digital Image Processing Laboratory	Course Code/ Course Type	UBTMLOE208/OE
Course Pattern:	2026	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical/ Oral
-	1	-	1	2	25	-	25

Pre-Requisite:

1. Digital signal Processing

Course Objectives (CO):	**The objectives of Digital Image processing Laboratory are:** 1. To become familiar with digital image fundamental operations 2. To get exposed to simple image enhancement techniques in Spatial and Frequency domain 3. To learn concepts of degradation function and restoration techniques 4. To study the image segmentation and representation techniques. 5. To become familiar with image compression and recognition methods
Course Learning Outcomes (CLO):	**Students would be able to:** 1. Learn the basics and fundamentals of digital image processing operations, such as Digitization, sampling, quantization, and 2D-transforms 2. Operate on images using the techniques of smoothing, sharpening and enhancement in spatial Domain. 3. Learn the basics of compression digital image and their different types. 4. Analyze the restoration concepts and filtering techniques. 5. Explore the basics of segmentation & features extraction techniques.

Practical Plan:

Practical Number	Practical Title	Week Number	Details	CLO	Hours
1	Practical 1	1	Conversion of 24 bit color image to 8 bit, 4 bit image.	CLO1	2
2	Practical 2	2	Perform Morphological operations – Erosion, Dilation, Opening, Closing.	CLO1	2
3	Practical 3	3	Apply image negation and power-law correction operations on image.	CLO1	2
4	Practical 4	4, 5	Study of statistical properties - Mean, Standard deviation, Variance and histogram plotting.	CLO1	4
5	Practical 5	6	Enhance image using histogram equalization and stretching.	CLO2	2
6	Practical 6	7	To perform image filtering in spatial domain.	CLO2	2
7	Practical 7	8	To perform image filtering in frequency domain.	CLO4	2
8	Practical 8	9	Perform image smoothing and sharpening operations.	CLO2	2

9	Practical 9	10	Detect image edges using Sobel, Prewitt and Roberts operator.	CLO4	2
10	Practical 10	11	Compress image using DCT / Wavelet transform.	CLO3	2
11	Practical 11	12, 13	Apply Global and adaptive thresholding to an image.	CLO4	4
12	Practical 12	14, 15	Compress image using DCT / Wavelet transform.	CLO5	4
				Total Hours	**30**

Learning Resources:

Text Books:

1. Rafael C. Gonzalez and Richard E. Woods, *Digital Image Processing*, Pearson, Third Edition, 2010.
2. Anil K. Jain, *Fundamentals of Digital Image Processing*, Pearson, 2002.

Reference Books:

1. Kenneth R. Castleman, *Digital Image Processing*, Pearson, 2006.
2. Rafael C. Gonzalez, Richard E. Woods, and Steven Eddins, *Digital Image Processing using MATLAB*, Pearson Education, Inc., 2011.

Online Resources/E-learning Resources:

1. Digital Image Processing, IIT Kharagpur, Prof. P. K. Biswas
   `https://nptel.ac.in/courses/117105079`
2. NPTEL Video Course: Digital Image Processing
   `https://www.digimat.in/nptel/courses/video/117105135/L02.html`

Name of the Program:	BTECH CSE-AI&ML	Semester: 4	Level: UG
Course Name:	Foundations of Cybersecurity in Linux	Course Code/ Course Type	MOOCCE402/MOOC
Course Pattern:	2026	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical/ Oral
-	-	2	2	2	50	-	-

Pre-Requisite:

1. Basic understanding of Linux and networking concepts

Course Objectives (CO):	**The objective of Foundations of Cybersecurity in Linux are:** 1. To introduce core concepts of cybersecurity and their application in Linux environments 2. To provide hands-on experience in configuring and securing Linux systems 3. To equip students with knowledge of system hardening, network security, and threat detection in Linux 4. To integrate theoretical cybersecurity principles with practical Linux system administration 5. To prepare students for entry-level roles in cybersecurity and Linux administration
Course Learning Outcomes (CLO):	**Students would be able to:** 1. Understand key principles of cybersecurity, including confidentiality, integrity, and availability 2. Implement user and file system security measures in Linux 3. Configure and manage secure network connections in Linux environments 4. Detect and respond to security incidents using Linux tools and logging mechanisms 5. Apply advanced system administration techniques to secure Linux servers

Course Contents/Syllabus:

Descriptors/Topics	CLO	Hours
UNIT I		
Foundations of Cybersecurity: Introduction to Cybersecurity (Core Concepts: CIA Triad (Confidentiality, Integrity, Availability), Common Threats and Attacks (Phishing, Malware, Ransomware), Understanding Security Policies (Risk Management and Compliance, Importance of Security Awareness), Fundamentals of Linux Security (Linux Permissions and File Ownership, Best Practices for Linux Security), Case Studies in Cybersecurity (Hands-on Exercise: Implement file permissions and security configurations in a Linux environment).	**CLO 1**	**6**
UNIT II		

Linux System Administration and Security Basics (Based on Red Hat RH134 - Red Hat System Administration II): Managing Users and Groups (User Authentication and Password Policies, Configuring Sudo for Privileged Access), File System Security (Access Control Lists (ACLs), Encrypting File Systems with LUKS), Process Management and Security (Understanding Process Priorities, Managing Process Permissions), Service Hardening (Disabling Unnecessary Services, Configuring System Logs for Security Audits), Hands-on Exercise: Harden a Linux system by securing user accounts and encrypting data.	**CLO 2**	**6**
UNIT III		
Securing Network Connections in Linux: Introduction to Network Security (Understanding Firewalls and iptables/nftables, Basics of SELinux and AppArmor), Configuring Secure Network Services (SSH Security: Keys, Configurations, and Best Practices, Configuring Secure Web and FTP Services), Secure Remote Access (VPN Configuration Basics, Managing Certificates and OpenSSL), Troubleshooting Network Issues (Analyzing Network Traffic with Wireshark, Using tcpdump for Incident Analysis), Hands-on Exercise: Set up a secure SSH server and configure firewall rules.	**CLO 3**	**6**
UNIT IV		
Advanced Linux Security and Incident Response: User Monitoring and Logging in Linux (Configuring rsyslog and journalctl, Setting Up Intrusion Detection Systems (IDS)), Security Automation (Using Bash Scripts for Security Monitoring, Introduction to Ansible for Security Automation), Incident Response in Linux (Analyzing Logs for Security Incidents, Isolating and Mitigating Threats), Forensics in Linux (Basics of Memory and Disk Forensics, Tools for Data Recovery and Analysis), Hands-on Exercise: Detect and analyze a simulated security incident in a Linux environment.	**CLO 4**	**6**
UNIT V		
Capstone Project and Integration: Comprehensive System Hardening (Applying Learned Security Measures to a Linux System, Securing Web Servers, Databases, and Applications), Configuring Linux for Secure Networking (Implementing Best Practices for Network Security, Advanced Firewall Configurations), Capstone Project (Design and Implement Secure Linux Environment, Document and Present Security Strategies and Configurations), Future Directions (Preparing for Advanced Certifications (RHCE, CompTIA Security+), Emerging Trends in Linux Security and Cybersecurity), Capstone Project Presentation: Deploy a secure Linux server with end-to-end security measures.	**CLO 5**	**6**
Total Hours		**30**

Learning Resources:

Text Books:

1. *Red Hat RH124: Red Hat System Administration I*
2. *Red Hat DO101: Introduction to OpenShift Applications*

Reference Books:

1. *Practical Guide to Linux Commands, Editors, and Shell Programming* by Mark G. Sobell
2. *Linux Bible* by Christopher Negus
3. *Cybersecurity for Beginners* by Raef Meeuwisse

Name of the Program:	B.TECH CSE-AI&ML	Semester: 4	Level: UG
Course Name:	German A1.2	Course Code/ Course Type	UFL202A/AEC
Course Pattern:	2026	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical/ Oral
2	-	-	-	2	-	-	-

Pre-Requisite:

1. Can understand and use familiar, everyday expressions and very simple sentences aimed at satisfying specific needs

Course Objectives (CO):	**The objective of German A1.2 are:** 1. To get along with a basic vocab 2. To understand German day to day culture 3. Can communicate in routine situations 4. To be able to have a direct exchange of information about familiar matters 5. To describe own surroundings
Course Learning Outcomes (CLO):	**Students would be able to:** 1. Communicate in the areas of immediate importance 2. Able to frame simple sentences in formal conversation 3. Translate simple sentences from English to the German language and vice-versa 4. Construct a dialogue, in the German language, for basic human interactions in a social context 5. Take part in an interaction relating to basic conversation

Course Contents/Syllabus:

Descriptors/Topics	CLO	Hours
UNIT I		
Kontakte: planning of letter writing, ramification of Letter, writing and understanding, discussion about language learning, find information from texts, understand conversations on various topics, texts related to office life. Grammar – Usage of Articles and Prepositions.	**CLO 1**	**6**
UNIT II		
Meine Wohnung: Understand home advertisements, describe house, how to reply invitations, how to express likes and dislikes, speak about different forms of living, how to write a text on house. Grammar – Adjectives.	**CLO 2**	**6**
UNIT III		
Alles Arbeit? Talk about daily routine, talk about past, understand job advertisements, understand blogs on jobs, express opinions about jobs, prepare telephonic dialogues, speak about jobs. Grammar – Past tense, Sentence connectors.	**CLO 3**	**6**
UNIT IV		
Kleidung und Mode: Speak about cloths and shopping, lead a discussion during cloths shopping, discussion in departmental store, understand and research information about Berlin. Grammar – Separable and non-separable verbs.	**CLO 4**	**6**
UNIT V		

Gerund und munter & Ab in den Urlaub: Learn body parts, health related dialogue, city orientation, travel reports, discussion regarding different travel destinations and weather. Grammar – Imperative, Time adverbs.	**CLO 5**	**6**
Total Hours		**30**

Learning Resources:

Text Books:

1. *Netzwerk A1*, Ernst klett Verlag & Goyal Publishers & Distributors Pvt. Ltd.
2. *Studio d A1*, Cornelesen Verlag & Goyal Publishers & Distributors Pvt. Ltd.
3. *Netzwerk Neu A1*, Ernst klett Verlag & Goyal Publishers & Distributors Pvt. Ltd.

Reference Books:

1. *Hallo Deutsch A1*, Ernst Klett Verlag, Goyal Publishers & Distributors Pvt. Ltd.
2. *Themen Aktuell 1*, Hueber Verlag
3. *Maximal*, Ernst klett Verlag & Goyal Publishers & Distributors Pvt. Ltd.

Online Resources/E-learning Resources:

1. Youtube: https://youtube.com/@LearnGermanwithAnja?si=BkJYDPi7TS0fT4lr
2. https://youtube.com/@deutschlernenmitheidi?si=TkICIabzioaU0roZ
3. Instagram: instagram.com/learngermanwithanja

Name of the Program:	B.Tech. CSE-AI&ML	Semester: 4	Level: UG
Course Name:	Japanese language skill - L2	Course Code/ Course Type	UFL202B/AEC
Course Pattern:	2026	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical/ Oral
2	-	-	-	2	-	-	-

Pre-Requisite:

1. Desire to get acquainted with the Japanese language. Basic knowledge of Hiragana and Katakana.

Course Objectives (CO):	**The objective of Japanese language skill - L2 are:** 1. To meet the needs of ever-growing industry, with respect to language support 2. To get introduced to Japanese society and culture through language 3. To promote multilingualism in exposing students to different cultures 4. Fostering respect for linguistic diversity 5. Learning additional language to develop a better memory, talent for problem solving, ability to concentrate
Course Learning Outcomes (CLO):	**Students would be able to:** 1. Read & write words that have been borrowed from other language 2. Comprehend and speak basic conversation with basic particles 3. Speak and write about Routine 4. Basic sentence patterns incorporated into short dialogues indicating how they are used in actual conversation 5. Comprehend grammatical structure, and improve communication abilities

Course Contents/Syllabus:

Descriptors/Topics	CLO	Hours
UNIT I		
Katakana Script: Katakana Script / Writing Kanji.	**CLO 1**	**6**
UNIT II		
System of demonstrative words: Minna no Nihongo lesson no. 1, 2 & 3.	**CLO 2**	**6**
UNIT III		
Minna no Nihongo lesson no. 4: Write and Speak basic sentences in correct tenses.	**CLO 3**	**6**
UNIT IV		
Reading and Conversation using particles: Reading - Basic conversation using particles. Listening - conversation related to particles. Speaking - Sentences about give, lend, teach, receive.	**CLO 4**	**6**
UNIT V		
Tenses and Routine Writing: Writing - Affirmative present, past & future. Negative present, past, & future sentences. Writing - About Routine.	**CLO 5**	**6**
Total Hours		**30**

Learning Resources:

Text Books:

1. *Minna no Nihongo*, "Japanese for everyone", Elementary Main Textbook, Goyal Publishers & Distributors Pvt. Ltd.

Reference Books:

1. *Shyoho Volume 1*
2. *Genki Japan*
3. *Haru Vol. 1 & 2*

Online Resources/E-learning Resources:

1. https://youtu.be/1JephUxTHxg?si=ouCwTXZc-fYgY9Kh
2. https://youtu.be/9EfbkBkF2ag?si=rLNzc55-REacMoGu
3. https://youtu.be/DpEolYasgyg?si=dya9ue-YMSHO3VOG

Name of the Program:	BTECH CSE-AI&ML	Semester: 4	Level: UG
Course Name:	UHV-II: Understanding Harmony	Course Code/ Course Type	ACUHV201/AC
Course Pattern:	2026	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical/ Oral
2	-	-	-	2	-	-	-

Pre-Requisite:

1. NIL

Course Objectives (CO):	**The objectives of UHV-II: Understanding Harmony are:** 1. To help the students appreciate the essential complementarity between values and skills to ensure sustained happiness and prosperity. 2. To facilitate the development of a holistic perspective among students towards life, profession and happiness. 3. To help students understand harmony at various levels of human living. 4. To enable the students to understand and live in harmony with self, family, society, and nature. 5. To strengthen commitment towards ethical conduct and responsible participation in life and profession.
Course Learning Outcomes (CLO):	**Students would be able to:** 1. Understand the importance of values and skills in achieving harmony. 2. Develop a holistic perception of life and profession. 3. Comprehend harmony in the self, family, society, nature and existence. 4. Apply the understanding of harmonious living in day-to-day life. 5. Practice ethical human conduct in personal and professional life.

Course Contents/Syllabus:

Descriptors/Topics	CLO	Hours
UNIT I		
Course Introduction - Need, Basic Guidelines, Content and Process for Value Education: Purpose and motivation for value education, self-exploration, process for understanding harmony, relationship between values and skills, continuous happiness and prosperity.	**CLO 1**	**6**
UNIT II		
Understanding Harmony in the Human Being - Harmony in Myself: Human being as coexistence of self and body, needs of self and body, physical facilities, right utilization of body, harmony in the self.	**CLO 2**	**6**
UNIT III		
Understanding Harmony in the Family and Society - Harmony in Human-Human Relationship: Trust, respect, affection, care, guidance, reverence, glory, gratitude and love, relationship with family, justice in human relationships, harmony in society.	**CLO 3**	**6**
UNIT IV		
Understanding Harmony in Nature and Existence - Whole Existence as Coexistence: Harmony in nature, interconnectedness, cyclical processes, mutual fulfillment among units in nature, coexistence and sustainable living.	**CLO 4**	**6**

UNIT V		
Implications of the Above Holistic Understanding of Harmony on Professional Ethics: Professional ethics, competence in professional work, ethical human conduct, holistic technologies, production systems, and responsibility in profession.	**CLO 5**	**6**
Total Hours		**30**

Learning Resources:

Text Books:

1. R. R. Gaur, R. Sangal, and G. P. Bagaria, *A Foundation Course in Human Values and Professional Ethics.*

Reference Books:

1. AICTE recommended material on Universal Human Values.

Name of the Program:	BTECH CSE-AI&ML	Semester: 3	Level: UG
Course Name:	Constitution of India	Course Code/ Course Type	ACCOI201/AC
Course Pattern:	2026	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical/ Oral
2	-	-	-	2	-	-	-

Pre-Requisite:

1. NIL

Course Objectives (CO):	**The objectives of Constitution of India are:** 1. To understand the historical background and framing of the Constitution of India. 2. To make students aware of the philosophy, features and structure of the Indian Constitution. 3. To familiarize students with Fundamental Rights, Duties and Directive Principles of State Policy. 4. To understand the structure and functioning of government institutions. 5. To develop constitutional values, civic responsibility and democratic participation.
Course Learning Outcomes (CLO):	**Students would be able to:** 1. Explain the historical background and salient features of the Constitution of India. 2. Understand the Preamble, citizenship, Fundamental Rights and Duties. 3. Comprehend the Directive Principles of State Policy and constitutional bodies. 4. Analyze the functioning of Union, State and Local governments. 5. Demonstrate awareness of constitutional values and responsibilities.

Course Contents/Syllabus:

Descriptors/Topics	CLO	Hours
UNIT I		
Introduction to Constitution: Meaning of constitution, constitutionalism, historical background, making of the Constitution, constituent assembly, philosophy of the Constitution.	**CLO 1**	**6**
UNIT II		
Preamble, Citizenship, Fundamental Rights and Duties: Preamble, citizenship, Fundamental Rights, Fundamental Duties, significance and interpretation.	**CLO 2**	**6**
UNIT III		
Directive Principles and Constitutional Bodies: Directive Principles of State Policy, significance, relation with rights, constitutional bodies and institutions.	**CLO 3**	**6**
UNIT IV		
Union, State and Local Government: Parliament, President, Prime Minister and Council of Ministers, Governor, Chief Minister, State Legislature, Panchayati Raj and Municipal bodies.	**CLO 4**	**6**

UNIT V		
Democracy, Elections and Constitutional Values: Election system, judiciary overview, rule of law, constitutional morality, citizenship values and civic responsibility.	**CLO 5**	**6**
Total Hours		**30**

Learning Resources:

Text Books:

1. The Constitution of India (Bare Act).
2. D. D. Basu, *Introduction to the Constitution of India*.

Reference Books:

1. Subhash C. Kashyap, *Our Constitution*.

Name of the Program:	BTECH CSE-AI&ML	Semester: 4	Level: UG
Course Name:	Professional Development Training-I	Course Code/ Course Type	PSD401/VSEC
Course Pattern:	2026	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical/ Oral
-	2	-	2	4	50	-	-

Pre-Requisite:

1. Prior knowledge of Basic Mathematics and English is essential

Course Objectives (CO):	**The objectives of Professional Development Training-I are:** 1. To enhance numerical aptitude and quantitative problem-solving ability of students. 2. To develop logical reasoning and analytical thinking skills for aptitude and placement preparation. 3. To improve verbal ability, reading comprehension, and written communication skills. 4. To strengthen students' confidence for group discussions, interviews, and professional interactions. 5. To prepare students for career readiness through resume writing, LinkedIn profile building, coding practice, and mock interview sessions.
Course Learning Outcomes (CLO):	**Students would be able to:** 1. Apply quantitative aptitude concepts to solve numerical and engineering-oriented problems. 2. Use logical reasoning techniques to solve analytical and pattern-based problems. 3. Demonstrate improved verbal ability and reading comprehension for effective communication. 4. Participate confidently in group discussions, interviews, and professional interaction rounds. 5. Prepare professional documents and demonstrate placement readiness through practice-based activities.

Course Contents/Syllabus:

Descriptors/Topics	CLO	Hours
UNIT I		
Numerical Ability-I: Number system, HCF and LCM, divisibility, percentages, ratios and proportion, averages, ages, profit and loss, alligation and mixtures, clocks and calendars, equations, time and work, introduction to aptitude problem-solving techniques.	**CLO 1**	**12**
UNIT II		
Numerical Ability-II: Permutations and combinations, probability, mean, median and mode, standard deviation and variance, simple and compound interest, linear equations, quadratic equations, trigonometry basics, graphical and tabular data interpretation, pie charts, arithmetic data analysis, quantitative comparison and problem-solving drills.	**CLO 1**	**12**
UNIT III		

Logical Reasoning and Analytical Thinking: Direction sense, family tree, syllogism, seating arrangement, team formation, coding and decoding, blood relations, number series, letter series, ranking and arrangements, game-based aptitude, analytical reasoning, logical patterns, puzzle solving, and practice-oriented reasoning sessions.	**CLO 2**	**12**
UNIT IV		
Verbal Ability and Reading Comprehension: Subject-verb agreement, articles and determiners, prepositions, tenses, parts of speech, active and passive voice, direct and indirect speech, conjunctions, sentence selection, contextual vocabulary, error spotting, sentence correction, sentence completion, synonyms and antonyms, reading comprehension, jumbled words and sentences, written communication exercises.	**CLO 3**	**12**
UNIT V		
Career Readiness and Professional Skills: SMART goal setting and career roadmap, professional etiquette, group discussion practice, HR interview preparation, technical interview orientation, resume writing, LinkedIn profile building, coding aptitude and problem-solving practice, mock interviews, mock coding interviews, confidence building, and presentation skills.	**CLO 4, CLO 5**	**12**
Total Hours		**60**

Learning Resources:

Text Books:

1. Arun Sharma, *Quantitative Aptitude*, 7th Edition, McGraw Hill Education Pvt. Ltd.
2. ETHNUS, *Aptimithra*, McGraw-Hill Education Pvt. Ltd.

Reference Books:

1. R. S. Aggarwal, *Quantitative Aptitude for Competitive Examinations*, S. Chand.
2. Norman Lewis, *Word Power Made Easy*, Goyal Publishers.
3. Shalini Agarwal, *Verbal and Non-Verbal Reasoning*, Arihant Publications.

Online Resources/E-learning Resources:

1. NPTEL / SWAYAM resources on aptitude, communication skills, and professional development.
2. Placement preparation platforms for numerical aptitude, reasoning, verbal ability, and interview practice.
3. Online resources for resume building, LinkedIn profile development, coding practice, and mock interviews.

COURSE SYLLABUS

CSE - AI&ML

SEMESTER-V

Name of the Program:	BTECH CSE-AI&ML	Semester: 5	Level: UG
Course Name:	Computational Theory	Course Code/ Course Type	UBTML321/PCC
Course Pattern:	2026	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical/ Oral
2	-	1	3	3	40	60	-

Pre-Requisite:

1. Discrete Mathematics
2. Digital Electronics & Logic Design

Course Objectives (CO):	**The objectives of Computational Theory are:** 1. To give an overview of the theoretical foundations of computer science from the perspective of formal languages 2. To illustrate finite state machines to solve problems in computing 3. To familiarize Regular grammars, context frees grammar 4. To propose computation solutions using Turing machines 5. To analyze the problem types
Course Learning Outcomes (CLO):	**Students would be able to:** 1. Elaborate basic concepts of formal languages of finite automata techniques 2. Develop formal mathematical methods to prove properties of languages, grammars and automata 3. Able to construct context free grammar for various languages 4. Applying normal form techniques push down automata and Turing Machines for any language 5. Illustrate the decidability or undecidability of various problems

Course Contents/Syllabus:

Descriptors/Topics	CLO	Hours
UNIT I		
FORMAL LANGUAGE THEORY AND FINITE AUTOMATA: Introduction, Basic concepts, Languages, Finite State Machine, Deterministic Finite Automata, Non-Deterministic Finite Automata, Equivalence of Deterministic and Nondeterministic Finite Automata, Minimization of Deterministic Finite Automata, Finite Automata with Epsilon Transitions, Eliminating Epsilon transitions, Introduction to Mealy and Moore Machine.	**CLO 1**	**6**
UNIT II		
REGULAR EXPRESSIONS: Introduction, Identities of Regular Expressions, Conversion of Regular Expressions to Finite Automata, Arden's Theorem, Closure properties of regular languages, Regular Grammar with Finite Automata., Pumping Lemma for Regular Languages.	**CLO 2**	**6**
UNIT III		
CONTEXT FREE LANGUAGE AND GRAMMAR: Context Free Language, Context Free Grammar - Derivation Trees, Sentential Forms, Leftmost and Rightmost derivations of Strings., Ambiguity in CFG's, Simplification of CFG, Chomsky Normal Form, Griebach Normal Form, Chomsky Hierarchy.	**CLO 3**	**6**

UNIT IV		
PUSHDOWN AUTOMATA: Definition, Model, Acceptance of CFL, Acceptance by Final State and Acceptance by Empty stack and its Equivalence, Equivalence of CFG and PDA. **TURING MACHINES (TM):** Formal definition and behavior, Languages of a TM, TM as accepters, and TM as a computer of integer functions, Types of TMs.	**CLO 4**	**6**
UNIT V		
COMPUTABILITY AND COMPLEXITY THEORY: Decidable and Un-decidable Problems, Undecidable Problems that are Recursively Enumerable, P Class and NP Class with examples, P vs NP Problems, NP-Complete NP-Hard Problems.	**CLO 5**	**6**
Total Hours		**30**

Learning Resources:

Text Books:

1. John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman (2007), *Introduction to Automata Theory, Languages and Computation*, 3rd Edition, Pearson Education, India
2. J. Martin (2007), *Introduction to Languages and the Theory of Computation*, 3rd Edition, TMH
3. Harry R. Lewis, Christos H. Papadimitriou (2001), *Elements of the Theory of Computation*, 2nd Edition, Pearson Education

Reference Books:

1. K. L. P. Mishra, N. Chandrashekaran (2003), *Theory of Computer Science – Automata, Languages and Computation*, 2nd Edition, Prentice Hall of India, India
2. Michael Sipser (2013), *Introduction to the Theory of Computation*, 3rd Edition, Thomson Brooks/Cole
3. Harry R. Lewis, Christos H. Papadimitriou (2001), *Elements of the Theory of Computation*, 2nd Edition, Pearson Education

Online Resources/E-learning Resources:

1. Udemy: The Complete Theory of Computation `https://www.udemy.com/course/the-complete-theory-of-computation/?couponCode=ST8MT40924`
2. NPTEL: Theory of Computation by Prof. Raghunath Tewari - IIT Kanpur `https://onlinecourses.nptel.ac.in/noc19_cs79/preview`
3. MIT OpenCourseWare: Automata, Computability, and Complexity (6.045J) `https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-045j-automata-computability-and-complexity`

Name of the Program:	BTECH CSE-AI&ML	Semester: 5	Level: UG
Course Name:	Fundamentals of Networking	Course Code/ Course Type	UBTML322/PCC
Course Pattern:	2026	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical/ Oral
3	-	-	3	3	40	60	-

Pre-Requisite:

1. Fundamental of Computers

Course Objectives (CO):	**The objectives of Fundamentals of Networking are:** 1. To gain the knowledge of communication systems 2. To learn and understand the history of Computer Network and its evolution with the help of service models 3. To learn the various principles of Network layer, its management and Routing algorithms at Network layer 4. To learn the services offered by Transport layer 5. To learn the Applications layer and session layer protocols; and its services
Course Learning Outcomes (CLO):	**Students would be able to:** 1. Identify various data communication techniques along with types of networks 2. Interpret OSI and TCP/IP Protocol suites 3. Design routing algorithms to find shortest path in network 4. Compare TCP and UDP services 5. Demonstrate application layer protocols

Course Contents/Syllabus:

Descriptors/Topics	CLO	Hours
UNIT I		
Introduction to Data Communication: Fundamentals of Data Communication, Type of Connections, Network Topologies, Types of Networks-LAN, WAN And MAN; Data and Signals, Periodic Analog Signals, Digital Signals, Transmission Impairment, Data Rate Limits, Performance; Introduction to Digital to Digital, Analog to Digital, Digital to Analog, Analog to Analog Conversions; Transmission Modes.	**CLO 1**	**9**
UNIT II		
Introduction to Computer Networks: Introduction to OSI and TCP/IP Protocol Suite, Classification of Addressing Mechanisms, Guided Media: Twisted Pair Cable, Coaxial Cable and Fiber-Optic Cable, Unguided Media: Wireless, Radio Waves, Microwaves and Infrared; Introduction to Data Link Layer.	**CLO 2**	**9**
UNIT III		
Network Layer and Routing Principles: Network Layer Services, Packet Switching: Datagram and Virtual Circuit Approach, Network Layer Performance: Delay, Throughput, Packet Loss, Congestion Control; IPv4: Datagram Format; Routing Algorithms: Distance Vector, Link-state, Path Vector Routing.	**CLO 3**	**9**

UNIT IV		
Transport Layer and its Services: Overview of Transport Layer, Transport Layer services, User Datagram Protocol (UDP): User Datagram, UDP Services, UDP Applications; Transmission Control Protocol (TCP): TCP Services, Features, TCP Segment, TCP Connection, TCP Congestion Control.	**CLO 4**	**9**
UNIT V		
Application Layer Protocols: Introduction to Application Layer, Client-Server Paradigm, Socket Interface, DHCP, FTP, TFTP, WWW & HTTP, Electronic Mail: SMTP, POP3, IMAP and MIME.	**CLO 5**	**9**
Total Hours		**45**

Learning Resources:

Text Books:

1. Behrouz A. Forouzan, *Data Communications and Networking*, 5th Ed., McGraw-Hill Education India Edition, 2013. ISBN-13: 9781259064753
2. Behrouz A. Forouzan, *TCP/IP Protocol Suite*, 4th Ed., Tata McGraw-Hill Edition, 2010. ISBN-13: 9780070706521
3. Andrew S. Tanenbaum, David J. Wetherall, *Computer Networks*, 5th Ed., Pearson Education, 2013. ISBN-13: 9780132126953

Reference Books:

1. James F. Kurose, Keith W. Ross, "Computer Networking – A Top-Down Approach Featuring the Internet", Fifth Edition, Pearson Education, 2009.
2. S. Tanenbaum , "Computer, Networks", PHI Publication, 4th edition, ISBN: 8178087855.
3. William Stallings, "Data and Computer Communications", Person Education, 8th Edition, ISBN:- 9788131715369.

Online Resources/E-learning Resources: hyperref enumitem

1. Computer Networks and Internet Protocol by Prof. Soumya Kanti Ghosh and Prof. Sandip Chakraborty – IIT Kharagpur
   `https://onlinecourses.nptel.ac.in/noc22_cs19/preview`
2. MIT OpenCourseWare: Computer System Engineering (6.033)
   `https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-033-computer-system`
3. GeeksforGeeks: Computer Network Tutorials
   `https://www.geeksforgeeks.org/computer-network-tutorials/`

Name of the Program:	BTECH CSE-AI&ML	Semester: 5	Level: UG
Course Name:	Fundamentals of Networking Lab	Course Code/ Course Type	UBTML323/PCC
Course Pattern:	2026	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical/ Oral
-	1	-	1	2	25	-	25

Pre-Requisite:

1. Fundamental of Computers

Course Objectives (CO):	**The objectives of Fundamentals of Networking Lab are:** 1. To establish communication among the computing nodes in various networking architectures. 2. Configure the computing nodes with understanding of protocols and technologies. 3. Use different communicating modes and standards for communication. 4. Use modern tools for network traffic analysis. 5. To learn network programming.
Course Learning Outcomes (CLO):	**Students would be able to:** 1. Comprehend working and architecture of college/ organization network. 2. Design network application by using various concepts of layered architecture. 3. Write program to analyze working of various protocols and packets. 4. Demonstrate LAN and WAN protocol behavior using Modern Tools. 5. Justify the working of error control and error detection mechanism using a program.

Practical Plan:

Practical Number	Practical Title	Week Number	Details	CLO	Hours
1	Network Topologies Setup	1	Set up and test different network topologies (star, bus, ring, mesh) using simulation tools like Cisco Packet Tracer or NS2/NS3	CLO1	2
2	Exploring OSI and TCP/IP Layers	2	Use Wireshark to capture network traffic and analyze headers for different layers.	CLO2	2
3	IP Addressing and Subnetting	3	Design an IPv4 addressing scheme and implement subnetting in a small network using Cisco Packet Tracer	CLO2	2
4	Routing Algorithm Implementation	4	Configure static and dynamic routing (RIP, OSPF) in Cisco Packet Tracer	CLO3	2
5	IPv4 Packet Analysis	5	Use Wireshark to capture and analyze IPv4 packets, identifying different fields in the packet structure	CLO3	2
6	UDP and TCP Communication	6	Implement a TCP client-server program to demonstrate connection establishment and data transfer	CLO4	2

7	TCP Congestion Control Analysis	7	Simulate TCP congestion control mechanisms (slow start, congestion avoidance) using NS2/NS3.	CLO4	2
8	Web Communication using HTTP	8	Set up a simple web server and client using Python Flask and analyze HTTP requests/responses	CLO5	2
9	File Transfer using FTP and TFTP	9	Set up an FTP server and client, transfer files, and analyze the protocol behavior.	CLO5	4
10	Mini Project	10	Mini Project in a group of 3 to 4 students	1, 2, 3, 4, 5	10

Learning Resources:

Text Books:

1. Behrouz A. Forouzan, *Data Communications and Networking*, 5th Ed., McGraw-Hill Education India Edition, 2013. ISBN-13: 9781259064753
2. Behrouz A. Forouzan, *TCP/IP Protocol Suite*, 4th Ed., Tata McGraw-Hill Edition, 2010. ISBN-13: 9780070706521
3. Andrew S. Tanenbaum, David J. Wetherall, *Computer Networks*, 5th Ed., Pearson Education, 2013. ISBN-13: 9780132126953

Reference Books:

1. James F. Kurose, Keith W. Ross, "Computer Networking – A Top-Down Approach Featuring the Internet", Fifth Edition, Pearson Education, 2009.
2. S. Tanenbaum , "Computer, Networks", PHI Publication, 4th edition, ISBN: 8178087855.
3. William Stallings, "Data and Computer Communications", Person Education, 8th Edition, ISBN:- 9788131715369.

Online Resources/E-learning Resources: hyperref enumitem

1. Computer Networks and Internet Protocol by Prof. Soumya Kanti Ghosh and Prof. Sandip Chakraborty – IIT Kharagpur
   `https://onlinecourses.nptel.ac.in/noc22_cs19/preview`
2. MIT OpenCourseWare: Computer System Engineering (6.033)
   `https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-033-computer-system`
3. GeeksforGeeks: Computer Network Tutorials
   `https://www.geeksforgeeks.org/computer-network-tutorials/`

Name of the Program:	BTECH CSE-AI&ML	Semester:	Level: UG
Course Name:	Artificial Intelligence	Course Code/ Course Type	UBTML324
Course Pattern:	2026	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical/ Oral
3	-	-	3	3	40	60	-

Pre-Requisite:

1. Data Structures and Algorithms
2. Discrete Mathematics & Logic
3. Basic Computer Science Concepts

Course Objectives (CO):	**The objectives of Artificial Intelligence are:** 1. Understanding of AI Concepts 2. Knowledge of Machine Learning Algorithms 3. Practical Skills in AI Programming 4. Understanding of Neural Networks and Deep Learning 5. Application of AI Techniques
Course Learning Outcomes (CLO):	**Students would be able to:** 1. Comprehend Fundamental Concepts 2. Apply Machine Learning Algorithms 3. Implement AI Models 4. Analyze and Evaluate AI Systems 5. Design Neural Network Architectures

Course Contents/Syllabus:

Descriptors/Topics	CLO	Hours
UNIT I		
Introduction to Artificial Intelligence, History, AI models, Learning aspects, Intelligent Agents, Rational Agent, Environment types.	**CLO 1**	**9**
UNIT II		
Problem space and search, Toy Problems, Uninformed search methods – Breadth First Search, Uniform Cost Search, Depth First Search, Depth Limited Search, Iterative Deepening Search, Bi-directional Search, Heuristic search methods - Best first, Greedy, A*, AO*, Hill Climbing, Local Search and optimization - Simulated Annealing, Local Beam Search, Adversarial search -Minimax, Alpha-Beta Pruning	**CLO 2**	**9**
UNIT III		
Knowledge Representation, Wumpus World, Propositional Logic, Predicate Logic, Unification and Lifting, Representing Knowledge using rules, Frame systems, Semantic networks, Uncertainty and methods, Bayesian Probability and belief network, Probabilistic reasoning, Forward and backward reasoning, Making simple decisions.	**CLO 3**	**9**

UNIT IV		
CSP as Search Problem, Backtracking Search for CSP, Forward checking, Constraint Propagation, Formulating Problem structure. Planning components, Blocks world, Goal Stack Planning, Planning as a state space search, Partial Order Planning, Multi-agent Planning.	**CLO 4**	**9**
UNIT V		
Perceptron, Perceptron Learning, Introduction to Machine Learning, Supervised, unsupervised methods, classification, regression, Decision trees, basics of natural language processing, application areas of AI	**CLO 5**	**9**
Total Hours		**45**

Learning Resources:

Text Books:

1. Stuart Russell and Peter Norvig (1995), *Artificial Intelligence: A Modern Approach*, Third Edition, Pearson, 2003.
2. Elaine Rich and Kevin Knight, *Artificial Intelligence*, Tata McGraw Hill, 1991
3. Nils J. Nilsson, *Artificial Intelligence: A New Synthesis*, Morgan Kaufmann, 1998

Reference Books:

1. Patrick Henry Winston, "Artificial Intelligence", Addison-Wesley, 1992
2. Jiaweihan, MichelineKamber, "Data Mining: Concepts and systems", Morgan Kaufmann Publishers
3. Machine Learning, Tom Mitchell, McGraw Hill, 1997,ISBN: 0-070-42807-2

Online Resources/E-learning Resources:

1. edX: Learn Artificial Intelligence from Top Universities
   `https://www.edx.org/learn/artificial-intelligence`
2. NPTEL: Artificial Intelligence by Prof. Mausam – IIT Delhi
   `https://onlinecourses.nptel.ac.in/noc22-cs56/preview`
3. W3Schools: Introduction to Artificial Intelligence
   `https://www.w3schools.com/ai/ai-whatis.asp`

Name of the Program:	BTECH CSE-AI&ML	Semester: 5	Level: UG
Course Name:	Artificial Intelligence Lab	Course Code/ Course Type	UBTML325
Course Pattern:	2026	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical/ Oral
-	1	-	1	2	25	-	25

Pre-Requisite:

1. Python Programming Language

Course Objectives (CO):	**The objectives of Artificial Intelligence Lab are:** 1. Apply basic AI search algorithms to solve real-world problems. 2. Implement knowledge representation techniques for AI-based reasoning. 3. Develop intelligent agents using decision-making strategies. 4. Implement machine learning algorithms for classification and prediction tasks. 5. Analyze and evaluate AI models using performance metrics and datasets.
Course Learning Outcomes (CLO):	**Students would be able to:** 1. Implement uninformed and informed search algorithms (like BFS, DFS, A*) to solve pathfinding problems. 2. Design and code rule-based systems using Prolog or Python to perform logical reasoning. 3. Simulate rational agents that take decisions using game theory or decision trees. 4. Develop machine learning models such as Naive Bayes or KNN for pattern recognition tasks. 5. Evaluate accuracy, precision, recall, and F1 score to assess the effectiveness of AI models.

Practical Plan:

Practical Number	Practical Title	Week Number	Details	CLO	Hours
1	Implement A* Search algorithm	1	Represents a node in the search space, containing the state, parent node, cost from the start node (g), and heuristic cost (h).	CLO1	2
2	Implement AO* Search algorithm	2	AO* (Adaptive A*) is an extension of the A* algorithm that dynamically updates the heuristic function during the search to provide a more informed search direction basic implementation of AO* in Python	CLO1	2
3	Solve and implement the game of tic-tac-toe using mini-max	3	Implementing Tic-Tac-Toe using the Mini-Max algorithm involves creating a game tree where each node represents a game state, and then recursively evaluating each possible move to determine the best move for the current player.	CLO2	2

4	Implement and test hill climbing based search algorithms to solve Travelling Salesman Problem.	4	Hill climbing is a local search algorithm that starts with an arbitrary solution to a problem	CLO5	2
5	Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using any standard Heart Disease Data Set.	5	Python program that constructs a simple Bayesian network for diagnosing heart disease using the Cleveland Heart Disease dataset, one of the standard datasets used for heart disease diagnosis	CLO2	2
6	Write a program to implement k-Nearest Neighbor algorithm to classify the iris data set. Print both correct and wrong predictions.	6	Python program to implement the k-Nearest Neighbor (k-NN) algorithm to classify the Iris dataset, and print both correct and wrong predictions	CLO3	2
7	Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points.	7	Below is a Python implementation of the Locally Weighted Regression (LWR) algorithm	CLO3	2
8	Implement Decision Tree in Python	8	Basic implementation of a Decision Tree classifier in Python	CLO3	2
9	Implement 8-puzzle problem	9	Implement 8-puzzle problem using Breadth First Search.	CLO3	4
10	Implementation of Travelling Salesman Person	10	Implementation of Travelling Salesman Person	CLO3	2
11	To Implement Bayesian Networks	11	To Implement Bayesian Networks and perform inferences	CLO4	2
12	To implement backward chaining algorithm	12	To implement backward chaining algorithm	CLO3	2

Learning Resources:

1. Stuart Russell and Peter Norvig (1995), *Artificial Intelligence: A Modern Approach*, Third Edition, Pearson, 2003.
2. Elaine Rich and Kevin Knight, *Artificial Intelligence*, Tata McGraw Hill, 1991
3. Nils J. Nilsson, *Artificial Intelligence: A New Synthesis*, Morgan Kaufmann, 1998

Reference Books:

1. Patrick Henry Winston, "Artificial Intelligence", Addison-Wesley, 1992
2. Jiaweihan, MichelineKamber, "Data Mining: Concepts and systems", Morgan Kaufmann Publishers
3. Machine Learning, Tom Mitchell, McGraw Hill, 1997,ISBN: 0-070-42807-2

Online Resources/E-learning Resources:

1. edX: Learn Artificial Intelligence from Top Universities
   `https://www.edx.org/learn/artificial-intelligence`
2. NPTEL: Artificial Intelligence by Prof. Mausam – IIT Delhi
   `https://onlinecourses.nptel.ac.in/noc22-cs56/preview`
3. W3Schools: Introduction to Artificial Intelligence
   `https://www.w3schools.com/ai/ai-whatis.asp`

Name of the Program:	BTECH CSE-AI&ML	Semester: 5	Level: UG
Course Name:	Web Programming Techniques	Course Code/ Course Type	UBTML326/PEC
Course Pattern:	2026	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical/ Oral
2	-	-	2	2	20	30	-

Pre-Requisite:

1. Fundamentals of HTML & CSS
2. Basic Understanding of the Internet and Web

Course Objectives (CO):	**The objectives of Web Programming Techniques are:** 1. To familiarize students with Web Programming basic concepts. 2. To learn and understand Web scripting languages. 3. To explore the Front end & Back-end web programming skills. 4. To understand and learn Mobile web development. 5. To understand and learn Web application deployment.
Course Learning Outcomes (CLO):	**Students would be able to:** 1. Develop Static and Dynamic website using technologies like HTML, CSS, Bootstrap. 2. Demonstrate the use of web scripting languages. 3. Develop web application with Front End and Back End Technologies. 4. Develop mobile website using JQuery Mobile. 5. Deploy web application on cloud using AWS.

Course Contents/Syllabus:

Descriptors/Topics	CLO	Hours
UNIT I		
Introduction to Web Systems :Evolution from static to dynamic web applications, Overview of Web 1.0, Web 2.0, Web 3.0, Web Architecture :Client-server model, 3-tier architecture, Overview of front-end, back-end, and databases, Internet Protocols, HTTP, HTTPS, FTP, TCP/IP basics, Request/Response cycle, Status codes (200, 404, 500) Domain & Hosting Concepts:DNS, IP, Domain Name Registration, Hosting platforms Tools Introduction: Developer Tools (Inspect, Console, Network tabs),Postman for testing REST APIs	**CLO 1**	**6**
UNIT II		
HTML5 Basics: Semantic tags (¡header¿, ¡footer¿, ¡article¿, etc.) for creating structured, accessible web pages. Forms and Multimedia: Creating forms for user input; embedding images, videos, and audio.CSS3 Basics: Styling using colors, fonts, and the box model. Layout Techniques: Using Flexbox and Grid for responsive and flexible designs. Responsive Design: Using media queries to make the website mobile-first and responsive. Bootstrap: Introduction to the Bootstrap framework for faster front-end development.	**CLO 2**	**6**

UNIT III		
JavaScript Basics: Variables, data types, operators, functions, control structures (if, switch, loops). DOM Manipulation: Accessing and manipulating HTML elements dynamically using JavaScript.Event Handling: Implementing event listeners (click, submit, etc.) to trigger actions in the DOM.AJAX: Using AJAX for asynchronous communication between the client and server.JSON: Understanding JSON format and working with JSON data for API requests.ES6 Features: Introduction to newer JavaScript features like arrow functions, template literals, and promises.	**CLO 3**	**6**
UNIT IV		
Node.js: Setting up a Node.js environment and creating a simple server.Express.js: Basics of routing and middleware in Express for handling HTTP requests. RESTful APIs: Designing REST APIs with GET, POST, PUT, DELETE methods. Database Integration: Connecting to MongoDB (NoSQL) or MySQL (Relational DB) for storing and retrieving data. CRUD Operations: Creating, reading, updating, and deleting records in a database. Session Management: Handling user sessions, cookies, and authentication.	**CLO 4**	**6**
UNIT V		
Machine Learning APIs: Introduction to deploying ML models using Flask or FastAPI for creating REST APIs.Model Inference: Sending data to the server for processing and returning predictions (e.g., sentiment analysis, recommendation).Frontend Integration: Connecting the front-end with the machine learning model API using JavaScript and AJAX for real-time predictions.ML Use Cases: Exploring AI/ML-based web applications like chatbots, recommendation systems, and sentiment analysis tools.Model Deployment: Hosting the ML model as a web service and using it in production applications.	**CLO 5**	**6**
Total Hours		**30**

Learning Resources:

Text Books:

1. Kogent Learning Solutions Inc, *Web Technologies: HTML, JAVASCRIPT, PHP, JAVA, JSP, XML and AJAX*, Blackbook, Dreamtech Press, Second Edition, ISBN: 9788177228496
2. Raymond Camden, Andy Matthews, *JQuery Mobile Web Development Essentials*, Packt Publishing, Second Edition, ISBN: 9781782167891
3. Robin Nixon, *Learning PHP, MySQL, JavaScript and CSS: A Step-by-Step Guide to Creating Dynamic Websites*, 5th Edition, O'Reilly Media, ISBN: 9781491978917

Reference Books:

1. Steven M. Schafer, "HTML, XHTML and CSS", Wiley India Edition, Fourth Edition,978- 81- 265-1635-3 .
2. Dr.HirenJoshi, Web Technology and Application Development, DreamTech, First,ISBN:978-93- 5004-088-1
3. Steven M. Schafer, "HTML, XHTML and CSS", Wiley India Edition, Fourth Edition,978- 81-265- 1635-3
4. Ivan Bayross,"Web Enabled Commercial Application Development Using HTML, JavaScript, DHTML and PHP,BPB Publications,4th Edition,ISBN:978-8183330084.

Online Resources/E-learning Resources:

1. Udemy: Advanced Web Developer Course – Beginner to Advanced
   `https://www.udemy.com/course/advanced-web-developer-course-beginner-to-advanced`
2. NPTEL via Shiksha: Web Development Courses and Certification
   `https://www.shiksha.com/online-courses/web-development-courses-certification-training-by-nptel`
3. MDN Web Docs: Learn Web Development (HTML, CSS, JS)
   `https://developer.mozilla.org/en-US/docs/Learn`

Name of the Program:	BTECH CSE-AI&ML	Semester: 5	Level: UG
Course Name:	Web Programming Techniques Lab	Course Code/ Course Type	UBTML327/PEC
Course Pattern:	2026	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical/ Oral
-	1	-	1	2	25	-	25

Pre-Requisite:

1. Proficiency in a programming language, such as Python or Java

Course Objectives (CO):	**The objectives of Web Programming Techniques Lab are:** 1. To familiarize students with the fundamentals of web development including client-server architecture and static web pages. 2. To develop proficiency in front-end technologies such as HTML5, CSS3, JavaScript, and responsive design frameworks. 3. To understand server-side programming using Node.js and API integration using AJAX and JSON. 4. To explore secure web development practices including user authentication, input sanitization, and common web vulnerabilities. 5. To deploy complete web applications using modern tools, frameworks, and hosting platforms.
Course Learning Outcomes (CLO):	**Students would be able to:** 1. Design and develop interactive static websites using HTML5, CSS3, and basic JavaScript. 2. Build responsive user interfaces using modern layout techniques like Flexbox and CSS Grid. 3. Develop dynamic web applications integrating frontend logic with RESTful APIs using JavaScript and AJAX. 4. Implement backend servers using Node.js or Python frameworks (Flask/FastAPI) and deploy ML-powered web services. 5. Apply secure coding practices such as input validation, JWT-based authentication, and protection against XSS/SQL Injection.

Practical Plan:

Practical Number	Practical Title	Week Number	Details	CLO	Hours
1	Client-server mode by designing a simple HTML page	1	Client-server model by designing a simple HTML page that demonstrates the request-response cycle. Use browser developer tools to analyze the flow. Analyze a simple API request using Postman and print the request/response headers and body.	CLO1	2
2	Set up a basic static website using HTML	2	Set up a basic static website using HTML and deploy it using a free web hosting service (like GitHub Pages or Netlify). Test its live deployment and perform browser debugging.	CLO1	2

3	Create a personal portfolio website using HTML5	3	Create a personal portfolio website using HTML5. Include sections like About Me, Projects, and Contact, with appropriate forms and multimedia (image, video, etc.).	CLO2	2
4	Develop a responsive webpage	4	Develop a responsive webpage using Flexbox and CSS Grid for layout. The page should adjust automatically across devices (desktop, tablet, mobile).	CLO2	2
5	Develop a simple to-do list application using JavaScript	5	Develop a simple to-do list application using JavaScript. The app should allow users to add, remove, and edit tasks dynamically using DOM manipulation.	CLO3	2
6	Build a basic weather application that	6	DBuild a basic weather application that fetches weather data from a public API (e.g., OpenWeatherMap) using AJAX and JSON. Display current weather information dynamically.	CLO3	2
7	Set up a Node.js server using Express.js	7	Set up a Node.js server using Express.js and handle basic routes (GET, POST). Create an API endpoint that returns JSON data.	CLO4	2
8	Deploy a simple machine learning model	8	Deploy a simple machine learning model (e.g., a sentiment analysis model) using Flask or FastAPI and expose it as an API endpoint.	CLO4	2
9	Create a secure login page with input sanitization	9	Create a secure login page with input sanitization and implement JWT authentication for securing user sessions. Use encryption for storing user passwords.	CLO5	2
10	Secure a web application from XSS and SQL	10	Secure a web application from XSS and SQL Injection attacks by properly validating and sanitizing inputs in forms and API endpoints.	CLO5	2

Learning Resources:

Text Books:

1. Kogent Learning Solutions Inc, *Web Technologies: HTML, JAVASCRIPT, PHP, JAVA, JSP, XML and AJAX*, Blackbook, Dreamtech Press, Second Edition, ISBN: 9788177228496
2. Raymond Camden, Andy Matthews, *JQuery Mobile Web Development Essentials*, Packt Publishing, Second Edition, ISBN: 9781782167891
3. Robin Nixon, *Learning PHP, MySQL, JavaScript and CSS: A Step-by-Step Guide to Creating Dynamic Websites*, 5th Edition, O'Reilly Media, ISBN: 9781491978917

Reference Books:

1. Steven M. Schafer, "HTML, XHTML and CSS", Wiley India Edition, Fourth Edition,978- 81- 265-1635-3 .
2. Dr.HirenJoshi, Web Technology and Application Development, DreamTech, First,ISBN:978-93- 5004-088-1
3. Steven M. Schafer, "HTML, XHTML and CSS", Wiley India Edition, Fourth Edition,978- 81-265- 1635-3
4. Ivan Bayross,"Web Enabled Commercial Application Development Using HTML, JavaScript, DHTML and PHP,BPB Publications,4th Edition,ISBN:978-8183330084.

Online Resources/E-learning Resources:

1. Udemy: Advanced Web Developer Course – Beginner to Advanced
   `https://www.udemy.com/course/advanced-web-developer-course-beginner-to-advanced`
2. NPTEL via Shiksha: Web Development Courses and Certification
   `https://www.shiksha.com/online-courses/web-development-courses-certification-training-by-nptel`
3. MDN Web Docs: Learn Web Development (HTML, CSS, JS)
   `https://developer.mozilla.org/en-US/docs/Learn`

Name of the Program:	BTECH CSE-AI&ML	Semester: 5	Level: UG
Course Name:	Foundations of Data Science	Course Code/ Course Type	UBTML328/PEC
Course Pattern:	2026	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA	ESA	Practical/ Oral
2	-	-	2	2	20	30	-

Pre-Requisite:

1. Knowledge of basic statistics and mathematics.
2. Basic programming skills in Python or R.

Course Objectives (CO):	**The objectives of Foundations of Data Science are:** 1. To understand the lifecycle and concepts of data science. 2. To learn data preprocessing techniques for data analysis. 3. To develop skills in statistical thinking and data summarization. 4. To apply visualization and exploration tools on real-world datasets. 5. To introduce the basics of machine learning and prediction.
Course Learning Outcomes (CLO):	**Students would be able to:** 1. Understand the workflow and tools used in data science projects. 2. Perform data preprocessing including cleaning, transformation, and reduction. 3. Analyze datasets using statistical measures and visualizations. 4. Apply exploratory data analysis using Python/R libraries. 5. Demonstrate basic supervised and unsupervised learning methods.

Course Contents/Syllabus:

Descriptors/Topics	CLO	Hours
UNIT I: Introduction to Data Science		
What is Data Science? Lifecycle of a data science project, Role of a Data Scientist, Applications of data science in different domains. Tools and programming languages used in Data Science. Types and sources of data, structured vs unstructured data.	CLO1	6
UNIT II: Data Preprocessing		
Data collection techniques. Data cleaning – handling missing values, outliers, noise. Data transformation – normalization, standardization. Encoding categorical variables. Data integration and reduction – dimensionality reduction techniques (PCA, LDA).	CLO2	6
UNIT III: Exploratory Data Analysis (EDA)		
Descriptive statistics: measures of central tendency, dispersion, shape. Correlation and covariance. Data visualization using Matplotlib, Seaborn, Plotly. Use of histograms, boxplots, scatter plots, heatmaps, and pair plots.	CLO3	6
UNIT IV: Introduction to Machine Learning		
Introduction to supervised and unsupervised learning. Types of ML algorithms. Regression vs Classification. Clustering methods – KMeans, DBSCAN. Model evaluation – accuracy, precision, recall, F1-score.	CLO4	6
UNIT V: Data Science Tools and Case Studies		

Python libraries – NumPy, pandas, scikit-learn, matplotlib. R programming basics for data science. Introduction to Jupyter Notebook, Google Colab. Case studies from domains like healthcare, marketing, finance.	CLO5	6
Total Hours		**30**

Learning Resources:

Text Books:

1. Cathy O'Neil and Rachel Schutt, *Doing Data Science*, O'Reilly Media, ISBN: 9781449358655
2. Joel Grus, *Data Science from Scratch*, 2nd Edition, O'Reilly Media, ISBN: 9781492041139
3. V.K. Jain, *Fundamentals of Data Science*, Khanna Publishing House, ISBN: 9789386173452

Reference Books:

1. Aurélien Géron, *Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow*, 2nd Edition, O'Reilly, ISBN: 9781492032649
2. Wes McKinney, *Python for Data Analysis*, 2nd Edition, O'Reilly, ISBN: 9781491957660
3. Hadley Wickham and Garrett Grolemund, *R for Data Science*, O'Reilly Media, ISBN: 9781491910399

Online Resources/E-learning Resources:

1. Coursera: What is Data Science? by IBM
   `https://www.coursera.org/learn/what-is-datascience`
2. NPTEL: Introduction to Data Science by Prof. Raghunathan – IIT Madras
   `https://nptel.ac.in/courses/106/106/106106179`
3. Kaggle: Data Science Courses and Tutorials
   `https://www.kaggle.com/learn/data-science`

Name of the Program:	BTECH CSE-AI&ML	Semester: 5	Level: UG
Course Name:	Foundations of Data Science Lab	Course Code/ Course Type	UBTML329/PEC
Course Pattern:	2026	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA	ESA	Practical/ Oral
-	1	-	1	2	25	-	25

Pre-Requisite:

1. Proficiency in a programming language such as Python or R
2. Basic knowledge of statistics and data formats

Course Objectives (CO):	**The objectives of Foundations of Data Science Lab are:** 1. To gain practical skills in data collection, preprocessing, and exploration 2. To perform basic data analysis and visualization using Python/R 3. To apply statistical measures and correlation techniques 4. To implement basic machine learning models on datasets 5. To develop insights using real-world case studies
Course Learning Outcomes (CLO):	**Students would be able to:** 1. Collect, clean, and preprocess data using Python/R 2. Perform exploratory data analysis using visual and statistical tools 3. Apply descriptive statistics and inferential methods on datasets 4. Build and evaluate basic machine learning models 5. Solve domain-specific problems using data science workflows

Practical Plan:

Prac. No.	Title	Week	Details	CLO	Hours
1	Data collection and loading	1	Load data from CSV, JSON, Excel, or online APIs into Python using pandas. Explore dataset dimensions, data types, and summary.	CLO1	2
2	Data cleaning	2	Handle missing data (mean, median, mode), remove duplicates, and fix data types. Identify and treat outliers.	CLO1	2
3	Data transformation	3	Apply normalization, standardization, and encoding on categorical features. Perform basic feature scaling.	CLO1	2
4	Descriptive statistics	4	Use NumPy/pandas to calculate mean, median, mode, variance, std dev, correlation, and covariance.	CLO2	2
5	Data visualization	5	Use matplotlib/seaborn to plot histograms, boxplots, scatterplots, heatmaps, pairplots. Interpret results.	CLO2	2
6	Exploratory Data Analysis (EDA)	6	Perform EDA on a real-world dataset (e.g., Titanic or Iris) with visual + statistical summaries.	CLO2	2
7	Supervised learning – regression	7	Build and evaluate a Linear Regression model. Use train-test split, plot predicted vs actual.	CLO3	2

8	Supervised learning – classification	8	Build and evaluate a Logistic Regression or Decision Tree model on classification dataset (e.g., Iris).	CLO4	2
9	Unsupervised learning	9	Apply KMeans clustering on sample data. Plot clusters. Evaluate with silhouette score.	CLO4	2
10	Case study / Mini-project	10	Analyze a domain dataset (e.g., healthcare, sales, social media), apply full pipeline: clean, EDA, model, visualize.	CLO5	2

Learning Resources:

Text Books:

1. Cathy O'Neil and Rachel Schutt, *Doing Data Science*, O'Reilly Media, ISBN: 9781449358655
2. Joel Grus, *Data Science from Scratch*, 2nd Edition, O'Reilly Media, ISBN: 9781492041139
3. V.K. Jain, *Fundamentals of Data Science*, Khanna Publishing House, ISBN: 9789386173452

Reference Books:

1. Aurélien Géron, *Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow*, 2nd Edition, O'Reilly, ISBN: 9781492032649
2. Wes McKinney, *Python for Data Analysis*, 2nd Edition, O'Reilly, ISBN: 9781491957660
3. Hadley Wickham and Garrett Grolemund, *R for Data Science*, O'Reilly Media, ISBN: 9781491910399

Online Resources/E-learning Resources:

1. Coursera: What is Data Science? by IBM
   `https://www.coursera.org/learn/what-is-datascience`
2. NPTEL: Introduction to Data Science by Prof. Raghunathan – IIT Madras
   `https://nptel.ac.in/courses/106/106/106106179`
3. Kaggle: Data Science Courses and Tutorials
   `https://www.kaggle.com/learn/data-science`

Name of the Program:	BTECH CSE-AI&ML	Semester: 5	Level: UG
Course Name:	Real Time Operating System	Course Code/ Course Type	UBTCEPE311/PEC
Course Pattern:	2025	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA	ESA	Practical/ Oral
3	-	-	3	3	40	60	-

Pre-Requisite:

1. Computer Networks, Operating Systems

Course Objectives (CO):	**The objectives of Real Time Operating System are:** 1. Understand the architecture and core concepts of the QNX RTOS. 2. Learn to develop and debug applications using the QNX Momentics IDE. 3. Gain knowledge of process and thread management, including synchronization techniques. 4. Explore inter-process communication (IPC) methods and their applications in QNX. 5. Understand hardware programming concepts, including interrupt handling and memory access.
Course Learning Outcomes (CLO):	**Students would be able to:** 1. Describe the QNX OS architecture and its microkernel-based design. 2. Develop and debug QNX-based applications using appropriate tools. 3. Apply process/thread management and synchronization techniques in QNX. 4. Implement inter-process communication methods for real-time systems. 5. Configure and build QNX boot/OS images for specific hardware platforms.

Course Contents/Syllabus:

Descriptors/Topics	CLO	Hours
UNIT I		
Introduction to QNX OS Architecture: Overview of QNX OS architecture: microkernel, process manager, and standards. Protected address spaces, process/thread model, and scheduling. Introduction to inter-process communication (IPC) and synchronization. Resource managers and shared objects.	CLO 1	10
UNIT II		
Processes, Threads, and Synchronization: Process management: creation, termination, and memory protection. Thread management: creation, termination, and synchronization. Synchronization techniques: mutexes, semaphores, and condition variables. Hands-on exercises: process/thread creation and synchronization.	CLO 2	9
UNIT III		
Inter-Process Communication (IPC): Overview of IPC methods in QNX: message passing, pulses, and shared memory. Comparing IPC methods: advantages and disadvantages. Practical implementation of IPC in QNX. Hands-on exercises: message passing and shared memory.	CLO 3	9
UNIT IV		

Hardware Programming and Timing: Hardware access methods: IO-mapped and memory-mapped IO. Interrupt handling and DMA-safe memory allocation. Timing architecture: periodic timing, one-shot timing, and timeouts. Hands-on exercises: interrupt handling and timing mechanisms.	CLO 4	9
UNIT V		
Building and Configuring QNX Boot/OS Images: Overview of QNX boot/OS image structure. Components of a boot image: startup code, kernel, drivers, and scripts. Building and loading boot images onto target hardware. Introduction to resource managers and their implementation.	CLO 5	8
Total Hours		**45**

Learning Resources:

Text Books:

1. QNX Neutrino RTOS Getting Started Guide, BlackBerry QNX
2. *Embedded Systems Architecture: Explore architectural concepts, pragmatic design patterns, and best practices*, Packt Publishing, ISBN: 978-1788832502
3. *Real-Time Systems: Design Principles for Distributed Embedded Applications*, Springer, ISBN: 978-1441982377

Reference Books:

1. *Real-Time Concepts for Embedded Systems*, CMP Books, ISBN: 978-1578201242
2. *Operating Systems: Internals and Design Principles*, Pearson, ISBN: 978-0134670959
3. *Embedded and Real-Time Operating Systems*, Springer, ISBN: 978-3319515922
4. *Mastering Embedded Linux Programming*, Packt Publishing, ISBN: 978-1787283282

Online Resources/E-learning Resources:

1. NPTEL – Real-Time Operating Systems
   `https://nptel.ac.in/courses/106/106/106106181/`
2. Coursera – Embedded Systems Courses
   `https://www.coursera.org`

Name of the Program:	BTECH CSE-AI&ML	Semester: 5	Level: UG
Course Name:	Real Time Operating System Laboratory	Course Code/ Course Type	UBTCEPE312/PEC
Course Pattern:	2025	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA	ESA	Practical/ Oral
-	1	-	1	2	25	-	25

Pre-Requisite:

1. Computer Networks, Operating Systems

Course Objectives (CO):	**The objectives of Real Time Operating System Laboratory are:** 1. Understand the architecture and core concepts of the QNX RTOS. 2. Learn to develop and debug applications using the QNX Momentics IDE. 3. Gain knowledge of process and thread management, including synchronization techniques. 4. Explore inter-process communication (IPC) methods and their applications in QNX. 5. Understand hardware programming concepts, including interrupt handling and memory access.
Course Learning Outcomes (CLO):	**Students would be able to:** 1. Describe the QNX OS architecture and its microkernel-based design. 2. Develop and debug QNX-based applications using appropriate tools. 3. Apply process/thread management and synchronization techniques in QNX. 4. Implement inter-process communication methods for real-time systems. 5. Configure and build QNX boot/OS images for specific hardware platforms.

Practical Plan:

Practical Number	Practical Title	Week Number	Details	CLO	Hours
1	QNX Configuration	1,2	QNX configuration and application development using QNX Momentics IDE.	CLO 1	2
2	Process Creation	3,4	Process and thread creation, management, and synchronization.	CLO 1	2
3	IPC	5,6	Implementation of IPC methods: passing message and shared memory.	CLO 2	2
4	Interrupt Handling	7,8	Interrupt handling and hardware access programming.	CLO 3	2
5	Deployment	9,10	Building and deploying QNX boot/OS images.	CLO 4	2
6	Mini Capstone Project	11-15	Mini capstone project: Design and implement a QNX-based embedded system.	CLO 1-5	2

Learning Resources:

Text Books:

1. QNX Neutrino RTOS User's Guide, QNX Software Systems.
2. *Programming for Embedded Systems*, Michael Barr, O'Reilly Media.

Reference Books:

1. *Hands-on RTOS with Microcontrollers*, Brian Amos, Packt Publishing, 2020.
2. *Operating System Concepts*, Abraham Silberschatz, Peter B. Galvin, Greg Gagne, 9th Edition, Wiley, 2018.

Online Resources/E-learning Resources:

1. QNX Everywhere page
   `https://blackberry.qnx.com/en/products/qnx-everywhere`
2. QNX on Reddit
   `https://www.reddit.com/r/QNX/`
3. QNX on StackOverflow
   `https://stackoverflow.com/questions/tagged/qnx`
4. QNX on YouTube
   `https://www.youtube.com/qnxcam`
5. Collection of open-source projects including Links for QNX
   `https://gitlab.com/qnx/projects`

Name of the Program:	BTECH CSE-AI&ML	Semester: 5	Level: UG
Course Name:	Introduction to Blockchain Technology and Applications	Course Code/ Course Type	MOOCML503 / MOOC
Course Pattern:	2026	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA	ESA	Practical/ Oral
-	-	2	2	2	50	-	-

Pre-Requisite:

1. Basic understanding of computer networks, distributed systems, and database concepts
2. Basic knowledge of cryptographic concepts such as hashing, public key, and private key
3. Familiarity with programming fundamentals and web-based applications

Course Objectives (CO):	**The objectives of this course are:** 1. To introduce the fundamental concepts, architecture, and working principles of blockchain technology. 2. To explain cryptographic primitives, hashing, digital signatures, and consensus mechanisms used in blockchain systems. 3. To enable students to understand Bitcoin, Ethereum, smart contracts, and decentralized applications. 4. To provide exposure to public, private, and permissioned blockchain platforms such as Ethereum, Hyperledger Fabric, and Corda. 5. To study blockchain applications in finance, healthcare, supply chain, e-governance, land registration, digital identity, and other domains.
Course Learning Outcomes (CLO):	**Students would be able to:** 1. Explain the need, evolution, architecture, and key components of blockchain technology. 2. Apply basic cryptographic concepts such as hash functions, digital signatures, and Merkle trees in blockchain context. 3. Analyze the working of Bitcoin, Ethereum, smart contracts, mining, and consensus mechanisms. 4. Differentiate between public, private, and permissioned blockchain platforms and identify suitable use cases. 5. Evaluate blockchain-based applications in real-world domains and prepare a basic implementation-oriented case study.

Course Contents:

Unit Contents	CLO	Hours
UNIT I – Introduction to Blockchain Technology		
Blockchain Fundamentals: Introduction to blockchain, need for decentralized systems, limitations of centralized databases, distributed ledger technology, peer-to-peer networks, immutability, transparency, auditability, trustless systems, blocks, transactions, chain structure, blockchain workflow, types of blockchain: public, private, consortium, and hybrid blockchain, difference between blockchain and traditional databases, major characteristics and challenges of blockchain adoption.	**CLO 1**	**6**
UNIT II – Cryptographic Foundations of Blockchain		

Cryptography and Security Concepts: Cryptographic hash functions, properties of hash functions, SHA family, hash pointer, Merkle tree and Merkle root, public key cryptography, private key and public key, digital signatures, transaction signing, wallets, addresses, authentication, non-repudiation, integrity verification, role of cryptography in blockchain security, basic attacks and security considerations.	**CLO 2**	**6**
UNIT III – Bitcoin, Mining, and Consensus Mechanisms		
Bitcoin and Consensus: Introduction to Bitcoin blockchain, Bitcoin transactions, UTXO model, blocks and block headers, mining process, nonce, hash puzzle, proof of work, mining difficulty, forks, double spending problem, Byzantine Generals Problem, consensus as distributed coordination, overview of consensus algorithms: Proof of Work, Proof of Stake, Practical Byzantine Fault Tolerance, Delegated Proof of Stake, Proof of Authority, and consensus requirements in public and permissioned blockchain systems.	**CLO 3**	**6**
UNIT IV – Ethereum, Smart Contracts, and Permissioned Blockchain		
Blockchain Platforms and Smart Contracts: Introduction to Ethereum, Ethereum accounts, gas, Ether, Ethereum Virtual Machine, smart contracts, decentralized applications, Solidity overview, use cases of smart contracts, limitations and risks of smart contracts, introduction to permissioned blockchain, Hyperledger Fabric architecture, peers, orderers, channels, chaincode, membership service provider, introduction to Corda and enterprise blockchain use cases.	**CLO 3, CLO 4**	**6**
UNIT V – Blockchain Applications and Case Studies		
Applications and Emerging Directions: Blockchain applications in cryptocurrency, banking and finance, supply chain management, healthcare and electronic health records, insurance, land registration, e-governance, digital identity, education records, energy trading, Internet of Things, and decentralized storage. Study of blockchain benefits, challenges, scalability issues, privacy concerns, regulatory issues, sustainability concerns, and future trends such as DeFi, NFTs, tokenization, Web3, cross-chain interoperability, and blockchain with AI.	**CLO 4, CLO 5**	**6**
Total Hours		**30**

Learning Resources:

Reference Books / Reading Material:

1. Narayanan, A., Bonneau, J., Felten, E., Miller, A., and Goldfeder, S., *Bitcoin and Cryptocurrency Technologies*, Princeton University Press.
2. Antonopoulos, A. M., *Mastering Bitcoin*, O'Reilly Media.
3. Antonopoulos, A. M. and Wood, G., *Mastering Ethereum*, O'Reilly Media.
4. Bashir, I., *Mastering Blockchain*, Packt Publishing.
5. Selected white papers and documentation on Bitcoin, Ethereum, Hyperledger Fabric, and Corda.

Online Resources / E-learning Resources:

1. NPTEL / SWAYAM: Introduction to Blockchain Technology and Applications.
2. NPTEL / SWAYAM: Blockchain and its Applications.
3. Ethereum Developer Documentation.
4. Hyperledger Fabric Documentation.
5. Corda Documentation.

Note:

1. The course may be mapped with NPTEL/SWAYAM MOOC content for online learning and certification.
2. Students may be encouraged to complete weekly assignments on the MOOC platform and submit progress screenshots.
3. Department may conduct additional internal quizzes, case-study presentations, and viva based on the MOOC syllabus.
4. Implementation exposure may be given through Remix IDE, MetaMask, Ganache, Ethereum testnet, or Hyperledger Fabric depending on available laboratory facilities.

Name of the Program:	BTECH CSE-AI&ML	Semester:5	Level: UG
Course Name:	Technical Seminar on Sustainable Environmental Solutions	Course Code/ Course Type	UBTML330/PROJ
Course Pattern:	2026	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical/ Oral
-	1	-	1	2	25	-	25

Pre-Requisite: NA

Course Objectives (CO):	**The objectives of Technical Seminar are:** 1. To expose students to contemporary advancements in Artificial Intelligence and Machine Learning through in-depth exploration of a specialized technical topic. 2. To cultivate independent research abilities by encouraging literature surveys, analysis of scientific papers, and synthesis of knowledge from various sources. 3. To develop effective communication skills through preparation and delivery of technical presentations. 4. To enhance report writing skills by guiding students in structuring and formatting technical documentation in standard formats like IEEE. 5. To instill critical thinking and confidence in students by engaging them in Q&A sessions and peer reviews during seminar presentations.
Course Learning Outcomes (CLO):	**Students would be able to:** 1. Identify recent trends and innovations in the field of AI and ML. 2. Conduct literature surveys and analyze research papers. 3. Deliver technical content effectively using oral and visual communication. 4. Answer queries and participate in discussions confidently. 5. Draft a well-structured technical report.

Course Contents/Syllabus:

Descriptors/Topics	CLO	Hours
1. Each student must select a topic related to recent advancements in AI, ML, or interdisciplinary domains. **2. Topics must be approved by the faculty coordinator or seminar in-charge.** **3. Students must prepare a seminar report of 15–20 pages in IEEE format.** **4. Presentation duration should be 10–12 minutes followed by 3–5 minutes of Q&A.** **5. Seminar will be evaluated on topic relevance, technical content, presentation, report, and Q&A.** **6. Regular attendance and timely submission of seminar work are mandatory.**	**CLO 1-5**	**15**
Total Hours		**30**

Name of the Program:	BTECH CSE-AI&ML	Semester:5	Level: UG
Course Name:	German A2.1	Course Code/ Course Type	UFL301A/AEC
Course Pattern:	2026	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical/ Oral
2	-	-	-	2	-	-	-

Pre-Requisite:

1. Able to have a basic conversation in German

Course Objectives (CO):	**The objectives of German are:** 1. To get familiar with food culture in Germany. 2. To comprehend professional and educational concepts 3. To apply advance grammar topics 4. To Analyze advance text 5. To Design and create texts in German
Course Learning Outcomes (CLO):	**Students would be able to:** 1. Comprehend food related texts 2. Enhance writing skills in German language 3. Enhance professional speaking skills of German language 4. Construct a dialogue, in the German language, for basic human interactions in a social context. 5. Take part in an interaction relating to formal conversation

Course Contents/Syllabus:

Descriptors/Topics	CLO	Hours
UNIT I		
Rund ums Essen Kitchen and cooking, Food habits, Emotions and assumptions Grammar – Possessive articles, reflexive verbs	**CLO 1**	**6**
UNIT II		
Nach der Schulzeit Daily activities and experiences during school time, school subjects, school types Grammar – Changing prepositions	**CLO 2**	**6**
UNIT III		
Medien in Alltag Media, activities in media, film Grammar – Degree of comparison	**CLO 3**	**6**
UNIT IV		
Groe und kleineGefühle Festivals and celebrations, invitation cards, thanksgiving cards Grammar – Adjective ending	**CLO 4**	**6**
UNIT V		
Was machen Sie beruflich? and Ganz schonmobil Daily activities in the working world, different professions, public transport and travelling towards working place Grammar – Clauses, Modalverbs in past tense	**CLO 5**	**6**
Total Hours		**30**

Learning Resources:

Text Books:

1. Netzwerk A1, Ernst klett Verlag and Goyal Publishers and Distributors Pvt. Ltd.
2. Studio d A1, Cornelesen Verlag and Goyal Publishers and Distributors Pvt. Ltd
3. Netzwerk Neu A1, Ernst klett Verlag and Goyal Publishers and Distributors Pvt. Ltd

Reference Books:

1. Hallo Deutsch A1,Ernst Klett Verlag, Goyal Publishers and Distributors Pvt. Ltd
2. ThemenAktuell 1, Hueber verlag
3. Maximal Ernst klett Verlag and Goyal Publishers and Distributors Pvt. Ltd

Online Resources/E-learning Resources:

1. Youtube :https://youtube.com/@LearnGermanwithAnja?si=BkJYDPi7TS0fT4lr
2. https://youtube.com/@deutschlernenmitheidi?si=TkICIabzioaU0roZ
3. Instagram : instagram.com/learngermanwithanja

Name of the Program:	BTECH CSE-AI&ML	Semester:5	Level: UG
Course Name:	Basic Japanese language skill	Course Code/ Course Type	UFL301B/AEC
Course Pattern:	2026	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical/ Oral
2	-	-	-	2	-	-	-

Pre-Requisite:
1. Desire to get acquainted with the Japanese language. Basic knowledge of Hiragana and Katakana. Reading and writing Japanese script with basic kanji

Course Objectives (CO):	**The objectives of Basic Japanese language skill are:** 1. Being fluent in a additional language will increase the opportunities in a competitive job market. 2. To develop students' basic abilities such as listening, speaking, reading and writing. 3. To enhance the listening skills and memory. 4. Unlock career potential with language skills. 5. To interpret a variety of cultural products in the target language from a critical perspective.
Course Learning Outcomes (CLO):	**Students would be able to:** 1. Read and write days / dates using Kanji. Write and speak basic sentences with adverb. 2. Identify relations, make sentences using adjectives. 3. Illustrate the location of particle and living things. 4. Conversation in the question answer format. 5. Express ambition appetite aspiration craving.

Course Contents/Syllabus:

Descriptors/Topics	CLO	Hours
UNIT I		
Minna no Nihongo lesson no.5 and 6 Express Days and dates using kanji. Speaking : days in month with kanji, Particals / Introduction to calenderWriting sentences using Verbs / Adverb Speaking : want to invite someone to do something	**CLO 1**	**6**
UNIT II		
Minna no Nihongo lesson no. 7 and 8 Writing : Verbs / method of an action /family members Speaking : Reference word and Information regarding family Introduction of Adjectives /tenses of adjectives	**CLO 2**	**6**
UNIT III		
Minna no Nihongo lesson no. 9 and 10 Adverbs and Preposition	**CLO 3**	**6**
UNIT IV		
Minna no Nihongo lesson no. 11 and 12 Counters, Adjectives / tenses of adjective	**CLO 4**	**6**
UNIT V		
Minna no Nihongo lesson no. 13 Desire/phrases	**CLO 5**	**6**
Total Hours		**30**

Learning Resources:

Text Books:

1. Minna no Nihongo , " Japanese for everyone" ,Elementary Main Textbook , Goyal Publishers and Distributors Pvt. Ltd.

Reference Books:

1. Shyoho Volume 1
2. Genki Japan
3. Haru Vol. 1 and 2

Online Resources/E-learning Resources:

1. https://www.youtube.com/watch?v=p9PEIsOzJ5E
2. https://www.youtube.com/watch?v=RJ1ZdIDJqoY
3. https://www.youtube.com/watch?v=Lo5-5k7EPIM

Name of the Program:	BTECH CSE-AI&ML	Semester:5	Level: UG
Course Name:	Professional Development Training-II	Course Code/ Course Type	PSD501/AC
Course Pattern:	2026	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical/ Oral
-	2	-	2	4	50	-	-

Pre-Requisite:NA

Course Objectives (CO):	**The objectives of Aptitude and Logical Reasoning are:** 1. To Familiarize Students with Different Types of Mathematical Problems. 2. To learn and Strengthen Logical Reasoning Skills. 3. To Develop Critical Thinking Skills. 4. To Improve Quantitative and Numerical Skills. 5. To Prepare Students for Standardized Tests and build Confidence in Problem-Solving.
Course Learning Outcomes (CLO):	**Students would be able to:** 1. Students will develop enhanced problem-solving abilities through Exposure to various types of aptitude and logical reasoning problems. 2. Sharpen their analytical thinking skills by learning to analyze and interpret different types of data, patterns, and logical structures. 3. Cultivate critical thinking abilities by challenging students to evaluate and assess information, arguments, and scenarios using logical reasoning principles. 4. Apply different forms of logical reasoning, such as deductive reasoning, inductive reasoning, and critical reasoning, to solve problems and make decisions. 5. Students will be able to develop soft skills and communication skills.

Course Contents/Syllabus:

Descriptors/Topics	CLO	Hours
UNIT I		
Quantitative Aptitude Number System, Problems on Ages, Percentage, Average, Time and Work, Profit and Loss, Permutation and Combination	**CLO 1**	**6**
UNIT II		
Logical Reasoning Number Series, Letter Series, Coding and Decoding, Calendars, Clocks	**CLO 2**	**6**
UNIT III		
Verbal Reasoning Subject-Verb Agreement, Preposition and Verbal Analogy, Closet test	**CLO 3**	**6**
UNIT IV		
Personality Development Resilience, Motivation and Listening skills, Self-confidence, Body language, Leadership, Goal setting, Emotional intelligence, Personal growth and development	**CLO 4**	**6**

UNIT V		
Soft Skills and Communication Skills Introduction to Teamwork, Collaboration and Time Management, Communication Skills, Organization Skills, Introduction to Critical Thinking, Leadership, Negotiation and Presentation Skills, Time Management, Adaptability Skills, actively listening in conversations, Public speaking, Effectively communicating ideas to others, Introduction to Career Development, Goal Setting, Emotional Intelligence Fundamentals, Building Adaptability and Resilience	**CLO 5**	**6**
Total Hours		**30**

Learning Resources:

Text Books:

1. Quantitative Aptitude for Competitive Examinations, R.S Agarwal, 2017
2. Quantitative Aptitude for All Competitive Examinations by Abhijit Guha,6th edition,2016
3. Word Power Made Easy by Norman Lewis, 2023

Reference Books:

1. The Pearson Guide to Quantitative Aptitude for Competitive Examinations by Dinesh khattar, 2nd Edition.

Name of the Program:	BTECH CSE-AI&ML	Semester: 5	Level: UG
Course Name:	Rural Immersion-I	Course Code/ Course Type	ACCRI301 / ACCRI302 / RI
Course Pattern:	2026	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA	ESA	Practical/ Oral
-	1	-	1	2	25	-	-

Pre-Requisite:

1. Sensitivity towards community engagement and social development
2. Basic communication, teamwork, and observation skills
3. Willingness to participate in field activities and rural/community interaction

Course Objectives (CO):	**The objectives of Rural Immersion are:** 1. To expose students to rural life, local governance, socio-economic conditions, and grassroots challenges. 2. To develop social responsibility, community sensitivity, and problem identification skills. 3. To encourage students to apply technical, organizational, and communication abilities in rural/community contexts. 4. To promote collaborative activities through student chapters, clubs, extension initiatives, IEEE/ACM activities, surveys, awareness drives, and village-level interaction. 5. To enable students to document, reflect upon, and propose sustainable solutions for identified rural issues.
Course Learning Outcomes (CLO):	**Students would be able to:** 1. Understand the structure, needs, and challenges of rural communities through direct interaction and observation. 2. Conduct basic surveys, need assessments, and community studies in rural settings. 3. Participate in awareness, service, outreach, or technology-enabled support activities for rural development. 4. Work effectively in teams while planning and executing rural/community engagement activities. 5. Prepare reports, reflections, and action-oriented suggestions based on rural immersion experiences.

Activity Guidelines:

Activities / Guidelines	CLO	Hours
Guideline I – Rural Orientation and Community Understanding		
Orientation and Exposure: Introduction to rural immersion, objectives and expected outcomes, importance of rural engagement in engineering education, understanding village ecosystem, local governance, panchayat structure, education, health, sanitation, agriculture, livelihood, digital access, and environmental issues. Students shall undergo orientation sessions before field activity.	**CLO 1**	**6**
Guideline II – Survey, Need Assessment, and Field Interaction		

Community Study and Survey Work: Students shall visit a rural area / village / adopted community and conduct structured observation, household survey, stakeholder interaction, institutional visit, or community mapping. The activity may include identification of issues related to education, health, water, sanitation, agriculture, waste management, digital literacy, employability, or social awareness.	**CLO 2**	**6**
Guideline III – Participation in Rural / Community Activities		
Extension and Engagement Activities: Students shall participate in at least one or more activity-based engagements such as cleanliness drive, digital literacy support, school outreach, environmental awareness, basic health/hygiene awareness, local data collection, poster campaign, women empowerment awareness, cyber safety awareness, sustainable technology demonstration, or village-level problem discussion. Activities may be conducted through departmental initiatives or student chapters such as IEEE, ACM, NSS, or similar forums.	**CLO 3, CLO 4**	**6**
Guideline IV – Rural Problem Identification and Solution Perspective		
Problem Analysis and Solution Thinking: Based on field experience, students shall identify one or more practical rural/community problems and discuss possible interventions or sustainable solutions. These may include low-cost technical ideas, awareness models, educational aids, digital tools, data management support, small automation concepts, or community assistance plans relevant to the local context.	**CLO 4, CLO 5**	**6**
Guideline V – Documentation, Reflection, and Presentation		
Reporting and Reflection: Students shall prepare an immersion report containing village/community profile, activities conducted, observations, survey findings, identified issues, proposed suggestions, photographs, participation evidence, and reflection on learning outcomes. Students shall present the activity through report submission, poster, presentation, or viva. Emphasis shall be given to social learning, teamwork, ethical engagement, and responsible citizenship.	**CLO 5**	**6**
Total Hours		**30**

Suggested Activities / Modes of Implementation:

1. Village visit / adopted village interaction / community immersion visit
2. Household or institution-level survey and data collection
3. Digital literacy, cyber awareness, or educational support sessions
4. Cleanliness, sustainability, environment, or waste-management awareness activities
5. School outreach, youth mentoring, or social awareness campaign
6. IEEE / ACM / NSS / Department activity in rural or semi-rural community
7. Rural problem identification and solution presentation
8. Reflection report, group presentation, poster, or documentary submission

Assessment Guidelines (CIA - 25 Marks):

1. Participation in Field / Rural Activity: 05 Marks
2. Survey / Community Interaction / Data Collection: 05 Marks
3. Documentation and Report Writing: 05 Marks
4. Presentation / Poster / Viva / Reflection: 05 Marks

5. Teamwork, Discipline, and Social Engagement: 05 Marks

Learning Resources:

Reference Books / Reading Material:

1. Selected material on rural development, community engagement, social innovation, and sustainable development.
2. Government reports / village development plans / local self-governance documents.
3. Activity manuals of IEEE, ACM, NSS, Unnat Bharat Abhiyan, and community engagement initiatives.

Online Resources / E-learning Resources:

1. Resources on rural development, social innovation, and community-based engineering activities.
2. IEEE / ACM student activity models for outreach and social engagement.
3. Government portals and public resources related to village development, sanitation, digital literacy, sustainability, and rural empowerment.

COURSE SYLLABUS

CSE - AI&ML

SEMESTER-VI

Name of the Program:	BTECH CSE-AI&ML	Semester: 6	Level: UG
Course Name:	Machine Learning	Course Code/ Course Type	UBTML331/PCC
Course Pattern:	2026	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical/ Oral
3	-	-	3	3	40	60	-

Pre-Requisite:

1. Applied Statistical Techniques
2. Introduction to Artificial Intelligence

Course Objectives (CO):	**The objectives of Machine Learning are::** 1. To explore the knowledge of Machine learning and its types. 2. To analyze various data pre-processing methods. 3. To learn Supervise learning methods. 4. To analyze the need of unsupervised learning methods. 5. To learn fundamental neural network algorithms.
Course Learning Outcomes (CLO):	**Students would be able to:** 1. Identify the needs and challenges of machine learning for real time applications. 2. Apply various data pre-processing techniques to simplify and speed up machine learning algorithms. 3. Apply appropriately supervised machine learning algorithms for real time applications. 4. Compare and contrast different clustering algorithms. 5. Design a neural network for solving engineering problems.

Course Contents/Syllabus:

Descriptors/Topics	CLO	Hours
UNIT I		
Introduction to Machine Learning, Comparison of Machine learning with traditional programming, ML vs AI vs Data Science. Types of learning: Supervised, Unsupervised, and semi-supervised, reinforcement learning techniques, Models of Machine learning: Geometric model, Probabilistic Models, Logical Models, Grouping and grading models, Parametric and non-parametric models. Important Elements of Machine Learning- Data formats, Learnability, Statistical learning approaches.	**CLO 1**	**9**
UNIT II		
Feature Engineering: Concept of Feature, preprocessing of data: Normalization and Scaling, Standardization, Managing missing values, Introduction to Dimensionality Reduction, Principal Component Analysis (PCA), Feature Extraction: Kernel PCA, Local Binary Pattern. Introduction to various Feature Selection Techniques, Sequential Forward Selection, Sequential Backward Selection. Statistical feature engineering: count-based, Length, Mean, Median, Mode etc. based feature vector creation. Multidimensional Scaling, Matrix Factorization Techniques.	**CLO 2**	**9**

UNIT III		
Supervised Learning : Bias, Variance, Generalization, Underfitting, Overfitting, Linear regression, Regression: Lasso regression, Ridge regression, Gradient descent algorithm. Evaluation Metrics: MAE, RMSE, R2 Classification: K-nearest neighbour, Support vector machine. Ensemble Learning: Bagging, Boosting, Random Forest, Adaboost. Binary-vs-Multiclass Classification, Balanced and Imbalanced Multiclass Classification Problems, Variants of Multiclass Classification: One-vs-One and One-vs-All Evaluation Metrics and Score: Accuracy, Precision, Recall, Fscore, Cross-validation, MicroAverage Precision and Recall, Micro-Average F-score, Macro-Average Precision and Recall, Macro-Average F-score	**CLO 3**	**9**
UNIT IV		
Unsupervised Learning: K-Means, K-medoids, Hierarchical, and Density-based Clustering, Spectral Clustering. Outlier analysis: introduction of isolation factor, local outlier factor. Evaluation metrics and score: elbow method, extrinsic and intrinsic methods.	**CLO 4**	**9**
UNIT V		
Introduction To Neural Networks: Artificial Neural Networks: Single Layer Neural Network, Multilayer Perceptron, Back Propagation Learning, Functional Link Artificial Neural Network, and Radial Basis Function Network, Activation functions, Introduction to Recurrent Neural Networks and Convolutional Neural Networks.	**CLO 5**	**9**
Total Hours		**45**

Learning Resources:

Text Books:

1. "Introduction to Machine Learning" by Ethem Alpaydin, PHI, 2nd Edition, 2013.
2. "Pattern Recognition and Machine Learning" by Bishop, Christopher M., and Nasser M. Nasrabadi, Vol. 4, No. 4, New York: Springer, 2006.
3. "Machine Learning: A Probabilistic Perspective" by Kevin P. Murphy, MIT Press, 2012. ISBN: 9780262018029

Reference Books:

1. "Machine learning", by Tom Mitchell, McGraw-Hill series in Computer Science, 1997 2. Shalev-Shwartz, Shai, and Shai Ben-David.
2. "Understanding machine learning: From theory to algorithms", by Shai Shalev-Shwartz and Shai Ben-David, Cambridge university press, 2017
3. "The Elements of Statistical Learning" Trevor Hastie, Robert Tibshirani and Jerome Friedman. Second Edition. 2009. [TH-2009]
4. "Mathematics for Machine Learning" by Marc Peter Deisenroth, A. Aldo Faisal, Cheng Soon Ong, Cambridge University Press (23 April 2020)
5. "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow", by Aurélien Géron O'Reilly Media, Inc. 2nd Edition

Online Resources/E-learning Resources:

1. Google Developers: Foundational Courses in Machine Learning
   `https://developers.google.com/machine-learning/foundational-courses`
2. NPTEL: Introduction to Machine Learning by Prof. Balaraman Ravindran – IIT Madras
   `https://onlinecourses.nptel.ac.in/noc19_cs79/preview`
3. Coursera: Machine Learning by Andrew Ng – Stanford University
   `https://www.coursera.org/learn/machine-learning`

Name of the Program:	BTECH CSE-AI&ML	Semester: 6	Level: UG
Course Name:	Machine Learning Lab	Course Code/ Course Type	UBTML332/PCC
Course Pattern:	2026	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical/ Oral
-	1	-	1	2	25	-	25

Pre-Requisite:

1. Basic knowledge of python Programming

Course Objectives (CO):	**The course objectives of Machine Learning Lab are:** 1. To explore the knowledge of Supervised Machine learning Algorithms. 2. To analyze different Classifier Models. 3. To learn unsupervised learning Models. 4. To analyze different clustering models. 5. To explore different neural network architectures.
Course Learning Outcomes (CLO):	**Students would be able to:** 1. To implement Supervised Machine learning Algorithms. 2. To design different Classifier Models. 3. To apply unsupervised learning Models for real life problems. 4. To apply and evaluate different clustering models. 5. To create different neural network architecture models.

Practical Plan:

Practical Number	Practical Title	Week Number	Details	CLO	Hours
1	Implement Regression models	1	Predict the price of the Uber ride from a given pickup point to the agreed drop-off location. Perform following tasks 1. Pre-process the dataset. 2. Identify outliers. 3. Check the correlation. 4. Implement linear regression and random forest regression models. 5. Evaluate the models and compare their respective scores like R2, RMSE, etc. Dataset link: https://www.kaggle.com/datasets/yasserh /uber-fares-dataset	CLO1	2

2	Implement binary classification model	2	Classify the email using the binary classification method. Email Spam detection has two states: 1. Normal State – Not Spam 2. Abnormal State – Spam. Use K-Nearest Neighbors and Support Vector Machine for classification. Analyze their performance. Dataset link: The emails.csv dataset on the Kaggle https://www.kaggle.com/datasets/ balaka18 / email-spam-classification-dataset-csv	CLO1	2
3	Implement Neural Network based classifier	3	Given a bank customer, build a neural network-based classifier that can determine whether they will leave or not in the next 6 months. Dataset Description: The case study is from an open-source dataset from Kaggle. The dataset contains 10,000 sample points with 14 distinct features such as CustomerId, CreditScore, Geography, Gender, Age, Tenure, Balance, etc. Link to the Kaggle project: https://www.kaggle.com/barelydedicated/ bank-customer-churn-modeling Perform following steps: 1. Read the dataset. 2. Distinguish the feature and target set and divide the data set into training and test sets. 3. Normalize the train and test data. 4. Initialize and build the model. Identify the points of improvement and implement the same. 5. Print the accuracy score and confusion matrix (5 points).	CLO5	2
4	Implement GD	4	Implement Gradient Descent Algorithm to find the local minima of a function. For example, find the local minima of the function y = $(x + 3)^2 starting from the point x = 2$	CLO2	2
5	Implement KNN	5	Implement K-Nearest Neighbors algorithm on diabetes.csv dataset. Compute confusion matrix, accuracy, error rate, precision and recall on the given dataset. Dataset link : https://www.kaggle.com/datasets / abdallamahgoub/diabetes	CLO4	2
6	Implement clustering model	6	Implement K-Means clustering / hierarchical clustering on sales_data_sample.csv dataset. Determine the number of clusters using the elbow method. Dataset link : https://www.kaggle.com/datasets/ kyanyoga /sample-sales-data	CLO4	2

7	Implement prediction model	7,8	Use the following dataset to analyze ups and downs in the market and predict future stock price returns based on Indian Market data from 2000 to 2020. Dataset Link: https://www.kaggle.com/datasets/sagara9595/stock-data	CLO5	2
8	Prediction model using neural network	9,10	Build a machine learning model that predicts the type of people who survived the Titanic shipwreck using passenger data (i.e. name, age, gender, socio-economic class, etc.). Dataset Link: https://www.kaggle.com/competitions/titanic/data	CLO5	2

Learning Resources:

Text Books:

1. "Introduction to Machine Learning" by Ethem Alpaydin, PHI, 2nd Edition, 2013.
2. "Pattern Recognition and Machine Learning" by Bishop, Christopher M., and Nasser M. Nasrabadi, Vol. 4, No. 4, New York: Springer, 2006.
3. "Machine Learning: A Probabilistic Perspective" by Kevin P. Murphy, MIT Press, 2012. ISBN: 9780262018029

Reference Books:

1. "Machine learning", by Tom Mitchell, McGraw-Hill series in Computer Science, 1997 2. Shalev-Shwartz, Shai, and Shai Ben-David.
2. "Understanding machine learning: From theory to algorithms", by Shai Shalev-Shwartz and Shai Ben-David, Cambridge university press, 2017
3. "The Elements of Statistical Learning" Trevor Hastie, Robert Tibshirani and Jerome Friedman. Second Edition. 2009. [TH-2009]
4. "Mathematics for Machine Learning" by Marc Peter Deisenroth, A. Aldo Faisal, Cheng Soon Ong, Cambridge University Press (23 April 2020)
5. "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow", by Aurélien Géron O'Reilly Media, Inc. 2nd Edition

Online Resources/E-learning Resources:

1. Google Developers: Foundational Courses in Machine Learning
   `https://developers.google.com/machine-learning/foundational-courses`
2. NPTEL: Introduction to Machine Learning by Prof. Balaraman Ravindran – IIT Madras
   `https://onlinecourses.nptel.ac.in/noc19_cs79/preview`
3. Coursera: Machine Learning by Andrew Ng – Stanford University
   `https://www.coursera.org/learn/machine-learning`

Name of the Program:	BTECH CSE-AI&ML	Semester: 6	Level: UG
Course Name:	Algorithmic Techniques and Strategies	Course Code/ Course Type	UBTCE333
Course Pattern:	2026	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical/ Oral
3	-	-	3	3	40	60	-

Pre-Requisite:

1. Knowledge of C Programming and DSA

Course Objectives (CO):	**The objectives of Algorithmic Techniques and Strategies are:** 1. Describe and express performance analysis of various algorithms, Fundamentals of Data Structures and their applications. 2. Explain and demonstrate Divide and Conquer technique to provide solutions for well-known problems like searching, Sorting etc. 3. Discuss Greedy method and solve problems which are based on Greedy method such as Knapsack problem, Single-source Shortest Path, etc. 4. Use Dynamic Programming to solve problems like All Pairs Shortest paths, Travelling Salesperson (TSP), etc. and also compare with Greedy method. 5. Choose Backtracking Algorithms for solving N-Queens, Sum of subsets Problems and compare /Contrast with Branch and Bound Technique.
Course Learning Outcomes (CLO):	**Students would be able to:** 1. To compare worst-case running time of algorithms and describe the fundamental of algorithmic problems. 2. To describe and apply problem solving techniques such as divide-and-conquer, greedy method, dynamic programming, etc. 3. To compare and contrast among various problem-solving techniques. 4. To elaborate and demonstrate NP- completeness. 5. To correctness of algorithms using inductive proofs and invariants.

Course Contents/Syllabus:

Descriptors/Topics	CLO	Hours
UNIT I		
Foundations of Algorithm Analysis: Algorithm, algorithm design strategies, time and space complexity, asymptotic notation, complexity analysis; Introduction to divide and conquer technique: merge sort, quick sort, binary search and its performance analysis, Strassen's matrix multiplication	**CLO 1**	**9**
UNIT II		
Divide and Conquer Algorithms: Concept and applications of divide and conquer approach in algorithm design, Concept and detail description of Binary Search algorithms and its analysis, Finding Minimum and maximum element in a list of items (Min-Max algorithm) and their analysis., Concepts of Order statistics, Median order. Brute force approach for selection, Selection in Worst Case Linear Time algorithm and its complexity analysis.	**CLO 2**	**9**

UNIT III		
Greedy Algorithms: Concept of Optimization Problems and Optimal solution. Introduction of Greedy Strategy for algorithm design. Elements of Greedy, Concept of Knapsak problem, Algorithm for Fractional Knapsack Problem examples and analysis of its complexity, Kruskal's and Prim's algorithms for Minimum Spanning Tree, their examples and complexity analysis. Correctness. Dijkstra Shortest Path Algorithms, example and its time complexity Purpose of Huffman Coding, Prefix Codes, Huffman Tree, Huffman Coding Algorithm, example and its Analysis.	**CLO 3**	**9**
UNIT IV		
Dynamic Programming: Concepts of Dynamic Programming approach for algorithm design, Greedy Algorithm vs Dynamic Programming, Recursion vs Dynamic Programming. Elements of Dynamic Programming Approach Concept of Matrix Chain Multiplication, its Algorithm, examples and complexity analysis,0-1 Knapsack problem and its complexity analysis, Floyd Warshall Algorithms for all pair shortest path problem, example and its complexity analysis.Travelling Salesman Problem and its analysis.	**CLO 4**	**9**
UNIT V		
Backtracking and NP Completeness Backtracking concept and its examples like 8 queen's problem, Hamiltonian cycle, Graph coloring problem etc. Introduction to branch & bound method, examples of branch and bound method like traveling salesman problem etc. Meaning of lower bound theory and its use in solving algebraic problem, introduction to parallel algorithms; String matching algorithms; Introduction to NP-completeness.	**CLO 5**	**9**
Total Hours		**45**

Learning Resources:

Text Books:

1. Introduction to Algorithms, Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein, PHI, Latest Edition.
2. Analysis and Design of Algorithms, Ellis Horowitz and Sartaj Sahni, Computer Science Press, Latest Edition.
3. Fundamentals of Algorithmics, Gilles Brassard and Paul Bratley, Prentice Hall, Latest Edition.

Reference Books:

1. The Design and Analysis of Algorithms, Alfred V. Aho, Jeffrey D. Ullman, Addison-Wesley, Latest Edition.
2. Algorithm Design, Michael T. Goodrich and Roberto Tamassia, Wiley India.
3. Introduction to the Design and Analysis of Algorithms, Anany Levitin, Pearson, Latest Edition.

Online Resources/E-learning Resources:

1. MIT OpenCourseWare: Introduction to Algorithms (6.006)
   `https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/`
2. NPTEL: Design and Analysis of Algorithms – IIT Madras
   `https://onlinecourses.nptel.ac.in/noc19_cs47/preview`
3. Coursera: Algorithms Part I by Princeton University
   `https://www.coursera.org/learn/algorithms-part1`

Name of the Program:	BTECH CSE-AI&ML	Semester: 6	Level: UG
Course Name:	Algorithmic Techniques and Strategies Lab	Course Code/ Course Type	UBTCE334
Course Pattern:	2026	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical/ Oral
-	1	-	1	2	25	-	25

Pre-Requisite:

1. Knowledge of C Programming and DSA

Course Objectives (CO):	**The objectives of Algorithmic Techniques and Strategies Lab are:** 1. To develop practical understanding of algorithm design techniques such as iterative methods, divide and conquer, greedy algorithms, dynamic programming, and backtracking. 2. To implement basic algorithms for searching, sorting, and selection problems efficiently. 3. To analyze and solve optimization problems using greedy strategies and dynamic programming approaches. 4. To demonstrate problem-solving skills for NP-Complete problems using backtracking and approximation algorithms. 5. To design mini-projects by applying combined algorithmic strategies and evaluating performance.
Course Learning Outcomes (CLO):	**Students would be able to:** 1. Implement and analyze iterative and recursive algorithms like GCD, Fibonacci, and basic sorting/searching. 2. Apply divide and conquer strategies for solving sorting and selection problems efficiently. 3. Solve optimization problems using greedy methods and evaluate their effectiveness. 4. Build and test solutions using dynamic programming for complex computational problems. 5. Solve combinatorial and NP-complete problems using backtracking and approximation algorithms.

Practical Plan:

Practical Number	Practical Title	Week Number	Details	CLO	Hours
1	Basic iterative algorithms GCD algorithm, Fibonacci Sequences, Sequential and Binary Search.	1	Basic iterative algorithms GCD algorithm, Fibonacci Sequences, Sequential and Binary Search.	CLO1	2
2	Basic iterative sorting algorithms: Bubble Sort, selection Sort, Insertion Sort.	2	Basic iterative sorting algorithms: Bubble Sort, selection Sort, Insertion Sort.	CLO1	2

3	Binary Search with Divide and conquer approach.	3	IBinary Search with Divide and conquer approach.	CLO2	2
4	Merge Sort, Heap sort, Quick Sort, Randomized Quick Sort	4	Merge Sort, Heap sort, Quick Sort, Randomized Quick Sort	CLO2	2
5	Revision and Mid Term Evaluation	5	Revision and Mid Term Evaluation	CLO1, CLO2	2
6	Selection Problem with divide and Conquer approach	6	Selection Problem with divide and Conquer approach	CLO3	2
7	Fractional Knapsack Problem, Job sequencing with deadline, Kruskal's algorithm, Prims algorithm, Dijkstra's Algorithm	7	Fractional Knapsack Problem, Job sequencing with deadline, Kruskal's algorithm, Prims algorithm, Dijkstra's Algorithm	CLO4	2
8	Implement the dynamic programming algorithms.	8	Implement the dynamic programming algorithms.	CLO4	2
9	Implement approximation Algorithm.	9	Implement approximation Algorithm.	CLO5	2
10	Implement Backtracking and NP Completeness	10	Implement Backtracking and NP Completeness	CLO5	2
11	Revision and 6-11 experiments evaluation	11	Revision and all experiments evaluation	CLO3,4,5	2
12	Mini Project /Task	12	Mini Project /Task	CLO1,2,3, 4,5	6

Learning Resources:

Text Books:

1. Introduction to Algorithms, Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein, PHI, Latest Edition.

2. Analysis and Design of Algorithms, Ellis Horowitz and Sartaj Sahni, Computer Science Press, Latest Edition.

3. Fundamentals of Algorithmics, Gilles Brassard and Paul Bratley, Prentice Hall, Latest Edition.

Reference Books:

1. The Design and Analysis of Algorithms, Alfred V. Aho, Jeffrey D. Ullman, Addison-Wesley, Latest Edition.
2. Algorithm Design, Michael T. Goodrich and Roberto Tamassia, Wiley India.
3. Introduction to the Design and Analysis of Algorithms, Anany Levitin, Pearson, Latest Edition.

Online Resources/E-learning Resources:

1. MIT OpenCourseWare: Introduction to Algorithms (6.006)
   https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/
2. NPTEL: Design and Analysis of Algorithms – IIT Madras
   https://onlinecourses.nptel.ac.in/noc19_cs47/preview
3. Coursera: Algorithms Part I by Princeton University
   https://www.coursera.org/learn/algorithms-part1

Name of the Program:	BTECH CSE-AI&ML	Semester: 6	Level: UG
Course Name:	Pattern recognition and Optimization	Course Code/ Course Type	UBTML335/PEC
Course Pattern:	2026	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical/ Oral
3	-	-	3	3	40	60	-

Pre-Requisite:

1. knowledge of linear algebra.
2. Proficiency in probability and statistics.
3. Understanding of multivariate calculus.

Course Objectives (CO):	**The objectives of Pattern recognition and Optimization are:** 1. To understand the concept of a pattern and the basic approach to the development of pattern recognition and machine intelligence algorithms. 2. To apply the knowledge of feature extraction methods, feature evaluation, and data mining on real life. 3. To apply both supervised and unsupervised classification methods to detect and characterize patterns in real-world data. 4. Develop prototype pattern recognition algorithms that can be used to study algorithm 5. To understand and learn Pattern Recognition and Optimization techniques
Course Learning Outcomes (CLO):	**Students would be able to:** 1. Understand the need and significance of mathematical fundamentals in pattern recognition to solve real- time problems. 2. Explore on supervised learning algorithms and to apply them for solving problems 3. Design pattern recognition models to extract interesting patterns from structured data like graph, syntactic description etc. 4. Understand the impact of dimensionality reduction on the design of intelligent models and to apply the dimensionality reduction techniques on data. 5. Apply various machine learning techniques like artificial neural networks, Support Vector machines, Fuzzy inference engines etc.to solve real-world problems.

Course Contents/Syllabus:

Descriptors/Topics	CLO	Hours
UNIT I		
Classification: Overview of pattern recognition-Discriminant Functions-Supervised learning Parametric estimation- Maximum likelihood estimation. Pattern Classifier: Bayesian parameter estimation-perceptron algorithm-LMSE algorithm problems with Bayes Approach-Pattern classification by distance functions-Minimum distance pattern classifier.	**CLO 1**	**9**

UNIT II		
Unsupervised Classification: Clustering for unsupervised learning and classification Clustering concept-C-means algorithm-Hierarchical clustering procedures-Graph theoretic approach to pattern clustering- Validity of clustering solutions. Structural Pattern Recognition: Elements off or mal grammars-String generation as pattern Syntactic Description-Parsing-Stochastic grammars structural representation. Feature Extraction and Selection: Entropy minimization-Karhunen-Loevetrans formation Feature selection through Functions Approximation-Binary feature selection.	**CLO 2**	**9**
UNIT III		
Neural Networks and Kernel Machines: Neural network structures for pattern recognition Neural network-based pattern associators– Self organizing networks-Support vector machines (SVM)-Kernel machines, Maximum margin classification, and generalizability and VC(Vapnik–Chervonenkis) dimension. Neuro Fuzzy and Genetic Algorithm classification: Fuzzy Logic-Fuzzy pattern classifiers Neuro-Fuzzy Systems-Pattern classification and optimization Using Genetic Algorithms, Recent Trends in pattern recognitions.	**CLO 3**	**9**
UNIT IV		
Introduction to Optimization: Historical Development, Engineering applications of Optimization, Design 04 vector and constraints, Constraint surface, Objective function, Classification of Optimization Problems	**CLO 4**	**9**
UNIT V		
Classical Optimization Techniques Single variable optimization, Constrained and unconstrained multi-variable 06 optimization, Direct substitution method, Lagrange's method of multipliers, Karush-Kuhn-Tucker conditions. Linear Programming Statement of an LP problem, Graphical Solution of an LP problem, Simplex 05 method, Dual simplex method. Non-linear Programming, Evolutionary Algorithms An overview of evolutionary algorithms.	**CLO 5**	**9**
Total Hours		**45**

Learning Resources:

Text Books:

1. Duda R.O., and Hart.P.E.,Pattern Classification and Scene Analysis, second edition, Wiley, 2001.
2. Robert J.Schalkoff, Pattern Recognition: Statistical, Structural and Neural Approaches, JohnWiley & Sons Inc., New York, 2007.
3. Trevor H, Robert T,Jerome Friedman, The Elements of Statistical Learning, Springer Series,2017.
4. J. K. Sharma, "Operations Research", Macmillan, 5th Edition, 2012.
5. R. Pannerselvan, "Operations Research", 2nd Edition, PHI Publications, 2006.

Reference Books:

1. Tou and Gonzales, Pattern Recognition Principles, Wesley Publication Company, London, 1974.
2. Morton Nadier and Eric Smith P., Pattern Recognition Engineering, John Wiley & Sons, NewYork, 1993.
3. Christopher M Bishop, Pattern Recognition and Machine Learning. Springer. 2011.
4. Engineering Optimization Theory and Practice, S.S.Rao, New Age International (P) Ltd, Publishers
5. Kalyanmoy Deb Multi-objective optimization using evolutionary algorithms John Wiley Publications
6. Jasbir S. Arora Introduction to Optimum Design McGraw Hill Publication.

Online Resources/E-learning Resources:

1. ResearchGate: Interactive E-Learning System Using Pattern Recognition and Augmented Reality
   `https://www.researchgate.net/publication/216814160_Interactive_ELearning_System_Using_Pattern`
2. NPTEL: Pattern Recognition and Applications (IIT Kharagpur)
   `https://nptel.ac.in/courses/117105101`
3. YouTube: Pattern Recognition – Basic Introduction (Lecture Video)
   `https://www.youtube.com/watch?v=BROB96fXtPI`

Name of the Program:	BTECH CSE-AI&ML	Semester: 6	Level: UG
Course Name:	Pattern recognition and Optimization Lab	Course Code/ Course Type	UBTML336/PEC
Course Pattern:	2026	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical/ Oral
-	1	-	1	2	25	-	25

Pre-Requisite:

1. Programming Languages.
2. Matlab/ Scilab

Course Objectives (CO):	**The objectives of Pattern recognition and Optimization Lab are:** 1. To familiarize students with MATLAB/Scilab/Python Programming basic concepts. 2. To learn and understand Pattern Recognition and Optimization techniques. 3. To explore Open-Source Software. 4. To understand and learn Computational facility. 5. To understand and learn Pattern Recognition and Optimization techniques.
Course Learning Outcomes (CLO):	**Students would be able to:** 1. Develop Pattern recognition techniques algorithm. 2. Demonstrate the use Pattern recognition and optimization techniques. 3. Develop optimization techniques. 4. Develop Pattern recognition techniques algorithm using Python/MATLAB. 5. Deploy Pattern recognition techniques using Mat lab/ Scilab

Practical Plan:

Practical Number	Practical Title	Week Number	Details	CLO	Hours
1	Implementation of Linear Regression using Gradient Descent	1	Implementation of Linear Regression using Gradient Descent	CLO1	2
2	Implementation of Unrestricted Search methods	2	Implementation of Unrestricted Search methods	CLO1	2
3	Implementation of Golden Section Method Optimization	3	Implementation of Golden Section Method Optimization	CLO1	2
4	Implementation of Fibonacci Method	4	Implementation of Fibonacci Method	CLO5	2
5	Implementation of Bacteria Foraging	5	Implementation of Bacteria Foraging	CLO5	2

6	Particle Swarm Optimization	6	Particle Swarm Optimization	CLO2	2
7	Univariate methods Ant colony optimization	7	Univariate methods Ant colony optimization	CLO2	2
8	Improving Fraud Detection in Financial Transactions through	8	Improving Fraud Detection in Financial Transactions through	CLO4	2
9	Implement a basic SVM classifier using Python and NumPy without kernel functions.	9	Implement a basic SVM classifier using Python and NumPy without kernel functions.	CLO4	2
10	Train the SVM classifier on a synthetic dataset with two classes.	10	Train the SVM classifier on a synthetic dataset with two classes.	CLO4	2
11	Implement the DE/rand/1/bin strategy to solve a constrained optimization problem.	11	Implement the DE/rand/1/bin strategy to solve a constrained optimization problem.	CLO4	2

Learning Resources:

Text Books:

1. Duda R.O., and Hart.P.E.,Pattern Classification and Scene Analysis, second edition, Wiley, 2001.
2. Robert J.Schalkoff, Pattern Recognition: Statistical, Structural and Neural Approaches, JohnWiley & Sons Inc., New York, 2007.
3. Trevor H, Robert T,Jerome Friedman, The Elements of Statistical Learning, Springer Series,2017.
4. J. K. Sharma, “Operations Research”, Macmillan, 5th Edition, 2012.
5. R. Pannerselvan, “Operations Research”, 2nd Edition, PHI Publications, 2006.

Reference Books:

1. Tou and Gonzales, Pattern Recognition Principles, Wesley Publication Company, London, 1974.
2. Morton Nadier and Eric Smith P., Pattern Recognition Engineering, John Wiley & Sons, NewYork, 1993.
3. Christopher M Bishop, Pattern Recognition and Machine Learning. Springer. 2011.
4. Engineering Optimization Theory and Practice, S.S.Rao, New Age International (P) Ltd, Publishers
5. Kalyanmoy Deb Multi-objective optimization using evolutionary algorithms John Wiley Publications
6. Jasbir S. Arora Introduction to Optimum Design McGraw Hill Publication.

Online Resources/E-learning Resources:

1. ResearchGate: Interactive E-Learning System Using Pattern Recognition and Augmented Reality
   `https://www.researchgate.net/publication/216814160_Interactive_ELearning_System_Using_Pattern`
2. NPTEL: Pattern Recognition and Applications (IIT Kharagpur)
   `https://nptel.ac.in/courses/117105101`
3. YouTube: Pattern Recognition – Basic Introduction (Lecture Video)
   `https://www.youtube.com/watch?v=BROB96fXtPI`

Name of the Program:	BTECH CSE-AI&ML	Semester: 6	Level: UG
Course Name:	Data Visualization Tools	Course Code/ Course Type	UBTML337/PEC
Course Pattern:	2026	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical/ Oral
3	-	-	3	3	40	60	-

Pre-Requisite:

1. Computer Networks

Course Objectives (CO):	**The objectives of Data Visualization Tools are:** 1. To recall the concepts of data visualization to develop charts, maps, tables, and other visual representations of data. 2. To recognize visualization tools to conduct data analysis, especially exploration of an unfamiliar dataset. 3. To apply the concept of interactive dashboards to combine several visualizations into a cohesive and functional whole. 4. To analyze and design features animations techniques. 5. To evaluate various principles of visualization.
Course Learning Outcomes (CLO):	**Students would be able to:** 1. Understand the basics of plotting techniques. 2. Explain the procedure various data visualization methods. 3. Apply knowledge of various animation types. 4. Analyze data the various principles of visualization. 5. Evaluate how to perform group operations.

Course Contents/Syllabus:

Descriptors/Topics	CLO	Hours
UNIT I: Basic Plotting Techniques		
Line plots, bar plots, pie charts, scatter plots, histograms, stacked bar charts. Introduction to Matplotlib: pyplot interface, figure anatomy, customization, titles, axes, grid, legends. Introduction to Seaborn: data-aware plotting, style themes. Using Plotly for interactive plotting. Subplotting with multiple figures. Comparative plotting across libraries. Exporting plots in various formats (SVG, PNG, PDF).	**CLO 1**	**9**
UNIT II: Applied and Statistical Visualizations		
Box plots for distribution insights. Violin plots and density plots using KDE. Area charts for temporal data visualization. Heat maps for correlation matrices and pivoted data. Tree maps for hierarchical and part-to-whole relationships. Introduction to graph networks using NetworkX and visualizing network data. Customizing colors, markers, annotations for analytical storytelling. Comparison of static vs dynamic statistical graphics.	**CLO 2**	**9**

UNIT III: Interactive Visualizations and Animation		
Dynamic charts using Plotly and Bokeh. Interactive dashboards using Panel and Streamlit. Dynamic maps using Folium and Plotly maps. Creating 2D and 3D animations using Matplotlib's FuncAnimation. Motion charts and storytelling with time-based datasets. Animation principles: sequencing, transitions, easing. Exploring Altair for declarative visualization. Creating statistical dashboards using Altair + Vega-Lite. Real-world use case demonstration (e.g., COVID tracker).	**CLO 3**	**9**
UNIT IV: Principles of Information Visualization		
Theory of visual perception and cognition. Gestalt principles: proximity, similarity, continuity, closure. Edward Tufte's principles: data-ink ratio, chartjunk, small multiples. Pre-attentive attributes: color, shape, size. Application of principles in real dashboard design. Evaluating dashboard effectiveness. Types of dashboards: strategic, analytical, operational. Best practices in choosing chart types. Accessibility and visual ethics in data visualization.	**CLO 4**	**9**
UNIT V: Data Aggregation and Group Operations		
Data grouping using pandas groupby mechanics. Aggregation functions: sum, mean, count, min, max, std. Applying multiple aggregations simultaneously. Split-apply-combine strategy in analysis workflows. Creating and manipulating pivot tables and cross tabulations. Hierarchical indexing and reshaping techniques. Visualizing grouped data effectively (bar plots, line plots, heatmaps). Case study: Sales data grouping and visualization.	**CLO 5**	**9**
Total Hours		**45**

Learning Resources:

Text Books:

1. McKinney, W.(2017). Python for Data Analysis: Data Wrangling with Pandas, NumPy and IPython. 2nd edition. O'Reilly Media.
2. O'Neil, C., & Schutt, R. (2013). Doing Data Science: Straight Talk from the Frontline O'Reilly Media.
3. Tamara Munzner, Visualization Analysis and Design, A K Peters Visualization Series, CRC Press, 2014.

Reference Books:

1. Scott Murray, Interactive Data Visualization for the Web, O'Reilly, 2013.
2. Alberto Cairo, The Functional Art: An Introduction to Information Graphics and Visualization, New Riders, 2012.
3. Nathan Yau, Visualize This: The FlowingData Guide to Design, Visualization and Statistics, John Wiley & Sons, 2011.

Online Resources/E-learning Resources:

1. Free Video Lectures: NPTEL - Introduction to Learning Analytics
   `https://freevideolectures.com/course/4041/nptel-introduction-to-learning-analytics/11`
2. NPTEL: Data Visualization (Mathematics Computing)
   `https://nptel.ac.in/courses/111106415`
3. NPTEL IIT Workshop: Data Visualization with R (Completed Course)
   `https://elearn.nptel.ac.in/shop/iit-workshops/completed/data-visualization-with-r/`

Name of the Program:	BTECH CSE-AI&ML	Semester: 6	Level: UG
Course Name:	Data Visualization Tools Lab	Course Code/ Course Type	UBTML338/PEC
Course Pattern:	2026	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical/ Oral
-	1	-	1	2	25	-	25

Pre-Requisite:

1. Computer Network

Course Objectives (CO):	**The objectives of Data Visualization Tools Lab are:** 1. To recall the concepts of NumPy operations 2. To recognize and explore pandas libraries. 3. To apply the concept data visualization using tableau. 4. To analyze and design features animations techniques. 5. To evaluate various principles of visualization.
Course Learning Outcomes (CLO):	**Students would be able to:** 1. Students will be able to understand the basics of numpy and pandas techniques. 2. Elaborate the procedure of various data visualization methods. 3. Apply knowledge of web scrapping. 4. Analyze data the various dashboard attributes. 5. Evaluate how to perform data visualization using tableau.

Practical Plan:

Practical Number	Practical Title	Week Number	Details	CLO	Hours
1	Numpy and Pandas	1,2	1. Creating a NumPy Array 2. The Shape and Reshaping of NumPy Array 3. Expanding and Squeezing a NumPy Array 4. Indexing and Slicing of NumPy Array	CLO1	4
2	Numpy and Pandas	3,4	1. Perform following operations using pandas. 2. Perform following operations using pandas. 3. Read the following file formats using pandas. 4. Read the following file formats.	CLO1	4
3	Discussion of workflow Exploratory Visualization	5,6	1. Data Joins 2. Creating visualizations with Tableau.	CLO2	4

4	Discussion of workflow Exploratory Visualization	7,8	1. Sorting, Top N, bottom N 2. Filtering Maps	CLO2	4
5	Web Scraping	9	Demonstrate web scraping using python	CLO3	2
6	Dashboard development & Tableau	10,11	1. Dashboard design principles 2. Dashboard interactivity 3. Connected "drill-down" dashboards	CLO4	4
7	Dashboard development & Tableau	12,13	1. Datasets exploration using tableau. 2. Fiscal Year Calculations and Parameter explorations	CLO5	4

Learning Resources:

Text Books:

1. McKinney, W.(2017). Python for Data Analysis: Data Wrangling with Pandas, NumPy and IPython. 2nd edition. O'Reilly Media.
2. O'Neil, C., & Schutt, R. (2013). Doing Data Science: Straight Talk from the Frontline O'Reilly Media.
3. Tamara Munzner, Visualization Analysis and Design, A K Peters Visualization Series, CRC Press, 2014.

Reference Books:

1. Scott Murray, Interactive Data Visualization for the Web, O'Reilly, 2013.
2. Alberto Cairo, The Functional Art: An Introduction to Information Graphics and Visualization, New Riders, 2012.
3. Nathan Yau, Visualize This: The FlowingData Guide to Design, Visualization and Statistics, John Wiley & Sons, 2011.

Online Resources/E-learning Resources:

1. Free Video Lectures: NPTEL – Introduction to Learning Analytics
   `https://freevideolectures.com/course/4041/nptel-introduction-to-learning-analytics/11`
2. NPTEL Course: Data Visualization – IIT Roorkee
   `https://nptel.ac.in/courses/111106415`
3. NPTEL IIT Workshop: Data Visualization with R (Completed)
   `https://elearn.nptel.ac.in/shop/iit-workshops/completed/data-visualization-with-r/`

Name of the Program:	BTECH CSE-AI&ML	Semester: 6	Level: UG
Course Name:	Soft Computing	Course Code/ Course Type	UBTML339/PEC
Course Pattern:	2026	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical/ Oral
3	-	-	3	3	40	60	-

Pre-Requisite:

1. Machine Learning Fundamentals and Neural Network.

Course Objectives (CO):	**The objectives of Soft Computing are:** 1. To introduce the fundamental concepts of Soft Computing. 2. To explore Fuzzy Logic, Neural Networks, and Genetic Algorithms. 3. To implement the Genetic Algorithms. 4. To apply Soft Computing techniques for solving real-world problems. 5. To understand hybrid systems involving fuzzy, neural, and evolutionary components
Course Learning Outcomes (CLO):	**Students would be able to:** 1. Understand the basic concepts and techniques of soft computing. 2. Apply fuzzy logic and reasoning to handle uncertainty and imprecision. 3. Analyze and implement neural networks for classification and prediction. 4. Understand and apply genetic algorithms for optimization problems. 5. Design hybrid soft computing systems for specific applications.

Course Contents/Syllabus:

Descriptors/Topics	CLO	Hours
UNIT I: Introduction to Soft Computing		
Definition and need for Soft Computing, Evolution of Soft Computing, Comparison between Hard Computing and Soft Computing. Components of Soft Computing: Fuzzy Logic, Neural Networks, Genetic Algorithms, Evolutionary Computing, Probabilistic Reasoning. Characteristics and advantages. Real-life applications in control systems, pattern recognition, robotics, business intelligence, and expert systems. Overview of hybrid approaches and industry use cases. Tools and environments (MATLAB/Octave/Python libraries).	**CLO 1**	**9**
UNIT II: Fuzzy Logic and Systems		
Crisp sets vs Fuzzy sets, Classical logic vs Fuzzy logic. Properties of fuzzy sets: support, height, alpha-cuts, normalization. Membership functions: triangular, trapezoidal, Gaussian, etc. Fuzzy set operations: union, intersection, complement. Fuzzy relations and fuzzy arithmetic. Linguistic variables and fuzzy if-then rules. Fuzzy reasoning and rule base construction. Fuzzy inference systems: Mamdani and Sugeno types. Defuzzification methods: centroid, bisector, mean of maxima. Applications in control systems, washing machines, and decision-making systems.	**CLO 2**	**9**

UNIT III: Artificial Neural Networks		
Introduction to biological neuron and artificial neuron. Perceptron and its learning rule, limitations. Multilayer Perceptron (MLP), architecture and training. Backpropagation algorithm: derivation, implementation, convergence. Activation functions: sigmoid, tanh, ReLU. Supervised vs unsupervised learning. Kohonen Self-Organizing Maps (SOM): training and visualization. Radial Basis Function (RBF) networks. Comparative advantages of different architectures. Real-world applications in classification, regression, and clustering.	**CLO 3**	**9**
UNIT IV: Genetic Algorithms and Evolutionary Computation		
Introduction to optimization and search techniques. Fundamentals of Genetic Algorithms (GA): inspiration from natural selection. Representation of chromosomes and gene encoding methods. Fitness function design. Selection techniques: roulette wheel, tournament, rank selection. Crossover techniques: single-point, two-point, uniform crossover. Mutation operations: bit-flip, swap, inversion. Elitism and replacement strategies. GA parameters tuning. Applications of GA in function optimization, feature selection, scheduling, and design automation. Limitations and enhancements.	**CLO 4**	**9**
UNIT V: Hybrid Systems and Applications		
Concept of hybrid systems: need and advantages. Neuro-Fuzzy Systems: architecture, learning, and application scenarios. Genetic-Fuzzy Systems: rule optimization, membership function tuning using GA. Integration of neural networks and evolutionary algorithms. Case studies: washing machine control, medical diagnosis, traffic light control, stock market prediction, and robotic navigation. Implementation using MATLAB/Simulink or Python-based toolkits (scikit-fuzzy, TensorFlow, DEAP). Future trends and scope in soft computing and hybrid AI.	**CLO 5**	**9**
Total Hours		**45**

Learning Resources:

Text Books:

1. S. Rajasekaran and G. A. Vijayalakshmi Pai, *Neural Networks, Fuzzy Logic, and Genetic Algorithms*, PHI.
2. J.S.R. Jang, C.T. Sun, E. Mizutani, *Neuro-Fuzzy and Soft Computing*, Pearson Education.
3. Timothy J. Ross, *Fuzzy Logic with Engineering Applications*, 4th Edition, Wiley.

Reference Books:

1. Timothy J. Ross, Fuzzy Logic with Engineering Applications, Wiley.
2. David E. Goldberg, Genetic Algorithms in Search, Optimization and Machine Learning, Addison Wesley.
3. Simon Haykin, Neural Networks: A Comprehensive Foundation, Pearson Education.

Online Resources/E-learning Resources:

1. NPTEL: Soft Computing by Prof. S. Sengupta – IIT Kharagpur
   `https://nptel.ac.in/courses/117105084`
2. GeeksforGeeks: Introduction to Soft Computing – Article Series
   `https://www.geeksforgeeks.org/introduction-to-soft-computing/`

Name of the Program:	BTECH CSE-AI&ML	Semester: 6	Level: UG
Course Name:	Soft Computing Lab	Course Code/ Course Type	UBTML340/PEC
Course Pattern:	2026	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical/ Oral
-	1	-	1	2	25	-	25

Pre-Requisite:

1. Machine Learning Fundamentals and Neural Network.

Course Objectives (CO):	**The objectives of Soft Computing Lab are:** 1. Understand basic tools and techniques used in soft computing. 2. Design fuzzy logic systems for real-world applications. 3. To implement artificial neural networks for data classification and regression tasks. 4. To apply genetic algorithms for solving optimization problems. 5. To integrate fuzzy logic and neural networks to develop adaptive intelligent systems
Course Learning Outcomes (CLO):	**Students would be able to:** 1. Demonstrate proficiency in MATLAB/Python for soft computing-related tasks. 2. Develop fuzzy logic-based solutions for uncertain and imprecise data. 3. Apply neural network algorithms to solve classification problems. 4. Construct genetic algorithm models for finding near-optimal solutions. 5. Combine fuzzy logic and neural networks to implement hybrid systems like ANFIS.

Practical Plan:

Practical Number	Practical Title	Week Number	Details	CLO	Hours
1	Introduction to MATLAB/NumPy for Soft Computing	1	Basics of MATLAB or Python NumPy, plotting functions, and matrix operations	CLO1	2
2	Fuzzy Logic System Implementation	2	Design a fuzzy inference system using fuzzification, rules, and defuzzification in MATLAB/Python	CLO2	2
3	Neural Networks using Backpropagation	3	Implement a feedforward neural network and backpropagation algorithm for pattern recognition	CLO3	2
4	Genetic Algorithm Implementation	4	Develop a GA to solve an optimization problem using crossover, mutation, and fitness function	CLO4	2
5	Neuro-Fuzzy System	5	Build a hybrid neuro-fuzzy inference system using ANFIS in MATLAB or Python	CLO5	2
6	Optimization using Particle Swarm Optimization (PSO)	6	Implement PSO to solve a mathematical optimization problem in Python or MATLAB.	CLO4	2

7	Clustering using Self-Organizing Maps (SOM)	7	Use SOM to perform unsupervised clustering on a given dataset.	CLO3	2
8	Implementation of Fuzzy C-Means Clustering	8	Apply fuzzy C-means for clustering and compare it with k-means.	CLO2	2
9	Hybrid Systems: Genetic Algorithm with Neural Networks	9	Train a neural network using GA for improved convergence.	CLO5	2
10	Mini Project: Soft Computing Based Application	10,11	Develop a mini project using any soft computing technique on real-world data.	CLO5	4

Learning Resources:

Text Books:

1. S. Rajasekaran and G. A. Vijayalakshmi Pai, *Neural Networks, Fuzzy Logic, and Genetic Algorithms*, PHI.
2. J.S.R. Jang, C.T. Sun, E. Mizutani, *Neuro-Fuzzy and Soft Computing*, Pearson Education.
3. Timothy J. Ross, *Fuzzy Logic with Engineering Applications*, 4th Edition, Wiley.

Reference Books:

1. Timothy J. Ross, Fuzzy Logic with Engineering Applications, Wiley.
2. David E. Goldberg, Genetic Algorithms in Search, Optimization and Machine Learning, Addison Wesley.
3. Simon Haykin, Neural Networks: A Comprehensive Foundation, Pearson Education.

Online Resources/E-learning Resources:

1. NPTEL: Soft Computing by Prof. S. Sengupta – IIT Kharagpur
   `https://nptel.ac.in/courses/117105084`
2. GeeksforGeeks: Introduction to Soft Computing – Article Series
   `https://www.geeksforgeeks.org/introduction-to-soft-computing/`

Name of the Program:	BTECH CSE-AI&ML	Semester: 6	Level: UG
Course Name:	Foundation of Big Data	Course Code/ Course Type	UBTML341/PEC
Course Pattern:	2026	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical/ Oral
3	-	-	3	3	40	60	-

Pre-Requisite:

1. Basic understanding of project management concepts and terminology.
2. Computer Skills, Mathematics or Statistics

Course Objectives (CO):	**The objectives of Foundation of Big Data are:** 1. Define key concepts and technologies in big data analytics, including Hadoop, NoSQL databases, and machine learning algorithms. 2. Implement and configure Hadoop for distributed data processing. 3. Evaluate the performance of different big data processing tools through comparative experiments. 4. Analyze the security and privacy implications of big data analytics. 5. Design and implement a data processing workflow using orchestration tools like Apache Airflow.
Course Learning Outcomes (CLO):	**Students would be able to:** 1. Articulate fundamental concepts in big data analytics and apply them to practical scenarios. 2. Gain hands-on experience in configuring and using big data tools for data processing. 3. Analyze and compare the performance of various big data processing tools. 4. Create solutions for real-world problems using big data analytics techniques. 5. Evaluate the ethical considerations and challenges in big data analytics.

Course Contents/Syllabus:

Descriptors/Topics	CLO	Hours
UNIT I: Introduction to Big Data		
Explanation of what constitutes big data, Key features that distinguish big data from traditional data and Characteristics of Big Data, Overview of the 3Vs: Volume, Velocity, Variety. Examples of big data applications in various industries, Importance and Applications of Big Data Analytics, Role of big data in decision-making, Overview of Big Data Technologies and Tools, Introduction to Hadoop, Apache Spark, and other frameworks, Comparison of batch and real-time processing.	**CLO 1**	**9**

UNIT II: Data Processing and Management		
Introduction to Hadoop and MapReduce, Hadoop ecosystem components (HDFS, MapReduce). Hands-on exercises on Hadoop setup and basic MapReduce programs, Data Storage and Retrieval in Distributed Systems. Distributed file systems and their advantages. Data storage strategies in distributed environments. NoSQL Databases in Big Data Analytics. Types of NoSQL databases (document, key-value, column-family, graph). Use cases and considerations for selecting NoSQL databases.	**CLO 2**	**9**
UNIT III: Data Analysis Techniques		
Exploratory Data Analysis (EDA): Data visualization techniques (scatter plots, histograms, etc.), Summary statistics and data profiling. Statistical Methods for Data Analysis: Hypothesis testing and confidence intervals, Regression analysis and correlation. Machine Learning Algorithms for Big Data: Overview of machine learning concepts, Application of machine learning in big data analytics.	**CLO 3**	**9**
UNIT IV: Big Data Tools and Platforms		
Overview of Big Data Analytics Tools: Apache Spark and its ecosystem, Apache Flink for stream processing, Comparison of various big data tools. Integration of Tools into the Analytics Workflow: Building end-to-end big data processing pipelines, Data workflow orchestration and management. Hands-on Exercises with Selected Tools: Practical sessions using Apache Spark for data processing, Real-world examples of big data applications.	**CLO 4**	**9**
UNIT V: Ethical Considerations in Big Data Analytics		
Privacy and Security Issues in Big Data: Risks associated with large-scale data collection and storage. Strategies for ensuring data privacy and security. Ethical Considerations in Data Collection and Usage: Responsible data handling practices, Regulatory compliance and legal aspects.	**CLO 5**	**9**
Total Hours		**45**

Learning Resources:

Text Books:

1. Thomas Erl, Wajid Khattak, Paul Buhler, *Big Data Fundamentals: Concepts, Drivers Techniques*, Pearson (The Service Technology Series).
2. V. Bhuvaneswari, J. Karthikeyan, *Big Data: A Beginner's Guide to Data Science*, CRC Press, ISBN: 9781032405014.
3. Seema Acharya, Subhashini Chellappan, *Big Data and Analytics*, Wiley India, ISBN: 9788126554782.

Reference Books:

1. Big Data Analytics: A Practical Guide for Managers by Arvind Sathi.
2. Hadoop: The Definitive Guide by Tom White.
3. Data Science for Business by Foster Provost and Tom Fawcett.
4. Big Data: A Revolution That Will Transform How We Live, Work, and Think by Viktor Mayer-Schönberger and Kenneth Cukier.

Online Resources/E-learning Resources:

1. https://nptel.ac.in/courses/106104189
2. https://www.coursera.org/specializations/big-data
3. https://www.edx.org/professional-certificate/uc-san-diegox-big-data

Name of the Program:	BTECH CSE-AI&ML	Semester: 6	Level: UG
Course Name:	Foundation of Big Data Lab	Course Code/ Course Type	UBTML342/PEC
Course Pattern:	2026	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical/ Oral
-	1	-	1	2	25	-	25

Pre-Requisite:

1. Knowledge in JAVA programming
2. Understanding of DBMS
3. Knowledge of Computer Networks

Course Objectives (CO):	**The objectives of Foundation of Big Data Lab are:** 1. To develop understanding of Big Data concepts. 2. To implement and analyze various algorithms used in big data analytics. 3. To apply big data applications to handle large-scale datasets efficiently. 4. To develop problem-solving skills by challenging students with complex scenarios. 5. To apply big data analytics techniques to derive meaningful insights.
Course Learning Outcomes (CLO):	**Students would be able to:** 1. Demonstrate proficiency in using big data analytics tools such as Hadoop, Spark, and associated frameworks. 2. Develop programming skills in languages commonly used in big data analytics, such as Java, Python, or Scala. 3. Process and analyze large datasets efficiently using distributed computing frameworks. 4. Create effective data visualizations to communicate insights derived from big data analytics. 5. Implement and evaluate various algorithms used in big data analytics, including machine learning algorithms.

Practical Plan:

Practical Number	Practical Title	Week Number	Details	CLO	Hours
1	Hadoop Setup and Simple MapReduce	1	Install and configure Hadoop on a local machine or small cluster. Create a simple MapReduce program to analyze sample data.	CLO1	2
2	NoSQL Database Implementation	2	Explore NoSQL databases. Install MongoDB or Cassandra. Create a schema for a specific use case and perform CRUD operations.	CLO2	2
3	Exploratory Data Analysis (EDA) with Python/R	3	Use Python (Pandas, Matplotlib) or R for EDA. Generate plots and summary statistics for a dataset.	CLO3	2
4	Machine Learning for Big Data	4	Apply ML algorithms to big data. Use classification or regression for a selected dataset.	CLO4	2

5	Big Data Processing with Apache Spark	5	Setup Spark cluster. Use Spark RDDs/DataFrames for transformations and actions on large datasets. Evaluate regression/classification model.	CLO5	2
6	Data Security and Privacy Assessment	6, 7	Identify data security risks. Implement privacy-preserving measures for sensitive big data.	CLO5	4
7	Real-world Big Data Application Development	8, 9	Identify a real-world problem. Implement and present a solution using big data tools.	CLO5	4
8	Comparative Analysis of Big Data Tools	10, 11, 12	Compare tools (e.g., Spark, Flink) based on speed, resource usage, scalability for a specific task.	CLO5	6

Learning Resources:

Text Books:

1. Big Data Fundamentals: Concepts, Drivers & Techniques (The Pearson Service Technology Series from Thomas Erl) by Thomas Erl, Wajid Khattak, Paul Buhler.
2. Principles of Big Data: Preparing, Sharing, and Analyzing Complex Information by Jules J. Berman.
3. Data Analytics Made Accessible by Anil Maheshwari.

Reference Books:

1. Big Data Analytics: A Practical Guide for Managers by Arvind Sathi.
2. Hadoop: The Definitive Guide by Tom White.
3. Data Science for Business by Foster Provost and Tom Fawcett.
4. Big Data: A Revolution That Will Transform How We Live, Work, and Think by Viktor Mayer-Schönberger and Kenneth Cukier.

Online Resources/E-learning Resources:

1. https://nptel.ac.in/courses/106104189
2. https://www.coursera.org/specializations/big-data
3. https://www.edx.org/learn/big-data

Name of the Program:	BTECH CSE-AI&ML	Semester: 6	Level: UG
Course Name:	Data Visualization using Tableau and R	Course Code/ Course Type	MOOCML602/PCC
Course Pattern:	2026	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical/ Oral
-	-	2	2	2	50	-	-

Pre-Requisite:

1. Fundamental knowledge of data analysis and statistics.
2. Basic programming experience in R or Python.

Course Objectives (CO):	**The objectives of Data Visualization using Tableau and R are:** 1. To introduce the principles and best practices of data visualization. 2. To explore data visualization techniques using Tableau. 3. To develop proficiency in data visualization using R libraries. 4. To enable students to analyze and interpret data through effective visual storytelling. 5. To apply visualization tools for real-world datasets across diverse domains.
Course Learning Outcomes (CLO):	**Students would be able to:** 1. Apply the principles of data visualization to communicate insights effectively. 2. Create interactive dashboards and visualizations using Tableau. 3. Use R libraries such as ggplot2, plotly, and shiny for building customized visuals. 4. Analyze datasets and interpret patterns through visual exploration. 5. Present data-driven stories for informed decision-making.

Course Contents/Syllabus:

Descriptors/Topics	CLO	Hours
UNIT I		
Introduction to Data Visualization: Importance, principles of visual perception, types of data (categorical, numerical, time-series), types of charts, overview of visualization tools.	CLO1	6
UNIT II		
Getting Started with Tableau: Tableau interface and architecture, connecting to data sources, creating basic charts (bar, line, pie, scatter), filters and groups, calculated fields.	CLO2	6
UNIT III		
Advanced Tableau Techniques: Dashboards, story points, map visualizations, parameter controls, data blending, Level of Detail (LOD) expressions, case studies.	CLO2	6
UNIT IV		
Data Visualization using R: Introduction to ggplot2, data wrangling with dplyr, interactive plots with plotly, building dashboards with shiny.	CLO3	6

UNIT V		
Case Studies and Capstone: Real-world visualization projects using Tableau and R, combining insights, visual storytelling, presentation and critique.	CLO4, CLO5	6
Total Hours		**30**

Learning Resources:

Text Books:

1. "Data Visualization: A Practical Introduction" by Kieran Healy.
2. "Learning Tableau" by Joshua N. Milligan.

Reference Books:

1. "Interactive Data Visualization for the Web" by Scott Murray.
2. "R Graphics Cookbook" by Winston Chang.
3. "The Big Book of Dashboards" by Steve Wexler, Jeffrey Shaffer, and Andy Cotgreave.
4. "Mastering Shiny" by Hadley Wickham.

Online Resources/E-learning Resources:

1. `https://public.tableau.com/en-us/s/resources` – Tableau Public Learning Resources.
2. `https://r4ds.had.co.nz/` – R for Data Science: ggplot2 and data visualization.
3. `https://www.coursera.org/learn/data-visualization` – Coursera: Data Visualization with Tableau by University of California Davis.

Name of the Program:	Foreign Language	Semester: 6	Level: UG/PG
Course Name:	German A2.2	Course Code/ Course Type	UFL302 A/AEC
Course Pattern:	2026	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical/ Oral
2	-	-	-	2	-	-	-

Pre-Requisite:

1. Can use simple means to describe the things related to immediate needs.

Course Objectives (CO):	**The objectives of German A2.2 are:** 1. To understand the main points when the standard language is used. 2. Describe dreams, goals and hopes. 3. To implement the acquired grammar topics. 4. To deal with most situations typically encountered in the language region. 5. To design and create texts in the areas of personal interest.
Course Learning Outcomes (CLO):	**Students would be able to:** 1. Comprehend advanced vocabulary terms. 2. Enhance expression skills in German language. 3. Enhance professional speaking skills of German language. 4. Construct short statements justifying own views and plans. 5. Take part in interactions associated with the topics such as work, school, leisure time, travelling, etc.

Course Contents/Syllabus:

Descriptors/Topics	CLO	Hours
UNIT I		
Gelernt ist gelernt: Different learning problems, exams and presentations. Grammar – KII, Genitive.	CLO1	6
UNIT II		
Sportlich sportlich: Different sport activities, connection between sport and different emotions. Grammar – deshalb and trotzdem.	CLO2	6
UNIT III		
Zusammen leben: Conflicts in an apartment, living in different types and living with pets. Grammar – Connectors (als and wenn).	CLO3	6
UNIT IV		
Gute Unterhaltung: Describe a picture, discussion on different music styles. Grammar – Interrogative articles.	CLO4	6
UNIT V		
Wie die Zeit vergeht! & Typisch, oder?: Express different wishes, write a story, speak about proverbs and clichés. Grammar – Relative sentences.	CLO5	6
Total Hours		**30**

Learning Resources:

Text Books:

1. Netzwerk A1, Ernst Klett Verlag Goyal Publishers Distributors Pvt. Ltd.
2. Studio d A1, Cornelsen Verlag Goyal Publishers Distributors Pvt. Ltd.
3. Netzwerk Neu A1, Ernst Klett Verlag Goyal Publishers Distributors Pvt. Ltd.

Reference Books:

1. Hallo Deutsch A1, Ernst Klett Verlag, Goyal Publishers & Distributors Pvt. Ltd.
2. Themen Aktuell 1, Hueber Verlag.
3. Maximal, Ernst Klett Verlag & Goyal Publishers & Distributors Pvt. Ltd.

Online Resources/E-learning Resources:

1. https://youtube.com/@LearnGermanwithAnja?si=BkJYDPi7TS0fT4lr
2. https://youtube.com/@deutschlernenmitheidi?si=TkICIabzioaU0roZ
3. https://instagram.com/learngermanwithanja

Name of the Program:	Foreign Language	Semester: 6	Level: UG/PG
Course Name:	Basic Japanese language skill	Course Code/ Course Type	UFL302B/VSEC
Course Pattern:	2026	Version	1.0
Assessment Scheme		Teaching Scheme	

Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical/ Oral
2	-	-	-	2	-	-	-

Pre-Requisite:

1. Desire to get acquainted with the Japanese language. Basic knowledge of Hiragana and Katakana. Reading and writing Japanese script with basic kanji. Basic conversation

Course Objectives (CO):	**The objectives of Basic Japanese language skill are:** 1. To meet the needs of ever-growing industry with respect to language support. 2. Access Global Job Opportunities with Language Skills. 3. Expand cognitive abilities and adaptability through language learning. 4. Promote cultural awareness and inclusivity through language acquisition. 5. To engage in cross-cultural dialogue and experiences through participation in curricular, co-curricular, and/or study abroad programs.
Course Learning Outcomes (CLO):	**Students would be able to:** 1. Acquire communicative proficiency / confidence . 2. Express your thoughts / desires in writing . 3. Read / Understand the Language script. 4. Develop listening skills . 5. Inter cultural awareness

Course Contents/Syllabus:

Descriptors/Topics	CLO	Hours
UNIT I		
Minna no Nihongo lesson no. 14 Te / Ta /Nai forms of verbs	**CLO 1**	**6**
UNIT II		
Minna no Nihongo lesson no. 15 Te forms of verbs /usage of te form	**CLO 2**	**6**
UNIT III		
Minna no Nihongo lesson no. 16 Adjective conjugation	**CLO 3**	**6**
UNIT IV		
Minna no Nihongo lesson no. 17 Verbs Nai forms	**CLO 4**	**6**
UNIT V		
Revision and Conversation practice	**CLO 5**	**6**
Total Hours		**30**

Learning Resources:

Text Books:

1. Minna no Nihongo , " Japanese for everyone" ,Elementary Main Textbook , Goyal Publishers and Distributors Pvt. Ltd

Reference Books:

1. Shyoho Volume 1
2. Genki Japan
3. Haru Vol. 1 and 2

Online Resources/E-learning Resources:

1. https://www.youtube.com/watch?v=T3hC03n-qWU
2. https://www.youtube.com/watch?v=T3hC03n-qWU
3. https://www.youtube.com/watch?v=vWUFZ4Z2F4c

Name of the Program:	BTECH CSE-AI&ML	Semester: 6	Level: UG
Course Name:	Career Readiness and Placement Preparation / Professional Ethics	Course Code/ Course Type	ACLR301 / ACCEVS301 / AEC
Course Pattern:	2026	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA	ESA	Practical/ Oral
-	2	-	2	4	50	-	-

Pre-Requisite:

1. Basic communication skills in English and willingness to participate in interactive placement activities
2. Basic knowledge of programming, data structures, databases, operating systems, computer networks, and core technical subjects
3. Awareness about resume writing, professional behaviour, teamwork, and workplace discipline
4. Readiness to participate in aptitude tests, group discussions, personal interviews, technical interviews, and mock placement drives

Course Objectives (CO):	**The objectives of this course are:** 1. To prepare students for campus placement processes including aptitude test, technical interview, HR interview, personal interview, and group discussion. 2. To develop resume writing, professional communication, self-introduction, presentation, and interview-facing skills. 3. To strengthen placement-oriented technical readiness through coding practice, core subject revision, project explanation, and problem-solving discussion. 4. To build confidence, teamwork, leadership, professional ethics, workplace discipline, and employability-oriented personality traits. 5. To enable students to participate effectively in mock placement drives and prepare a complete placement readiness portfolio.
Course Learning Outcomes (CLO):	**Students would be able to:** 1. Prepare an effective resume, professional profile, self-introduction, and placement portfolio. 2. Demonstrate aptitude, reasoning, verbal ability, coding, and technical problem-solving skills required for campus placements. 3. Participate confidently in group discussions, personal interviews, HR interviews, and technical interviews. 4. Explain academic projects, internships, certifications, technical skills, and achievements in a professional manner. 5. Demonstrate professional ethics, workplace behaviour, communication etiquette, teamwork, and interview readiness.

Course Contents / Activity Guidelines:

Activities / Guidelines	CLO	Hours
Guideline I – Career Readiness, Resume Building, and Professional Profile Development		
Career Orientation and Profile Preparation: Introduction to campus placement process, company selection process, eligibility criteria, job roles for CSE-AI&ML students, resume structure, ATS-friendly resume writing, cover letter, LinkedIn profile, GitHub profile, portfolio preparation, project documentation, certification presentation, professional email writing, self-introduction, elevator pitch, and grooming for placement activities.	CLO 1	6

Guideline II – Aptitude, Verbal Ability, and Logical Reasoning for Placement		
Placement Aptitude Preparation: Quantitative aptitude topics including percentages, profit and loss, ratio and proportion, time and work, time-speed-distance, averages, probability, permutations and combinations, and basic data interpretation. Logical reasoning topics including series, coding-decoding, blood relations, directions, seating arrangement, syllogism, puzzles, and analytical reasoning. Verbal ability topics including grammar, sentence correction, reading comprehension, vocabulary, para-jumbles, and verbal reasoning.	**CLO 2**	**6**
Guideline III – Technical Interview and Coding Readiness		
Technical Interview Preparation: Technical revision for placement covering programming fundamentals, object-oriented programming, data structures, algorithms, database management systems, operating systems, computer networks, software engineering, AI/ML basics, and web/database project concepts. Coding readiness through problem solving on arrays, strings, recursion, searching, sorting, linked lists, stacks, queues, trees, graphs, hashing, SQL queries, debugging, code explanation, time complexity, and space complexity. Preparation for project-based technical questions, internship explanation, certification-based questions, and real-time problem-solving discussions.	**CLO 2, CLO 4**	**6**
Guideline IV – Group Discussion, Personal Interview, and HR Interview		
GD, PI, and HR Preparation: Group discussion objectives, types of GD, current affairs-based GD, abstract topic GD, case-based GD, do's and don'ts of GD, opening and concluding a GD, leadership in GD, active listening, structured argumentation, respectful disagreement, body language, voice modulation, and teamwork. Personal interview preparation including self-introduction, strengths and weaknesses, career goals, academic background, project explanation, gap justification, internship discussion, achievements, failure handling, situational questions, behavioural questions, salary and relocation discussion, and HR interview etiquette.	**CLO 3, CLO 5**	**6**
Guideline V – Mock Placement Drive, Professional Ethics, and Workplace Readiness		
Mock Drive and Professional Ethics: Complete mock placement process including resume screening, aptitude test, coding test, group discussion, technical interview, personal interview, HR interview, and feedback session. Professional ethics, workplace behaviour, integrity, punctuality, accountability, confidentiality, email etiquette, meeting etiquette, teamwork, conflict management, diversity and inclusion, responsible use of AI tools, plagiarism avoidance, cybersecurity awareness at workplace, professional conduct during internships, and preparation of final placement readiness portfolio.	**CLO 3, CLO 4, CLO 5**	**6**
Total Hours		**30**

Assessment Guidelines (CIA - 50 Marks):

1. Resume, LinkedIn/GitHub Profile, and Placement Portfolio: 10 Marks
2. Aptitude / Reasoning / Verbal Ability Test: 10 Marks
3. Technical Interview / Coding Test / Core Subject Viva: 10 Marks
4. Group Discussion and Personal Interview Performance: 10 Marks
5. Mock Placement Drive, Professional Ethics, Attendance, and Participation: 10 Marks

Indicative Evaluation Rubrics:

Evaluation Component	Expected Evidence	Marks
Resume and Professional Profile	Resume, LinkedIn/GitHub profile, project portfolio, self-introduction, and career objective clarity	**10**
Aptitude and Verbal Readiness	Performance in quantitative aptitude, logical reasoning, verbal ability, and reading comprehension test	**10**

Technical Readiness	Coding test, technical viva, core subject knowledge, project explanation, SQL/query practice, and debugging ability	**10**
GD, PI, and HR Interview	Communication, confidence, body language, structured thinking, listening skills, professional answers, and interview etiquette	**10**
Mock Drive and Professional Ethics	Participation in complete mock placement process, punctuality, workplace ethics, feedback improvement, and overall readiness	**10**

Suggested Activities / Modes of Implementation:

1. Resume writing workshop and individual resume review
2. LinkedIn, GitHub, portfolio, and project profile building activity
3. Weekly aptitude, reasoning, and verbal ability practice test
4. Coding test practice using arrays, strings, recursion, SQL, and data structures
5. Technical interview preparation from core subjects and academic projects
6. Group discussion practice on current affairs, abstract topics, and case studies
7. Personal interview and HR interview mock practice
8. Professional ethics, workplace behaviour, and corporate communication activity
9. Complete mock placement drive with feedback and improvement report
10. Final placement readiness portfolio submission

Suggested GD Topics:

1. Artificial Intelligence: Opportunity or Threat?
2. Work from Home versus Work from Office
3. Impact of Social Media on Youth
4. Digital India and Rural Transformation
5. Data Privacy in the Age of AI
6. Is Coding Still Important in the AI Era?
7. Start-up Culture among Engineering Students
8. Cybersecurity Awareness for Common Citizens
9. Automation and Future Employment
10. Ethics of Using Generative AI in Education

Suggested Technical Interview Areas:

1. Programming fundamentals, OOP concepts, exception handling, and file handling
2. Data structures: arrays, strings, linked lists, stacks, queues, trees, graphs, and hashing
3. Algorithms: searching, sorting, recursion, greedy approach, dynamic programming basics, and complexity analysis
4. DBMS: SQL queries, normalization, keys, joins, transactions, indexing, and ER diagrams

5. Operating systems: process, thread, scheduling, memory management, deadlock, and file system basics
6. Computer networks: OSI model, TCP/IP, IP addressing, DNS, HTTP/HTTPS, routing, and network security basics
7. Software engineering: SDLC, testing, agile, version control, Git, and project documentation
8. AI/ML basics: supervised learning, unsupervised learning, classification, regression, clustering, model evaluation, and overfitting
9. Web and database projects: frontend, backend, API, database connectivity, authentication, and deployment basics
10. Academic project explanation: problem statement, architecture, tools used, individual contribution, challenges, and future scope

Learning Resources:

Reference Books / Reading Material:

1. Aggarwal, R. S., *Quantitative Aptitude for Competitive Examinations*, S. Chand Publishing.
2. Aggarwal, R. S., *A Modern Approach to Verbal and Non-Verbal Reasoning*, S. Chand Publishing.
3. Sinha, A. K., *The Art of Placement Preparation*, selected placement training material.
4. Robbins, S. P. and Judge, T. A., *Organizational Behavior*, Pearson.
5. Selected company-specific placement papers, HR interview question banks, technical interview notes, and coding practice material.

Online Resources / E-learning Resources:

1. NPTEL / SWAYAM: Soft Skills.
2. NPTEL / SWAYAM: Employment Communication: A Lab Based Course.
3. SWAYAM / SWAYAM Plus employability and career skills courses.
4. Open coding platforms for practice in programming, SQL, data structures, and algorithms.
5. Company placement preparation resources, previous placement papers, and mock interview practice platforms.

Note:

1. This course shall be conducted as a placement-oriented activity course with active participation in tests, GDs, interviews, and mock placement drives.
2. The course may be supported by T&P Cell, department placement coordinators, industry experts, alumni, and faculty mentors.
3. Students shall maintain a placement readiness portfolio containing resume, profile links, aptitude scores, coding practice evidence, interview feedback, and improvement plan.
4. Assessment shall be continuous and activity-based. Attendance, punctuality, professional conduct, and participation shall be considered for evaluation.
5. Students may be encouraged to complete relevant free online modules from NPTEL/SWAYAM and submit progress or completion evidence.

Name of the Program:	BTECH CSE-AI&ML	Semester: 6	Level: UG
Course Name:	Rural Immersion-II	Course Code/ Course Type	ACCRI401 / ACCRI402 / RI
Course Pattern:	2026	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA	ESA	Practical/ Oral
-	1	-	1	2	25	-	-

Pre-Requisite:

1. Successful completion of Rural Immersion-I or basic exposure to rural/community engagement activities
2. Basic understanding of survey, observation, community interaction, and problem identification
3. Ability to work in teams and willingness to design simple technology-enabled or socially relevant interventions

Course Objectives (CO):	**The objectives of Rural Immersion-II are:** 1. To enable students to revisit, validate, and analyze rural/community problems identified through field exposure. 2. To develop the ability to design feasible, low-cost, inclusive, and sustainable solutions for rural/community needs. 3. To encourage students to apply engineering, AI, digital tools, data collection methods, awareness models, and social innovation approaches in rural contexts. 4. To promote prototype development, campaign design, digital intervention, or action-plan preparation through departmental activities, IEEE, ACM, NSS, UBA, or similar platforms. 5. To enable students to evaluate, document, and present the social relevance, feasibility, and expected impact of rural intervention activities.
Course Learning Outcomes (CLO):	**Students would be able to:** 1. Analyze rural/community problems using field observations, stakeholder interaction, and basic need validation. 2. Apply basic data collection, digital tools, awareness methods, or participatory approaches for rural/community problem understanding. 3. Design a feasible solution, prototype, awareness campaign, digital support model, or implementation plan for a selected rural/community issue. 4. Demonstrate teamwork, ethical conduct, communication, and social responsibility while engaging with rural stakeholders. 5. Prepare an impact-oriented report and presentation reflecting problem analysis, intervention design, community feedback, and learning outcomes.

Activity Guidelines:

Activities / Guidelines	CLO	Hours
Guideline I – Review of Rural Immersion-I and Problem Validation		
Review and Validation of Community Issues: Students shall review the observations, survey outcomes, community interactions, and problem statements identified during Rural Immersion-I or earlier rural/community activities. The unit shall focus on revisiting selected problems, validating their relevance through stakeholder discussion, understanding root causes, identifying affected groups, and prioritizing issues based on feasibility, urgency, sustainability, and social impact.	**CLO 1**	**6**
Guideline II – Data Collection, Community Mapping, and Need Analysis		

Advanced Field Study and Need Analysis: Students shall conduct focused data collection through structured surveys, interviews, focus group discussion, institutional interaction, digital forms, community mapping, resource mapping, or observational study. The activity may include analysis of rural issues related to education, digital literacy, health awareness, agriculture, environment, water, sanitation, livelihood, women empowerment, cyber safety, financial literacy, or access to public services. Students shall summarize findings using simple tables, charts, maps, or problem trees.	**CLO 1, CLO 2**	**6**
Guideline III – Design of Rural Intervention / Technology-Enabled Solution		
Solution Design and Intervention Planning: Based on validated needs, students shall design a feasible rural/community intervention. The solution may be a low-cost technical prototype, mobile/web-based information support, AI-enabled awareness model, digital literacy module, cyber safety campaign, school learning aid, data management format, sustainability model, agricultural support idea, health/hygiene awareness plan, or community service initiative. The intervention shall consider affordability, usability, inclusiveness, language/local context, ethical concerns, and sustainability.	**CLO 2, CLO 3**	**6**
Guideline IV – Implementation, Demonstration, and Community Engagement		
Execution of Activity / Prototype / Campaign: Students shall implement, demonstrate, or pilot the proposed solution in a rural/community setting. The activity may include conducting an awareness session, technology demonstration, digital literacy workshop, school outreach, environmental activity, cyber safety drive, health or hygiene campaign, survey-based advisory, poster presentation, community discussion, prototype demonstration, or IEEE/ACM/NSS/UBA-supported outreach activity. Students shall collect basic feedback from participants, beneficiaries, teachers, local representatives, or community stakeholders.	**CLO 3, CLO 4**	**6**
Guideline V – Impact Assessment, Reflection, and Final Presentation		
Impact Documentation and Presentation: Students shall prepare a final report including problem background, need validation, methodology, data collected, solution/intervention design, implementation evidence, photographs, feedback, limitations, ethical considerations, sustainability scope, and future action plan. Students shall present their work through report submission, poster, PPT, viva, documentary, prototype demonstration, or community impact presentation. Emphasis shall be given to measurable learning, responsible citizenship, interdisciplinary thinking, and social innovation.	**CLO 5**	**6**
Total Hours		**30**

Suggested Activities / Modes of Implementation:

1. Revisit and validate a rural/community problem identified during Rural Immersion-I.
2. Conduct focused survey, stakeholder interview, focus group discussion, or community mapping.
3. Design a low-cost prototype, awareness module, digital literacy module, cyber safety module, or rural service support model.
4. Conduct activity through IEEE, ACM, NSS, Unnat Bharat Abhiyan, departmental clubs, student chapters, or extension cell.
5. Organize rural school outreach, digital literacy session, AI awareness session, cyber hygiene drive, health/hygiene awareness, environment awareness, or financial literacy activity.
6. Prepare simple digital tools such as Google Forms, awareness posters, QR-based resources, dashboards, local-language content, or basic mobile/web support pages.
7. Demonstrate a simple technical solution related to water, waste, agriculture, education, digital access, rural entrepreneurship, safety, or public service awareness.
8. Collect community feedback and prepare a future improvement plan.

9. Submit final report, poster, presentation, documentary, reflection diary, or prototype demonstration.

Assessment Guidelines (CIA - 25 Marks):

1. Problem Validation and Need Analysis: 05 Marks
2. Field Activity / Community Interaction / Data Collection: 05 Marks
3. Solution Design / Prototype / Intervention Planning: 05 Marks
4. Implementation, Demonstration, and Community Feedback: 05 Marks
5. Final Report, Presentation, Reflection, and Teamwork: 05 Marks

Indicative Evaluation Rubrics:

Evaluation Component	Expected Evidence	Marks
Problem Validation and Need Analysis	Clearly defined rural/community problem, stakeholder interaction, need validation, problem prioritization, and relevance to local context	**05**
Field Activity and Data Collection	Survey forms, interview notes, observation records, photographs, community mapping, or data summary	**05**
Solution Design / Prototype / Intervention	Feasible solution, campaign design, prototype, digital support model, awareness material, or action plan with sustainability consideration	**05**
Implementation and Feedback	Evidence of activity execution, participation, community engagement, feedback forms, beneficiary response, and teamwork	**05**
Report and Presentation	Final report, reflection, poster/PPT/viva, documentation quality, ethical considerations, limitations, and future scope	**05**

Suggested Problem Areas for Rural Immersion-II:

1. Digital literacy and online public service access in rural communities
2. Cyber safety awareness for rural students, women, farmers, and senior citizens
3. AI awareness and responsible use of digital tools for school students
4. Rural school education support using simple digital content or learning kits
5. Water conservation, sanitation, hygiene, and waste management awareness
6. Agriculture information support, weather awareness, market access, or advisory models
7. Women empowerment, financial literacy, self-help group digital support, or entrepreneurship awareness
8. Health, nutrition, hygiene, mental well-being, or preventive care awareness
9. Environment, sustainability, plantation, plastic reduction, and climate awareness
10. Local governance, government schemes awareness, and digital documentation support

Learning Resources:

Reference Books / Reading Material:

1. Selected reading material on rural development, social innovation, community engagement, participatory rural appraisal, and sustainable development.

2. Government reports, Gram Panchayat Development Plans, village development plans, and local self-governance documents.
3. Manuals and activity guidelines of IEEE, ACM, NSS, Unnat Bharat Abhiyan, and similar community engagement initiatives.
4. Selected case studies on rural technology interventions, digital literacy, social entrepreneurship, and community-based engineering solutions.

Online Resources / E-learning Resources:

1. Government portals related to rural development, Digital India, sanitation, sustainability, education, agriculture, and public services.
2. IEEE, ACM, NSS, and Unnat Bharat Abhiyan resources for student outreach and social responsibility activities.
3. Open educational resources related to community engagement, digital literacy, cyber hygiene, sustainable development goals, and rural innovation.
4. Local government websites, village-level public data sources, and community development resources for activity planning.

Note:

1. Rural Immersion-II should preferably be conducted as a continuation of Rural Immersion-I, where students move from rural exposure and problem identification to need validation, solution design, implementation, and impact documentation.
2. Activities may be individual or group-based, but the final evaluation shall consider individual participation, reflection, documentation, and contribution.
3. The activity shall be conducted with due care for ethics, consent, dignity of the community, cultural sensitivity, and responsible use of collected data.
4. The department may map this course with IEEE, ACM, NSS, UBA, extension activities, village adoption initiatives, school outreach, social innovation clubs, or rural entrepreneurship activities.

COURSE SYLLABUS

CSE - AI&ML

SEMESTER-VII

Name of the Program:	B.Tech. CSE-AI&ML	Semester: 7	Level: UG
Course Name:	Deep Learning	Course Code / Course Type	UBTML401
Course Pattern:	2026	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical/ Oral
3	-	-	3	3	40	60	-

Pre-Requisite:

1. Basics of Machine Learning
2. Python Programming Language

Course Objectives (CO):	**The objectives of Deep Learning are:** 1. Understand the fundamental principles of deep learning and the architecture of neural networks. 2. Apply convolutional neural networks (CNNs) for image and video processing tasks. 3. Analyze and implement recurrent and recursive neural network models, including LSTMs, for sequence modeling tasks. 4. Explore dimensionality reduction and representation learning using autoencoders and linear factor models. 5. Examine and implement deep generative models for unsupervised and semi-supervised learning tasks.
Course Learning Outcomes (CLO):	**Students would be able to:** 1. Explain the core concepts and architecture of neural networks. 2. Analyze and implement convolutional neural network (CNN) architectures. 3. Apply Recurrent Neural Networks (RNNs) and Long Short-Term Memory (LSTM) models to sequence data, and evaluate their performance. 4. Explore and implement linear factor models and autoencoders for dimensionality reduction, representation learning, and unsupervised learning tasks. 5. Examine and implement deep generative models including Restricted Boltzmann Machines.

Course Contents/Syllabus:

Descriptors/Topics	CLO	Hours
UNIT I		
Understanding Deep Learning and its application: Introduction to Deep Learning (DL), democratization of DL, neural networks overview, anatomy, and math, data representations, decision trees, random forests, boosting machines.	CLO1	9
UNIT II		
Convolutional Neural Networks (CNN): Supervised DL, convolution and pooling, Dropout, CNN architectures: LeNet, AlexNet, ZFNet, VGGNet, GoogleNet, ResNet, DenseNet.	CLO2	9

UNIT III		
RNNs and LSTMs: RNN architecture, forward/backward passes, training, BPTT, LSTM gates and cell, variants: peephole, coupled forget/input gates.	CLO3	9
UNIT IV		
Linear Factor Models and Autoencoders: Monte Carlo Methods, Stochastic Maximum Likelihood, Contrastive Divergence.	CLO4	9
UNIT V		
Deep Generative Models: Boltzmann Machines, RBM, Deep Belief Networks, Deep Boltzmann Machines, Convolutional Boltzmann Machine.	CLO5	9
Total Hours		**45**

Learning Resources:

Text Books:

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, MIT Press.
2. Adam Gibson, Josh Patterson, Deep Learning, O'Reilly Media, Inc.
3. Francois Chollet, Deep Learning with Python, Manning Publications.

Reference Books:

1. Ian Goodfellow, Yoshua Bengio, and Aaron Courville, Deep Learning, http://www.deeplearningbook.org.
2. Bengio, Yoshua. Learning Deep Architectures for AI (Foundations and Trends in Machine Learning).
3. Michael Nielsen, Neural Networks and Deep Learning, Free online textbook.

Online Resources/E-learning Resources:

1. https://onlinecourses.nptel.ac.in/noc20_cs11/preview – Deep Learning by Prof. Prabir Kumar Biswas, IIT Kharagpur.
2. https://onlinecourses.nptel.ac.in/noc24_cs59/preview – By Prof. Sudarshan Iyengar, Prof. Padmavati, IIT Ropar.
3. https://www.coursera.org/specializations/deep-learning – Deep Learning Specialization by Andrew Ng, Coursera.

Name of the Program:	B.Tech. CSE- AI&ML	Semester: 7	Level: UG
Course Name:	Deep Learning Lab	Course Code/ Course Type	UBTML402/PCC
Course Pattern:	2026	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA	ESA	Practical/ Oral
-	1	-	1	2	25	-	25

Pre-Requisite:

1. Basics of Machine Learning
2. Python Programming Language

Course Objectives (CO):	**The objectives of Deep Learning Lab are:** 1. To understand and implement core concepts of neural networks including perceptron and multilayer perceptrons. 2. To apply convolutional neural networks (CNNs) and leverage transfer learning for efficient image classification. 3. To implement recurrent neural networks (RNNs) and LSTM models for text and sequential data analysis. 4. To explore dimensionality reduction, representation learning, and reconstruction using autoencoders. 5. To analyze and develop generative models like GANs and deploy deep learning models in real-time environments.
Course Learning Outcomes (CLO):	**Students would be able to:** 1. Implement and experiment with fundamental neural network models including perceptrons and MLPs. 2. Design and evaluate convolutional neural networks and apply transfer learning for vision tasks. 3. Build and assess sequential models using RNNs and LSTMs for tasks like sentiment analysis and forecasting. 4. Apply and interpret autoencoders for feature learning, dimensionality reduction, and data reconstruction. 5. Develop and deploy deep generative models like GANs and demonstrate their use in creative and analytical applications.

Practical Plan:

Practical No.	Title	Week No.	Details	CLO	Hours
1	Introduction to Python Libraries	Week 1	Use NumPy, Pandas, Matplotlib, TensorFlow, and PyTorch to explore data and plot results.	CLO1	2
2	Building a Perceptron Model	Week 2	Implement a single-layer perceptron for binary classification using NumPy/TensorFlow.	CLO1	2
3	Multilayer Perceptron (MLP)	Week 3	Train an MLP for digit classification using MNIST dataset with Keras.	CLO2	2
4	CNN for Image Classification	Week 4	Design and evaluate CNN on CIFAR-10 dataset for image classification.	CLO2	2
5	Transfer Learning	Week 5	Use pre-trained models (VGG16/ResNet) to classify custom images using fine-tuning.	CLO3	2
6	RNN for Sentiment Analysis	Week 6	Perform sentiment analysis on IMDB dataset using RNN.	CLO3	2

7	LSTM for Time Series Forecasting	Week 7	Apply LSTM to predict stock prices from historical data.	CLO4	2
8	Autoencoders	Week 8	Implement autoencoders to compress and reconstruct MNIST images.	CLO4	2
9	GANs for Image Generation	Week 9	Build a simple GAN to generate digits using MNIST.	CLO5	2
10	Mini Project: Deploy DL Model	Week 10	Design and deploy a deep learning model using Flask or Streamlit.	CLO5	4

Learning Resources:

Text Books:

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, MIT Press
2. Adam Gibson, Josh Patterson, Deep Learning, O'Reilly Media, Inc.
3. Francois Chollet, Deep Learning with Python, Manning Publications

Reference Books:

1. Ian Goodfellow, Yoshua Bengio, and Aaron Courville, Deep Learning, `http://www.deeplearningbook.org`
2. Bengio, Yoshua. Learning deep architectures for AI (Foundations and Trends in Machine Learning)
3. Michael Nielsen, Neural Networks and Deep Learning, Free online textbook.

Online Resources/E-learning Resources:

1. `https://onlinecourses.nptel.ac.in/noc20_cs11/preview` – Deep Learning by Prof. Prabir Kumar Biswas, IIT Kharagpur
2. `https://onlinecourses.nptel.ac.in/noc24_cs59/preview` – Deep Learning by Prof. Sudarshan Iyengar, IIT Ropar
3. `https://www.coursera.org/specializations/deep-learning` – Deep Learning Specialization by Andrew Ng, Coursera

Name of the Program:	B.Tech. CSE- AI&ML	Semester: 7	Level: UG
Course Name:	Natural Language Processing	Course Code/ Course Type	UBTML403 / PEC
Course Pattern:	2026	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical/ Oral
3	-	-	3	3	40	60	-

Pre-Requisite:

1. Basics of Machine Learning and Artificial Intelligence
2. Python Programming and Libraries like NLTK, spaCy

Course Objectives (CO):	**The objectives of Natural Language Processing are:** 1. Understand the basic concepts and components of Natural Language Processing. 2. Apply statistical and rule-based NLP techniques for processing and analyzing text. 3. Implement machine learning algorithms for text classification and sentiment analysis. 4. Explore vector-based and contextualized representations of words and documents. 5. Develop NLP applications like chatbots, translators, and QA systems.
Course Learning Outcomes (CLO):	**Students would be able to:** 1. Explain foundational concepts of NLP including tokenization, stemming, and parsing. 2. Implement POS tagging and syntactic parsing using HMMs and FSTs. 3. Apply ML techniques for WSD, NER, sentiment analysis, and text classification. 4. Use advanced embedding techniques (Word2Vec, GloVe, BERT) for text representation. 5. Design and deploy end-to-end NLP applications.

Course Contents/Syllabus:

Descriptors/Topics	CLO	Hours
UNIT I – Introduction to NLP & Text Processing		
Introduction to NLP, Language models and N-grams, Smoothing techniques, Regular expressions, Tokenization, Sentence segmentation, Stopword removal, Morphological analysis, Inflection and derivation, Stemming (Porter, Snowball), Lemmatization using NLTK/spaCy, Normalization, Handling non-English characters.	CLO1	9
UNIT II – Syntax Analysis & POS Tagging		
Part-of-Speech tagging: Rule-based, stochastic, and transformation-based; HMMs and Viterbi; Finite-State Automata; Context-Free Grammars and syntax trees; Top-down, bottom-up, Earley's parser; Constituency vs Dependency parsing; Dependency parsers; Treebanks (Penn Treebank); NLTK/spaCy implementations.	CLO2	9

UNIT III – Semantic Analysis & Text Classification		
Word Sense Disambiguation (Lesk, supervised, unsupervised); Named Entity Recognition (NER); Sentiment Analysis: Lexicon-based, ML-based; Text Classification using Naive Bayes, SVM, Logistic Regression; Feature extraction (BoW, TF-IDF); Model evaluation: Precision, Recall, F1 Score; Pipeline implementation using Scikit-learn.	CLO3	9
UNIT IV – Word Embeddings & Vector Semantics		
Vector Space Models; TF-IDF; Word2Vec (CBOW, Skip-gram); GloVe; FastText embeddings; One-hot encoding vs distributed embeddings; Contextual embeddings (ELMo, BERT, RoBERTa); Tokenization in transformers; Visualization using PCA/t-SNE; Fine-tuning pre-trained transformers.	CLO4	9
UNIT V – NLP Applications & Trends		
Applications: Machine Translation (Statistical, Neural - Seq2Seq, Transformer), Chatbots (Intent recognition, Dialogue flow), Text Summarization (Extractive, Abstractive), QA Systems, Speech-to-Text overview, Zero-shot multilingual models, Bias and ethical issues in NLP, HuggingFace/Transformers overview.	CLO5	9
Total Hours		**45**

Learning Resources:

Text Books:

1. Daniel Jurafsky and James H. Martin, *Speech and Language Processing*, Pearson.
2. Steven Bird, Ewan Klein, and Edward Loper, *Natural Language Processing with Python*, O'Reilly.

Reference Books:

1. Jacob Eisenstein, *Introduction to Natural Language Processing*, MIT Press.
2. Yoav Goldberg, *Neural Network Methods in NLP*, Morgan Claypool.

Online Resources/E-learning Resources:

1. https://nptel.ac.in/courses/106105158
2. https://web.stanford.edu/class/cs224n/
3. https://huggingface.co/docs/transformers/

Name of the Program:	B.Tech. CSE- AI&ML	Semester: 7	Level: UG
Course Name:	Natural Language Processing Lab	Course Code/ Course Type	UBTML404 / PEC
Course Pattern:	2026	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA	ESA	Practical/ Oral
-	1	-	1	2	25	-	25

Pre-Requisite:

1. Knowledge of Machine Learning
2. Python Programming Language

Course Objectives (CO):	**The course objectives of Natural Language Processing lab are:** 1. To familiarize students with text preprocessing and basic NLP techniques. 2. To implement NLP algorithms for classification, tagging, and parsing. 3. To explore and apply word embeddings and modern language models. 4. To develop real-world applications using NLP libraries and toolkits. 5. To evaluate NLP systems with appropriate metrics.
Course Learning Outcomes (CLO):	**Students would be able to:** 1. Perform text preprocessing and tokenization tasks. 2. Apply POS tagging and parsing techniques. 3. Build NLP models for sentiment analysis and classification. 4. Utilize word embeddings and contextual models. 5. Develop mini NLP projects using standard libraries.

Practical Plan:

No.	Title	Week No.	Details	CLO	Hours
1	Text Preprocessing using NLTK/spaCy	1	Tokenization, Stopword Removal, Lemmatization	CLO1	2
2	Regular Expressions for NLP	2	Extract dates, emails, patterns from text using regex	CLO1	2
3	POS Tagging using NLTK	3	Apply rule-based and statistical POS tagging	CLO2	2
4	Parsing Techniques	4	Dependency and Constituency parsing with examples	CLO2	4
5	Text Classification	5	Build sentiment classifier using Naive Bayes	CLO3	2
6	Named Entity Recognition	6	Apply NER models using spaCy or HuggingFace	CLO3	2
7	Word Embeddings	7	Use Word2Vec/GloVe to represent text data	CLO3	2
8	Contextual Embeddings	8	BERT embeddings using Transformers library	CLO4	2
9	Chatbot Mini Project	9	Build rule-based/generative chatbot using transformers/dialogflow	CLO4	2

10	Text Summarization	10	Implement extractive/abstractive summarization models	CLO5	2
11	Mini Project Presentation	11	Showcase end-to-end NLP project with evaluation	CLO5	2
12	Consolidated Lab Task 1	12	Integrated task using all prior concepts	CLO1-CLO5	2
				Total Hours	**30**

Learning Resources:

Text Books:

1. Daniel Jurafsky and James H. Martin, *Speech and Language Processing*, Pearson.
2. Steven Bird, Ewan Klein, and Edward Loper, *Natural Language Processing with Python*, O'Reilly.

Reference Books:

1. Jacob Eisenstein, *Introduction to Natural Language Processing*, MIT Press.
2. Yoav Goldberg, *Neural Network Methods in NLP*, Morgan Claypool.

Online Resources/E-learning Resources:

1. https://nptel.ac.in/courses/106105158
2. https://web.stanford.edu/class/cs224n/
3. https://huggingface.co/docs/transformers/

Name of the Program:	B.Tech. CSE- AI&ML	Semester: 7	Level: UG
Course Name:	Generative AI and Applications	Course Code/ Course Type	UBTML405/ PEC
Course Pattern:	2026	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical/ Oral
3	-	-	3	3	40	60	-

Pre-Requisite:

1. Machine Learning Fundamentals
2. Neural Network Concepts

Course Objectives (CO):	**The course objectives of Generative AI and Applications are:** 1. Understand core concepts of Generative AI. 2. Explore applications in image generation, text synthesis, and data augmentation. 3. Gain familiarity with frameworks like TensorFlow and PyTorch for implementing generative models. 4. Conduct hands-on projects using GANs, diffusion models, and prompt engineering. 5. Analyze trends and evaluate Generative AI across industry use-cases.
Course Learning Outcomes (CLO):	**Students would be able to:** 1. Analyze use cases and benefits of Generative AI in real-world applications. 2. Identify and apply techniques for generative content creation and evaluation. 3. Evaluate risks and ethical concerns associated with Generative AI. 4. Design AI processes tailored for organizational and industry-specific needs. 5. Assess upcoming advancements and forecast AI integration trends.

Course Contents/Syllabus:

Descriptors/Topics	CLO	Hours
UNIT I – Introduction to Generative AI		
Generative AI: How it works, Use Cases, Introduction to Non-Generative AI, Differences and comparative outputs, Pros/Cons of each. Applications: Image Synthesis, Text Generation, Creative Design, Music Composition, Data Augmentation, Drug Discovery.	CLO1	9
UNIT II – Text Data Understanding		
Text types: Structured, Unstructured, Semi-structured; Text Preprocessing techniques; NLP for semantic analysis, improving decision-making; Techniques for creating and enhancing textual content.	CLO2	9
UNIT III – AI for Image Generation & Prompt Evaluation		
Image Generation using GANs and Diffusion Models, Origin and training data for Stable Diffusion; Prompt Engineering: Techniques, evaluation strategies, context sensitivity. Prompt performance evaluation across domains.	CLO3	10

UNIT IV – Enterprise AI & Business Applications		
Enterprise AI: Core elements, organizational roles, real-world use-cases, comparison with conventional AI. Business department applications, benefits, limitations, and strategic adoption challenges.	CLO4	9
UNIT V – Trends and Future Directions of Generative AI		
Generative AI's evolution in industry: Key trends – creativity, personalization, GAN innovation, Conversational AI, NLP growth, AI infrastructure improvements, research contributions.	CLO5	8
Total Hours		**45**

Learning Resources:

Text Books:

1. Learn Python Generative AI: Journey from Autoencoders to Transformers (2026)
2. The Potential of Generative AI (2026)
3. Generative AI for Everyone by Altaf Rehmani

Reference Books:

1. Generative Deep Learning by David Foster
2. Grokking Deep Learning by Andrew Trask
3. Hands-On Generative Adversarial Networks with Keras by Rajalingappaa Shanmugamani
4. Deep Learning by Ian Goodfellow, Yoshua Bengio, and Aaron Courville

Online Resources/E-learning Resources:

1. https://aws.amazon.com/ai/generative-ai/
2. https://www.blockchain-council.org/certifications/certified-generative-ai-expert/
3. https://www.deeplearning.ai/short-courses/generative-ai-with-llms/
4. https://huggingface.co/learn
5. https://developers.google.com/machine-learning/gan

Name of the Program:	B.Tech. CSE- AI&ML	Semester: 7	Level: UG
Course Name:	Generative AI and Applications Lab	Course Code/ Course Type	UBTML406 / PEC
Course Pattern:	2026	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA	ESA	Practical/ Oral
-	1	-	1	2	25	-	25

Pre-Requisite:

1. Fundamentals of Machine Learning
2. Basics of Neural Networks and Python Programming

Course Objectives (CO):	**The course objectives of Generative AI and Applications lab are:** 1. To understand and implement basic generative models like VAEs, GANs, and Diffusion Models. 2. To build real-time applications in image and text generation. 3. To explore prompt engineering techniques and prompt evaluation. 4. To apply and analyze generative AI techniques using PyTorch/TensorFlow frameworks. 5. To design, develop and present a mini project showcasing Generative AI application.
Course Learning Outcomes (CLO):	**Students would be able to:** 1. Implement and visualize core generative models like GANs and VAEs. 2. Perform image generation and augmentation using generative techniques. 3. Apply prompt engineering and evaluation on text/image models. 4. Utilize industry tools like Hugging Face Transformers and Diffusers. 5. Build and demonstrate a mini-project with real-world relevance.

Practical Plan:

No.	Title	Week No.	Details	CLO	Hours
1	Introduction to Generative AI Libraries	1	Explore Hugging Face, TensorFlow, and PyTorch generative tools.	CLO1	2
2	Implementing a Variational Autoencoder (VAE)	2	Encode and reconstruct images using VAEs. Visualize the latent space.	CLO1	2
3	Basic GAN using MNIST	3	Train a simple GAN on handwritten digits dataset.	CLO1	2
4	Image Generation using DCGAN	4	Design and evaluate a Deep Convolutional GAN on fashion images.	CLO2	2
5	Conditional GAN	5	Generate images based on class labels using CGAN.	CLO2	2
6	Diffusion Models Introduction	6	Generate images using pretrained diffusion models (e.g., Stable Diffusion).	CLO2	2
7	Prompt Engineering for Text Generation	7	Use prompts with OpenAI/GPT for story generation. Analyze outcomes.	CLO3	2
8	Prompt Evaluation Techniques	8	Evaluate and refine prompts for diverse tasks using evaluation metrics.	CLO3	2

9	Real-Time Text-to-Image Generation	9	Use tools like DALL·E or MidJourney API with prompts.	CLO4	2
10	Industry Application: Generative AI in Business	10	Case study and notebook implementation on business data augmentation.	CLO4	2
11	Mini Project Development	11	Start mini project based on healthcare, education, or retail use-case.	CLO5	2
12	Mini Project Presentation	12	Demonstrate and present generative AI-based application.	CLO5	2
				Total Hours	**30**

Learning Resources:

Text Books:

1. Learn Python Generative AI: Journey from Autoencoders to Transformers (2026)
2. Generative AI for Everyone by Altaf Rehmani

Reference Books:

1. Generative Deep Learning by David Foster
2. Hands-On GANs with Keras by Rajalingappaa Shanmugamani
3. Deep Learning by Ian Goodfellow, Yoshua Bengio, and Aaron Courville

Online Resources/E-learning Resources:

1. https://huggingface.co/learn
2. https://www.deeplearning.ai/short-courses/generative-ai-with-llms/
3. https://aws.amazon.com/ai/generative-ai/
4. https://github.com/huggingface/diffusers
5. https://developers.google.com/machine-learning/gan

Name of the Program:	B.Tech. CSE- AI&ML	Semester: 7	Level: UG
Course Name:	DevOps	Course Code/ Course Type	MOOCML702/PCC
Course Pattern:	2026	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical/ Oral
-	-	2	2	2	50	-	-

Pre-Requisite:

1. Basic knowledge of Linux commands and shell scripting.
2. Familiarity with software development life cycle (SDLC) and version control systems.

Course Objectives (CO):	**The course objectives of DevOps are:** 1. To introduce the DevOps culture and key principles of continuous integration and delivery. 2. To provide knowledge about tools for automation, orchestration, and configuration management. 3. To understand containerization using Docker and orchestration with Kubernetes. 4. To explore DevOps practices in cloud environments. 5. To analyze real-time deployment pipelines and monitor application performance.
Course Learning Outcomes (CLO):	**Students would be able to:** 1. Describe the DevOps life cycle and continuous delivery pipeline. 2. Apply version control, containerization, and CI/CD tools. 3. Configure deployment automation and infrastructure as code using tools like Ansible and Jenkins. 4. Manage cloud-native applications using Kubernetes and Docker. 5. Evaluate DevOps pipelines with monitoring and feedback mechanisms.

Course Contents/Syllabus:

Descriptors/Topics	CLO	Hours
UNIT I – Introduction to DevOps		
DevOps overview, Agile vs DevOps, DevOps lifecycle, Collaboration and communication in DevOps, Introduction to CI/CD, benefits and challenges of DevOps.	CLO1	6
UNIT II – Version Control and Automation Tools		
Introduction to Git and GitHub, Branching, Merging, Git workflows, Continuous integration using Jenkins, Introduction to configuration management tools (Chef, Puppet, Ansible).	CLO2	6
UNIT III – Containerization and Orchestration		
Docker architecture, Dockerfile, container lifecycle, Docker Compose, Kubernetes architecture, Pods, Services, Deployments, Helm, container orchestration and scaling strategies.	CLO3	6
UNIT IV – DevOps in the Cloud		
DevOps in AWS, Azure, and GCP; DevOps as a service; Infrastructure as Code (IaC) with Terraform; Case studies of cloud-native CI/CD implementations.	CLO4	6

UNIT V – Monitoring and Feedback		
Application and infrastructure monitoring: Prometheus, Grafana, ELK stack; Log management, alerting and visualization; DevOps metrics; Feedback loops for performance improvement.	CLO5	6
Total Hours		**30**

Learning Resources:

Text Books:

1. Gene Kim, Patrick Debois, John Willis, Jez Humble – *The DevOps Handbook*, IT Revolution Press.
2. Len Bass, Ingo Weber, Liming Zhu – *DevOps: A Software Architect's Perspective*, Addison-Wesley.

Reference Books:

1. Viktor Farcic – *The DevOps Toolkit*, LeanPub.
2. Kelsey Hightower – *Kubernetes: Up Running*, O'Reilly Media.
3. Yevgeniy Brikman – *Terraform: Up Running*, O'Reilly Media.

Online Resources/E-learning Resources:

1. https://www.edx.org/learn/devops
2. https://www.coursera.org/specializations/devops
3. https://www.udemy.com/course/devops-practices-and-tools/
4. https://www.katacoda.com/courses/devops
5. https://learn.microsoft.com/en-us/devops/

Name of the Program:	B.Tech. CSE- AI&ML	Semester: 7	Level: UG
Course Name:	Major Project - I AI&ML	Course Code/ Course Type	UBTML408/PROJ
Course Pattern:	2026	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical/ Oral
-	2	-	2	4	20	-	30

Pre-Requisite:

1. Basics of Software Engineering and Computer Programming Concepts
2. Basics of Programming Language such as C, MATLAB, Python

Course Objectives (CO):	**The course objectives of Major Project - I AI&ML are:** 1. To comprehend the Product Development Process. 2. To plan for various activities of the major project and channelize the work towards product development. 3. To build, design and implement real-time applications using available platforms. 4. To inculcate research culture in students for their technical growth.
Course Learning Outcomes (CLO):	**Students would be able to:** 1. Comprehend, plan, and execute the major project with appreciable research outcomes. 2. Design real-time applications considering emerging areas in technology. 3. Prepare good quality technical reports based on the project. 4. Demonstrate technical ideas and their relevance to current technology. 5. Publish good quality papers in reputed journals and present their work in reputed conferences.

Course Contents/Syllabus:

Descriptors/Topics	CLO	Hours
1. Individual students must identify a real-time problem and develop an innovative solution under the guidance of a project mentor. **2. Sponsored projects or project internships from reputed companies/institutions are encouraged.** **3. Projects must be based on current technologies or research areas and should demonstrate societal or industrial relevance.** **4. Students should submit a detailed Project Report-I as part of term work, covering design methodology, implementation plans, and expected outcomes.** **5. Students must aim for minimum 2 publications (preferably Scopus-indexed) as part of the research output from the project work.** **6. Evaluation will include proposal presentation, mid-evaluation, documentation review, and final demo.**	**CLO 1-5**	**30**
Total Hours		**30**

COURSE SYLLABUS

CSE - AI&ML

SEMESTER-VIII

Name of the Program:	B.Tech. CSE- AI&ML	Semester: 8	Level: UG
Course Name:	Computer Vision and Video Processing	Course Code / Course Type	UBTML409
Course Pattern:	2026	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical/ Oral
3	-	-	3	3	40	60	-

Pre-Requisite:

1. Basics of Image Processing and Linear Algebra
2. Programming experience in Python (OpenCV, NumPy)

Course Objectives (CO):	**The objectives of Computer Vision and Video Processing are:** 1. To understand the fundamentals of image formation, feature detection, and camera geometry. 2. To analyze visual information using classical and deep learning approaches. 3. To study motion analysis and video tracking techniques. 4. To explore applications of computer vision in real-time systems. 5. To implement vision pipelines using standard tools and libraries.
Course Learning Outcomes (CLO):	**Students would be able to:** 1. Explain fundamental concepts of computer vision including image filtering, edge detection, and geometric transformations. 2. Apply feature extraction and object detection techniques using classical and learning-based methods. 3. Analyze motion and track objects in video sequences. 4. Design vision pipelines for applications such as surveillance, AR/VR, and autonomous systems. 5. Implement real-time vision solutions using OpenCV, TensorFlow, or PyTorch.

Course Contents/Syllabus:

Descriptors/Topics	CLO	Hours
UNIT I – Image Formation and Filtering		
Image formation, digital camera model, radiometry and color models. Spatial and frequency domain filtering, convolution, Gaussian and edge filters, histogram equalization.	CLO1	9
UNIT II – Feature Detection and Matching		
Interest point detection: Harris, FAST, and SIFT; feature description and matching. Epipolar geometry, homographies, RANSAC, camera calibration.	CLO2	9
UNIT III – Object Detection and Recognition		
Segmentation: thresholding, region-based, clustering. Object detection using Viola-Jones, HOG+SVM, YOLO, SSD. Deep CNNs for image classification.	CLO3	9
UNIT IV – Motion Estimation and Tracking		
Optical flow (Lucas-Kanade, Horn-Schunck), background subtraction, object tracking: Kalman filter, Meanshift, Camshift, Deep SORT, action recognition.	CLO4	9
UNIT V – Applications and Real-time Deployment		

Real-time vision systems: face recognition, license plate detection, gesture recognition, video surveillance, vision for robotics and AR/VR. Deployment with OpenCV, TensorFlow Lite, NVIDIA Jetson.	CLO5	9
Total Hours		**45**

Learning Resources:

Text Books:

1. Richard Szeliski, *Computer Vision: Algorithms and Applications*, Springer.
2. Simon Prince, *Computer Vision: Models, Learning, and Inference*, Cambridge University Press.
3. Adrian Rosebrock, *Practical Python and OpenCV*, PyImageSearch.

Reference Books:

1. Gary Bradski and Adrian Kaehler, *Learning OpenCV 4*, O'Reilly Media.
2. D. Forsyth and J. Ponce, *Computer Vision: A Modern Approach*, Pearson.

Online Resources/E-learning Resources:

1. `https://opencv.org/` – Official OpenCV Documentation.
2. `https://pyimagesearch.com/` – OpenCV + Deep Learning tutorials.
3. `https://www.coursera.org/learn/computer-vision-basics` – Coursera: University at Buffalo.
4. `https://nptel.ac.in/courses/106105232` – NPTEL: Computer Vision by IIT Hyderabad.

Name of the Program:	B.Tech. CSE- AI&ML	Semester: 8	Level: UG
Course Name:	Computer Vision and Video Processing Lab	Course Code/ Course Type	UBTML410/PCC
Course Pattern:	2026	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA	ESA	Practical/ Oral
-	1	-	1	2	25	-	25

Pre-Requisite:

1. Basics of Image Processing and Linear Algebra
2. Programming experience in Python (OpenCV, NumPy)

Course Objectives (CO):	**The objectives of the Computer Vision and Video Processing lab are:** 1. To explore basic operations of image and video processing using OpenCV. 2. To implement feature detection, object detection, and segmentation techniques. 3. To apply motion estimation, optical flow, and video tracking algorithms. 4. To integrate deep learning models for vision tasks. 5. To develop real-time computer vision applications using open-source tools.
Course Learning Outcomes (CLO):	**Students would be able to:** 1. Perform basic image transformations and filtering. 2. Detect and describe visual features for object recognition. 3. Implement motion estimation and video tracking techniques. 4. Use deep learning for detection and classification tasks. 5. Build and deploy real-time computer vision systems.

Practical Plan:

No.	Title	Week No.	Details	CLO	Hours
1	Image Operations	1	Perform image loading, cropping, resizing, color conversion using OpenCV.	CLO1	2
2	Filtering and Edge Detection	2	Apply Gaussian blur, Sobel, and Canny edge detection.	CLO1	2
3	Feature Detection	3	Implement Harris, SIFT, and ORB feature detectors.	CLO2	2
4	Object Detection with HOG + SVM	4	Use HOG descriptors and train SVM for human detection.	CLO2	2
5	Object Detection using CNN	5	Apply YOLOv5 or SSD for real-time object detection.	CLO4	2
6	Video Processing	6	Read/write frames from video, apply filters frame-by-frame.	CLO3	2
7	Motion Detection	7	Implement optical flow (Lucas-Kanade, Farneback) on video.	CLO3	2
8	Object Tracking	8	Track objects using Meanshift/Camshift/Deep SORT.	CLO3	2

9	Face Recognition App	9	Build a face recognition system using deep learning.	CLO4	2
10	Mini Project	10	Develop and demonstrate a real-time vision application.	CLO5	4

Learning Resources:

Text Books:

1. Adrian Rosebrock, *Practical Python and OpenCV*, PyImageSearch.
2. Richard Szeliski, *Computer Vision: Algorithms and Applications*, Springer.

Reference Books:

1. Gary Bradski, Adrian Kaehler, *Learning OpenCV 4*, O'Reilly Media.
2. Simon Prince, *Computer Vision: Models, Learning, and Inference*, Cambridge University Press.

Online Resources/E-learning Resources:

1. `https://opencv.org/` – Official OpenCV Documentation.
2. `https://pyimagesearch.com/` – Tutorials on Computer Vision and Deep Learning.
3. `https://www.coursera.org/learn/computer-vision-basics` – Coursera: Introduction to Computer Vision.
4. `https://nptel.ac.in/courses/106105232` – NPTEL Course on Computer Vision by IIT Hyderabad.

Name of the Program:	B.Tech. CSE- AI&ML	Semester: 8	Level: UG
Course Name:	Principles of Research & Intellectual Property	Course Code / Course Type	UBTML411 / PCC
Course Pattern:	2026	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA	ESA	Practical/ Oral
2	-	-	2	2	20	30	-

Pre-Requisite:

1. Basic understanding of research and academic writing.
2. Familiarity with scientific problem-solving and documentation.

Course Objectives (CO):	**The objectives of Principles of Research & Intellectual Property are:** 1. To understand the foundations and types of research methodology. 2. To learn how to formulate and define research problems. 3. To build ethical research practices and handle academic integrity. 4. To provide knowledge about Intellectual Property Rights (IPR) and filing mechanisms. 5. To improve skills in technical writing, documentation, and publication ethics.
Course Learning Outcomes (CLO):	**Students would be able to:** 1. Describe research processes and distinguish among various research designs. 2. Formulate a well-defined research problem and prepare a design for data collection and analysis. 3. Follow ethical standards in research including plagiarism detection. 4. Explain types of IPRs and outline procedures for patent filing. 5. Write structured research reports, papers, and proposals using standard formats.

Course Contents/Syllabus:

Descriptors/Topics	CLO	Hours
UNIT I – Foundations of Research Methodology		
Nature and objectives of research; research types and characteristics; scientific research method; theory-building and hypothesis testing; deductive vs inductive reasoning; research cycle; emerging interdisciplinary research trends.	CLO1	6
UNIT II – Formulating and Designing Research		
Identification and formulation of research problems, literature review strategies, research objectives and hypotheses, variables, population and sample, sampling methods, qualitative and quantitative research, experimental design, pilot study.	CLO2	6
UNIT III – Ethics, Integrity, and Plagiarism		
Need for research ethics, ethical practices in data handling and authorship, plagiarism types and detection tools, IRB guidelines, role of funding agencies and publishers, case studies on research misconduct and retractions.	CLO3	6

UNIT IV – Intellectual Property Rights (IPR)		
Introduction to IPRs, copyright, patents, trademarks, trade secrets; international treaties: TRIPS, WIPO; process of patent filing in India; patent search, patent analytics, IPR in academia and start-ups, role of incubators.	CLO4	6
UNIT V – Technical Writing, Documentation & Presentation		
Research report structure, referencing styles (IEEE/APA/MLA), citation tools (Mendeley, Zotero), writing conference/journal papers, abstracts and posters, technical presentations, proposal writing, grant applications, review writing.	CLO5	6
Total Hours		**30**

Learning Resources:

Text Books:

1. C.R. Kothari, *Research Methodology: Methods and Techniques*, New Age International.
2. Ranjit Kumar, *Research Methodology: A Step-by-Step Guide*, Sage Publications.
3. P. K. Gupta and D. S. Hira, *Research Methodology and IPR*, Katson Publishing House.

Reference Books:

1. Neeraj Pandey and Khushdeep Dharni, *Intellectual Property Rights*, PHI Learning.
2. Satyajeet A. Deshmukh, *Research Methodology & IPR*, TechKnowledge Publications.
3. Mayall, *Industrial Design*, McGraw Hill.

Online Resources/E-learning Resources:

1. `https://nptel.ac.in/courses/121106007` – NPTEL Course on Research Methodology.
2. `https://swayam.gov.in/nd1_noc20_hs33/preview` – SWAYAM Course on IPR by NLU Delhi.
3. `https://www.wipo.int/portal/en/index.html` – WIPO (World Intellectual Property Organization).

Name of the Program:	B.Tech. CSE- AI&ML	Semester: 8	Level: UG
Course Name:	Time Series Forecasting	Course Code / Course Type	UBTML412 / PEC
Course Pattern:	2026	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA	ESA	Practical/ Oral
3	-	-	3	3	40	60	-

Pre-Requisite:

1. Understanding of statistics and probability
2. Python programming with Pandas, NumPy, and Matplotlib

Course Objectives (CO):	**The objectives of Time Series Forecasting are:** 1. Understand time series components and patterns 2. Preprocess and transform time series data for analysis 3. Apply classical and statistical forecasting methods 4. Utilize deep learning models for time-dependent data 5. Evaluate and deploy forecasting models in practice
Course Learning Outcomes (CLO):	**Students would be able to:** 1. Analyze time series data structure and detect patterns 2. Transform and engineer features for modeling 3. Implement ARIMA, Holt-Winters, and SARIMA models 4. Build LSTM and GRU-based forecasting models 5. Compare forecasting performance using evaluation metrics

Course Contents/Syllabus:

Descriptors/Topics	CLO	Hours
UNIT I – Fundamentals of Time Series and Components		
Introduction to time series data and applications, univariate vs multivariate time series. Components of time series: trend, seasonality, cyclic patterns, and residuals. Time series plotting, visualization, decomposition (additive and multiplicative). Use of moving averages and exponential smoothing for trend and noise reduction. Introduction to time domain vs frequency domain analysis. Case studies: stock prices, temperature data, and traffic analysis.	CLO1	9
UNIT II – Data Preparation, Feature Engineering, and Stationarity		
Importance of stationarity, types (weak/strong), methods to test (ADF, KPSS). Data transformations: log, power, differencing, Box-Cox transformation. Feature extraction from time series: lag variables, rolling mean and std, calendar features, Fourier transforms. Handling missing values and outliers. Feature scaling techniques. Exploratory data analysis (EDA) for time series. Implementation using Python (Pandas, statsmodels, tsfresh).	CLO2	9
UNIT III – Classical Time Series Forecasting Models		
Autoregressive (AR), Moving Average (MA), ARMA, and ARIMA models – assumptions, model selection using AIC/BIC, residual diagnostics. Seasonal ARIMA (SARIMA), STL decomposition, and X13ARIMA-SEATS. Exponential Smoothing: Simple, Holt's, and Holt-Winters Seasonal methods. Comparison of models and selection. Forecast intervals and prediction accuracy. Applications using statsmodels and pmdarima in Python.	CLO3	9

UNIT IV – Machine Learning and Deep Learning Techniques for Forecasting		
Supervised learning for time series: converting series to supervised format. ML models: Linear Regression, Decision Trees, Random Forest, Gradient Boosting. Limitations of classical models. Deep learning for time series: RNNs, LSTM, GRU, encoder-decoder architectures. Attention mechanism for long sequences. Use of sliding windows, walk-forward validation, hyperparameter tuning. Tools: TensorFlow/Keras, Scikit-learn.	CLO4	9
UNIT V – Evaluation, Model Deployment and Industrial Applications		
Evaluation metrics: MAE, RMSE, RMSLE, SMAPE, MASE, cross-validation in time series (TimeSeriesSplit). Walk-forward validation, error analysis and model confidence intervals. Deployment of models using Streamlit, Flask, or FastAPI. Use of dashboards for visualization. Case studies: energy demand forecasting, e-commerce sales, weather forecasting, and IoT sensor data. Introduction to AutoML tools (Prophet, Darts, GluonTS).	CLO5	9
Total Hours		**45**

Learning Resources:

Text Books:

1. Rob J. Hyndman and George Athanasopoulos, *Forecasting: Principles and Practice*, OTexts.
2. Galit Shmueli, *Practical Time Series Forecasting*, Axelrod Schnall.
3. Chris Chatfield, *The Analysis of Time Series: An Introduction*, CRC Press.

Reference Books:

1. Jason Brownlee, *Deep Learning for Time Series Forecasting*, Machine Learning Mastery.
2. Adhikari and Agrawal, *An Introductory Study on Time Series Modeling and Forecasting.*
3. Cowpertwait & Metcalfe, *Introductory Time Series with R*, Springer.

Online Resources/E-learning Resources:

1. https://otexts.com/fpp3/ – Forecasting Principles and Practice.
2. https://www.coursera.org/learn/time-series – Coursera: Time Series Forecasting by Univ. of Colorado.
3. https://machinelearningmastery.com/start-here/#timeseries – Jason Brownlee's Time Series Portal.

Name of the Program:	B.Tech. CSE-AI&ML	Semester: 8	Level: UG
Course Name:	Time Series Forecasting Lab	Course Code/ Course Type	UBTML413 / PEC
Course Pattern:	2026	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA	ESA	Practical/ Oral
-	1	-	1	2	25	-	25

Pre-Requisite:

1. Basic understanding of Python and libraries like Pandas, NumPy, Matplotlib.
2. Knowledge of fundamental statistical and ML concepts.

Course Objectives (CO):	**The objectives of this lab are:** 1. To understand the principles of time series data and exploratory analysis techniques. 2. To implement traditional forecasting models such as AR, MA, ARIMA, and SARIMA. 3. To explore seasonality, trend, and decomposition in real datasets. 4. To apply machine learning and deep learning models for forecasting tasks. 5. To evaluate model performance using appropriate metrics.
Course Learning Outcomes (CLO):	**Students would be able to:** 1. Preprocess and visualize time series data effectively. 2. Apply statistical models like ARIMA and SARIMA for forecasting. 3. Analyze components like trend, seasonality, and residuals. 4. Build ML/DL models such as LSTM and Prophet for forecasting. 5. Compare models using MSE, RMSE, MAPE, and MAE metrics.

Practical Plan:

No.	Title	Week No.	Details	CLO	Hours
1	Time Series Overview and Data Loading	1	Load and visualize stock/weather/IoT datasets. Identify types of time series.	CLO1	2
2	Time Series Decomposition	2	Use additive and multiplicative decomposition using statsmodels.	CLO1	2
3	Stationarity	3	Perform ADF/KPSS test; apply differencing to achieve stationarity.	CLO1	2
4	Autocorrelation and PACF	4	Generate ACF and PACF plots for parameter selection.	CLO2	2
5	ARIMA and SARIMA Modeling	5	Implement ARIMA/SARIMA on seasonal datasets (e.g., airline, sales).	CLO2	2
6	Smoothing Techniques	6	Apply moving averages, exponential smoothing, Holt-Winters models.	CLO3	2
7	Forecast Evaluation	7	Evaluate models using RMSE, MAPE, MAE. Plot forecast intervals.	CLO5	2
8	ML Models for Forecasting	8	Use regression, Random Forest, SVR for forecasting future values.	CLO4	2

9	LSTM for Forecasting	9	Train LSTM on time series using Keras for univariate sequences.	CLO4	2
10	Prophet for Forecasting	10	Use Facebook Prophet for holidays, seasonal and trend prediction.	CLO4	2
11	Capstone Project – Dataset Selection	11	Select domain-specific time series data for project; define objectives.	CLO1–CLO5	2
12	Capstone Project – Implementation	12	Implement model pipeline, present results, compare models.	CLO1–CLO5	2
				Total Hours	**30**

Learning Resources:

Text Books:

1. Rob J Hyndman and George Athanasopoulos, *Forecasting: Principles and Practice*, OTexts.
2. Sean J. Taylor and Benjamin Letham, *Forecasting at Scale*, Facebook Research.

Reference Books:

1. Jason Brownlee, *Deep Learning for Time Series Forecasting*, Machine Learning Mastery.
2. Aileen Nielsen, *Practical Time Series Analysis*, O'Reilly Media.

Online Resources/E-learning Resources:

1. https://otexts.com/fpp3/
2. https://www.coursera.org/learn/time-series
3. https://facebook.github.io/prophet/docs/quick_start.html
4. https://machinelearningmastery.com/start-here/#timeseries

Name of the Program:	B.Tech. CSE- AI&ML	Semester: 8	Level: UG
Course Name:	Foundations of Business Analytics	Course Code / Course Type	UBTML414 / PEC
Course Pattern:	2026	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA	ESA	Practical/ Oral
3	-	-	3	3	40	60	-

Pre-Requisite:

1. Basic understanding of statistics, probability, and data visualization.
2. Python programming with libraries like Pandas, NumPy, Matplotlib.

Course Objectives (CO):	**The objectives of Foundations of Business Analytics are:** 1. Understand the fundamentals and scope of business analytics and its applications. 2. Analyze historical data to uncover patterns and trends using statistical and ML techniques. 3. Design descriptive, predictive, and prescriptive analytics workflows. 4. Interpret business analytics outcomes and support data-driven decision-making. 5. Apply tools and techniques for real-world business problem-solving across domains.
Course Learning Outcomes (CLO):	**Students would be able to:** 1. Explain the concepts and lifecycle of business analytics. 2. Perform exploratory data analysis using business-relevant data. 3. Apply ML techniques for demand forecasting, customer segmentation, and churn prediction. 4. Build dashboards and business reports for decision support. 5. Demonstrate domain-specific analytics use-cases using modern tools.

Course Contents/Syllabus:

Descriptors/Topics	CLO	Hours
UNIT I – Introduction to Business Analytics		
Overview of business analytics – definition, types (descriptive, predictive, prescriptive), scope. Business intelligence vs business analytics. Analytics lifecycle. Role of a business analyst. Structured vs unstructured data. Case studies: retail, manufacturing, healthcare. Tools used in business analytics: Excel, Tableau, Power BI, Python.	CLO1	9
UNIT II – Descriptive Analytics and Data Visualization		
Data types, central tendency, variability, skewness, and kurtosis. Data preparation and cleaning. Univariate, bivariate, multivariate analysis. Visualization: histograms, bar charts, boxplots, scatterplots. Dashboards and KPIs. Visualization best practices. BI tools (Tableau/Power BI) for storytelling. Use of Python libraries (Matplotlib, Seaborn, Plotly).	CLO2	9
UNIT III – Predictive Analytics using Statistical and ML Methods		
Linear regression, logistic regression, k-means clustering, decision trees, random forests. Churn analysis, RFM segmentation, customer lifetime value. Time series forecasting basics. Model validation techniques – cross-validation, train-test splits. Overfitting, bias-variance tradeoff. Feature engineering and selection. Applications in CRM, HR, and sales.	CLO3	9
UNIT IV – Prescriptive Analytics and Optimization		

Introduction to optimization. Linear programming (LP), integer programming (IP). Solver tools (Excel Solver, SciPy.optimize). Use cases: resource allocation, supply chain, portfolio optimization. Simulation models using Monte Carlo simulation. Scenario analysis, what-if analysis. Decision trees for strategic decision making.	CLO4	9
UNIT V – Industry Applications and Emerging Trends		
Business analytics in finance, marketing, retail, healthcare, logistics. Real-time analytics and streaming data. Introduction to cloud analytics platforms (AWS QuickSight, Google Data Studio). Ethics and governance in business analytics. Future trends: explainable AI, augmented analytics, automated ML. Capstone case studies and project briefing.	CLO5	9
Total Hours		**45**

Learning Resources:

Text Books:

1. James R. Evans, *Business Analytics: Methods, Models, and Decisions*, Pearson.
2. U. Dinesh Kumar, *Business Analytics: The Science of Data-Driven Decision Making*, Wiley.
3. Galit Shmueli et al., *Data Mining for Business Analytics*, Wiley.

Reference Books:

1. Vohra, *Business Analytics: Concepts and Applications*, McGraw-Hill.
2. Foster Provost and Tom Fawcett, *Data Science for Business*, O'Reilly Media.
3. Bernard Marr, *Big Data in Practice*, Wiley.

Online Resources/E-learning Resources:

1. `https://www.edx.org/professional-certificate/columbiax-business-analytics`
2. `https://www.coursera.org/specializations/business-analytics` – Wharton Business School
3. `https://www.tableau.com/learn/training` – Tableau Training

Name of the Program:	B.Tech. CSE- AI&ML	Semester: 8	Level: UG
Course Name:	Foundations of Business Analytics Lab	Course Code/ Course Type	UBTML415 / PEC
Course Pattern:	2026	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA	ESA	Practical/ Oral
-	1	-	1	2	25	-	25

Pre-Requisite:

1. Basic understanding of statistics and Excel/BI tools.
2. Python and data handling libraries (Pandas, NumPy).

Course Objectives (CO):	**The objectives of Foundations of Business Analytics Lab are:** 1. Understand business data processing and visualization techniques. 2. Apply analytics methods for solving real-world problems. 3. Explore predictive and prescriptive analytics using Python or BI tools. 4. Generate business reports and dashboards. 5. Evaluate the insights and recommendations derived from analytics.
Course Learning Outcomes (CLO):	**The students will be able to:** 1. Perform EDA and data cleaning on business datasets. 2. Apply regression, classification, and clustering techniques. 3. Visualize and interpret data using BI tools or Python libraries. 4. Build and optimize analytical models for business insights. 5. Present and communicate results using dashboards and reports.

Practical Plan:

No.	Title	Week No.	Details	CLO	Hours
1	Business Analytics Tools	1	Load and analyze datasets using Excel/Power BI and Python.	CLO1	2
2	EDA	2	Descriptive stats and visualization using Seaborn/Matplotlib.	CLO1	2
3	Data Cleaning	3	Handle missing data, outliers, and normalization.	CLO1	2
4	Regression Modeling	4	Linear regression for forecasting sales or demand.	CLO2	2
5	Classification Modeling	5	Logistic regression / decision trees for prediction.	CLO2	2
6	Market Segmentation	6	Clustering using k-means and DBSCAN on customer data.	CLO2	2
7	Dashboards	7	Create interactive dashboards using Power BI/Tableau.	CLO3	2

8	Optimization Models	8	Solve optimization problems using Excel Solver.	CLO4	2
9	Real-Time Analytics	9	Dash/Streamlit/Google Data Studio for dynamic data.	CLO4	2
10	Capstone Project I	10	Select domain dataset, define project problem statement.	CLO1–CLO5	2
11	Capstone Project II	11	Model building, evaluation, and result analysis.	CLO1–CLO5	2
12	Capstone Project III	12	Present report and dashboard with findings.	CLO1–CLO5	2
				Total Hours	**30**

Learning Resources:

Text Books:

1. James R. Evans, *Business Analytics: Methods, Models, and Decisions*, Pearson.
2. U. Dinesh Kumar, *Business Analytics*, Wiley.
3. Galit Shmueli et al., *Data Mining for Business Analytics*, Wiley.

Reference Books:

1. Foster Provost and Tom Fawcett, *Data Science for Business*, O'Reilly.
2. Vohra, *Business Analytics: Concepts and Applications*, McGraw-Hill.
3. Bernard Marr, *Big Data in Practice*, Wiley.

Online Resources/E-learning Resources:

1. `https://www.coursera.org/specializations/business-analytics` – Wharton, University of Pennsylvania.
2. `https://www.edx.org/professional-certificate/columbiax-business-analytics`
3. `https://www.tableau.com/learn/training` – Tableau Learning Resources.

Name of the Program:	B.Tech. CSE- AI&ML	Semester: 8	Level: UG
Course Name:	Prompt Engineering	Course Code/ Course Type	MOOCML801 / PEC
Course Pattern:	2026	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical/ Oral
-	-	2	2	2	25	-	25

Pre-Requisite:

1. Basic understanding of NLP and Machine Learning.
2. Familiarity with generative models and Python programming.

Course Objectives (CO):	**The course objectives of Prompt Engineering are:** 1. Understand the principles of prompt design for large language models (LLMs). 2. Explore different prompting strategies and their impact on LLM responses. 3. Learn to evaluate prompt quality and refine prompts iteratively. 4. Examine ethical issues and bias mitigation in prompt formulation. 5. Apply prompt engineering in real-world applications using APIs like OpenAI.
Course Learning Outcomes (CLO):	**Students would be able to:** 1. Explain the fundamentals of prompt engineering and LLM architectures. 2. Construct zero-shot, one-shot, and few-shot prompts for generative tasks. 3. Evaluate and fine-tune prompts using performance and safety metrics. 4. Apply prompts in different application domains such as QA, coding, and translation. 5. Analyze and mitigate biases and ethical challenges in prompt usage.

Course Contents/Syllabus:

Descriptors/Topics	CLO	Hours
UNIT I – Introduction to Prompt Engineering		
Overview of Natural Language Generation, evolution of LLMs, foundation models. Introduction to Prompt Engineering: Role, need, and scope. Prompt types – instructional, completion-based, and conversational. Prompt structure, prompt templates, prompt tuning basics. Differences between few-shot learning and prompt engineering. Real-world examples of prompt effectiveness.	CLO1	6

UNIT II – Prompting Strategies		
Zero-shot, one-shot, and few-shot prompting techniques. Chain-of-thought prompting, role prompting, reflexive prompting, and self-consistency. Instruction-tuned models. Prompt injection attacks and prevention. Common prompt design mistakes and debugging. Prompt engineering use cases in domains such as legal, medical, and finance. Case studies and comparisons.	CLO2	6
UNIT III – Prompt Optimization and Evaluation		
Prompt quality evaluation methods: BLEU, ROUGE, METEOR, BERTScore, human evaluations. Prompt effectiveness testing – prompt variation experiments. Iterative refinement and few-shot fine-tuning. Latency vs accuracy trade-off. Prompt chaining and modular prompts. Prompt injection testing. Frameworks and tools for testing prompts: Promptfoo, LangChain.	CLO3	6
UNIT IV – Applications of Prompt Engineering		
Prompting for content generation: blog writing, creative storytelling, tweet generation. Prompting for information extraction, summarization, code generation (Copilot, CodeWhisperer). Translation and multilingual generation. Instruction-based prompting for dialog agents and personal assistants. Implementation using APIs – OpenAI, Cohere, HuggingFace Transformers.	CLO4	6
UNIT V – Ethics, Safety, and Responsible Prompting		
Bias in prompts and outputs, hallucination and misinformation challenges. Prompting for fairness and safety. Bias mitigation strategies. Transparency and explainability of prompts. Guidelines and frameworks for responsible AI and prompt construction. OpenAI's usage policies and industry standards. Future directions of prompt engineering and alignment.	CLO5	6
Total Hours		**30**

Learning Resources:

Text Books:

1. Nate Kong, *The Art of Prompt Engineering with ChatGPT*, Independently Published.
2. James Phoenix, *Prompt Engineering: Learn the Art of Prompting AI*, AI Publishing.
3. Jason D. Brown, *Mastering Prompt Engineering*, LeanPub.

Reference Books:

1. Shubham Saboo, *Prompt Engineering for Generative AI*, Packt Publishing.
2. OpenAI Technical Reports and Documentation.
3. Papers With Code – Prompting Benchmarks.

Online Resources/E-learning Resources:

1. https://platform.openai.com/docs/guides/prompt-engineering
2. https://huggingface.co/blog/prompt-engineering
3. https://learn.deeplearning.ai/chatgpt-prompt-eng
4. https://promptingguide.ai/

Name of the Program:	B.Tech. CSE- AI&ML	Semester: 8	Level: UG
Course Name:	Machine Learning for Cybersecurity	Course Code/ Course Type	MOOCML802 / PEC
Course Pattern:	2026	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical/ Oral
-	-	2	2	2	25	-	25

Pre-Requisite:

1. Strong foundation in Machine Learning algorithms and supervised/unsupervised learning.
2. Basics of network security and cyber threat landscape.

Course Objectives (CO):	**The objectives of this course are:** 1. To understand how ML techniques can be leveraged to solve cybersecurity problems. 2. To explore supervised, unsupervised, and deep learning techniques for detecting and preventing cyber threats. 3. To develop intelligent systems for intrusion detection, malware analysis, and anomaly detection. 4. To apply ML models on real cybersecurity datasets and interpret results. 5. To investigate adversarial attacks and defense mechanisms in ML-based systems.
Course Learning Outcomes (CLO):	**Students would be able to:** 1. Analyze the application of machine learning in cyber threat detection. 2. Apply ML models to real-world datasets like NSL-KDD, CICIDS, etc. 3. Design models for malware detection, intrusion detection, and spam filtering. 4. Evaluate the robustness of ML models against adversarial attacks. 5. Develop end-to-end ML-based cybersecurity solutions with ethical considerations.

Course Contents/Syllabus:

Descriptors/Topics	CLO	Hours
UNIT I – Introduction to ML in Cybersecurity		
Cybersecurity fundamentals, threat taxonomy, intrusion types. Overview of ML – classification, clustering, anomaly detection. ML lifecycle in cybersecurity. Public datasets: KDD99, NSL-KDD, CICIDS2017. Challenges in applying ML to cybersecurity. Supervised vs unsupervised learning for security.	CLO1	6

UNIT II – Supervised Learning Applications		
Binary/multiclass classification models for spam detection, phishing, malware detection. Logistic regression, SVM, decision trees, random forests. Feature extraction from packet captures, logs, email headers. Case study: Email spam filtering. Evaluation metrics: Precision, Recall, F1, AUC.	CLO2	6
UNIT III – Unsupervised Learning & Anomaly Detection		
Clustering: k-means, DBSCAN. Anomaly detection techniques: One-class SVM, Isolation Forest. Use in intrusion detection systems (IDS), insider threat detection, abnormal login detection. Dimensionality reduction: PCA, t-SNE for visualization. Case study: Network anomaly detection using CICIDS.	CLO2	6
UNIT IV – Deep Learning and Cybersecurity		
Deep neural networks, CNN, RNN/LSTM for sequence modeling of logs. Autoencoders for anomaly detection. Malware classification with CNNs on binary file images. Threat intelligence from logs using NLP and BERT. Transfer learning for small cybersecurity datasets. Hands-on with TensorFlow/Keras.	CLO3	6
UNIT V – Adversarial ML and Security Considerations		
Adversarial attacks on ML models: evasion, poisoning. Black-box vs white-box attacks. Model robustness and defense strategies (adversarial training, input preprocessing). Secure model deployment, explainability in cybersecurity. Ethical and legal implications of ML in security.	CLO4, CLO5	6
Total Hours		**30**

Learning Resources:

Text Books:

1. Clarence Chio, David Freeman, *Machine Learning and Security*, O'Reilly.
2. Emmanuel Tsukerman, *Machine Learning for Cybersecurity Cookbook*, Packt Publishing.
3. Richard Harang, *Machine Learning and Data Science Blueprints for Cybersecurity*, Packt.

Reference Books:

1. Michael Sikorski, Andrew Honig, *Practical Malware Analysis*, No Starch Press.
2. Josh Saxe, Hillary Sanders, *Malware Data Science*, No Starch Press.
3. Ian Goodfellow et al., *Deep Learning*, MIT Press – for foundational DL understanding.

Online Resources/E-learning Resources:

1. https://cybersecurity.att.com/blogs/security-essentials/machine-learning-in-cybersecurity
2. https://www.coursera.org/learn/machine-learning-security
3. https://github.com/guardrailsio/awesome-ml-security
4. https://www.unb.ca/cic/datasets/index.html – Cybersecurity public datasets

Name of the Program:	B.Tech. CSE- AI&ML	Semester: 8	Level: UG
Course Name:	Virtual Reality	Course Code/ Course Type	MOOCML803 / PEC
Course Pattern:	2026	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical/ Oral
-	-	1	1	1	25	-	25

Pre-Requisite:

1. Familiarity with 3D graphics and computer vision concepts.
2. Basics of human-computer interaction and multimedia systems.

Course Objectives (CO):	**The objectives of this course are:** 1. To introduce the concepts and principles of virtual reality (VR) systems. 2. To explore the components of VR including hardware, software, and interaction techniques. 3. To understand the human perception mechanisms relevant to immersive systems. 4. To evaluate real-world applications and trends of VR in diverse domains. 5. To study design guidelines and ethical issues in VR development.
Course Learning Outcomes (CLO):	**Students would be able to:** 1. Describe the architecture and working of a virtual reality system. 2. Identify suitable hardware and software components for VR applications. 3. Understand the impact of human visual and motion perception on VR system design. 4. Analyze and critique use cases of VR in healthcare, gaming, education, etc. 5. Discuss ethical and accessibility concerns related to immersive technologies.

Course Contents/Syllabus:

Descriptors/Topics	CLO	Hours
UNIT I – Introduction to Virtual Reality		
Definition and history of VR; Mixed reality spectrum (VR, AR, MR); Types of VR systems – immersive, semi-immersive, non-immersive; Key applications in different industries; VR vs 3D gaming.	CLO1	3
UNIT II – VR Hardware and Software		
Head-mounted displays (HMD), motion trackers, gloves, controllers; Audio and haptic feedback systems; VR engines: Unity, Unreal Engine; VR APIs and SDKs; Device integration and drivers.	CLO2	3
UNIT III – Human Factors and Perception in VR		

Human visual system, depth cues, stereoscopy, motion parallax; Field of View (FoV), refresh rate, latency; Motion sickness and cybersickness; Interaction metaphors – gaze, gesture, controller-based.	CLO3	3
UNIT IV – Applications and Use Cases		
Case studies: VR in healthcare (surgery, phobia therapy), education (virtual labs), gaming (immersive worlds), military, training simulations; Emerging trends – Metaverse, VR for empathy.	CLO4	3
UNIT V – Design Guidelines and Ethics		
User experience design for VR; Guidelines for VR development; Accessibility in VR; Ethics: data privacy, addiction, psychological impact; Sustainable development and inclusivity in immersive tech.	CLO5	3
Total Hours		**15**

Learning Resources:

Text Books:

1. Jason Jerald, *The VR Book: Human-Centered Design for Virtual Reality*, Morgan & Claypool.
2. Grigore C. Burdea and Philippe Coiffet, *Virtual Reality Technology*, Wiley.
3. Tony Parisi, *Learning Virtual Reality*, O'Reilly.

Reference Books:

1. Alan Craig, *Understanding Augmented Reality*, Morgan Kaufmann.
2. Steven M. LaValle, *Virtual Reality*, online textbook.
3. Doug Bowman et al., *3D User Interfaces: Theory and Practice*, Addison-Wesley.

Online Resources/E-learning Resources:

1. `https://www.coursera.org/learn/virtual-reality` – Coursera: University of London.
2. `https://learn.unity.com/` – Unity Learn Platform.
3. `https://xrbootcamp.com/` – XR Development and Design Bootcamps.
4. `https://vr.google.com/` – Google VR tools and experiments.

Name of the Program:	B.Tech. CSE-AI&ML	Semester: 8	Level: UG
Course Name:	Major Project-II	Course Code/ Course Type	UBTML416 / PROJ
Course Pattern:	2026	Version	1.0

Assessment Scheme					Teaching Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical/ Oral
-	6	-	6	12	100	-	100

Pre-Requisite:

1. Basics of Software Engineering and Computer Programming Concepts
2. Basics of Programming Language such as C, MATLAB, Python

Course Objectives (CO):	**The objectives of Project Phase II are:** 1. To comprehend the Product Development Process. 2. To plan and organize activities related to real-time project development. 3. To implement a technical solution using appropriate platforms and tools. 4. To enhance research, documentation, and publication capabilities. 5. To demonstrate ethical, societal, and professional responsibilities during development.
Course Learning Outcomes (CLO):	**Students would be able to:** 1. Comprehend, plan and execute a complete real-world project. 2. Design innovative solutions using appropriate hardware/software platforms. 3. Prepare structured project documentation and technical reports. 4. Demonstrate the implemented system and validate the results. 5. Publish and present the work in reputed journals/conferences.

Course Contents/Syllabus:

Sr. No.	Descriptors/Topics	Week	CLO	Hours
1	Guide allotment, application for sponsorship/internship, finalization of topic and platform, project planning	1, 2	CLO1	8
2	Literature review, finalization of methodology and specifications, Review 1	3, 4	CLO2	8
3	Exploration of tools, implementation of block design, system flow validation, Review 2	5, 6	CLO3	8
4	Module simulation and integration on selected platform, performance testing	Week 7, 8	CLO4	8
5	Project report writing, copyright/paper publication, final demonstration and review	9, 10	CLO5	8
			Total Hours	**40**