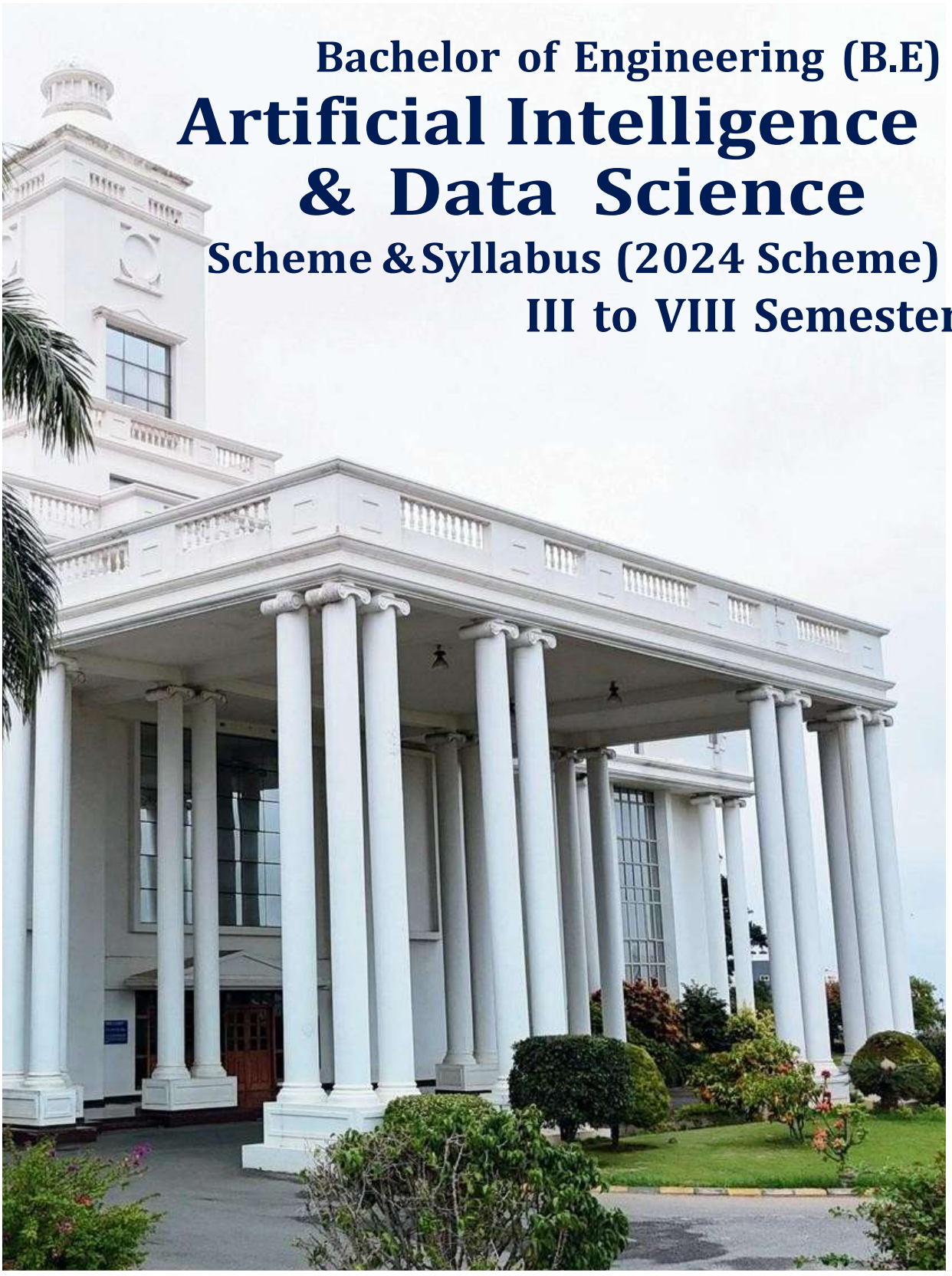
GLOBAL ACADEMY OF TECHNOLOGY
(Autonomous)Approved by AICTE, Affiliated to VTU
Ideal Homes, Rajarajeshwarinagar, Bengaluru - 560 098

Bachelor of Engineering (B.E)

Artificial Intelligence & Data Science

Scheme & Syllabus (2024 Scheme)

III to VIII Semester



BE Programs: CSE, ISE, AI&DS, ECE, CS-AI&ML, EEE, ME, CE, AE, AI&ML
PG Programs: M. Tech (CSE), M. Tech (Structural Engineering), MBA
Ph. D Programs: VTU Affiliated Research Centers in Engineering

DEPARTMENT VISION

To achieve high levels of quality education by utilizing cutting-edge technology, cultivating a collaborative culture, and propagating customer-focused innovations in order to benefit society as a whole.

DEPARTMENT MISSION

1. To strengthen the theoretical and practical aspects of the learning process by strong research culture in collaboration with communities to build healthy and sustainable world.

2. To Contribute towards greater association between academia and businesses to establish entrepreneurship among young minds.

3. Concentrate efforts towards application areas in health care, agriculture, transport and environment.

PROGRAM EDUCATIONAL OBJECTIVES(PEOs)

1. Ability to exhibit professional skills as Data Analysts to develop intelligent solutions for various engineering and science applications. ‘

2. Imbibe passion for life-long learning, innovation, career-growth, leadership qualities, and professional ethics.

3. Efficient team leaders, effective communicators and capable of working in multidisciplinary environment as entrepreneurs and contribute to cutting edge technologies and society.

PROGRAM SPECIFIC OUTCOMES

1. Design, develop and implement applications and system software.

2. Develop intelligent solutions using Data Science technologies to cater the societal needs.

PROGRAM OUTCOMES

PO1: Engineering Knowledge:

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

PO2: Problem Analysis:

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

PO3: Design/Development of Solutions:

Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs

with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required (WK5).

PO4: Conduct Investigations of Complex Problems:

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

PO5: Engineering Tool Usage:

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

PO6: The Engineer and The World:

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

PO7: Ethics:

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

PO8: Individual and Collaborative Teamwork:

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

PO9: Communication:

Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and

write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences.

PO10: Project Management and Finance:

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

PO11: Life-Long Learning:

Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies, and iii) critical thinking in the broadest context of technological change .

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B.E. in Artificial Intelligence and Data Science

Scheme of Teaching and Examinations 2025

III SEMESTER

Sl. No	Course	Course Code	Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	SDA	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	BSC	BMATS24301	Discrete Mathematics	TD & PSB: MAT	3	0	0	0	03	50	50	100	3
2	IPCC	BAD24302	Operating Systems	TD & PSB: AIDS	3	0	2	0	03	50	50	100	4
3	IPCC	BAD24303	Data Science with Python	TD & PSB: AIDS	3	0	2	0	03	50	50	100	4
4	PCC	BAD24304	Data Structures and its Applications	TD & PSB: AIDS	3	0	0	0	03	50	50	100	3
5	PCCL	BADL24305	Data Structures Lab	TD & PSB: AIDS	0	0	2	0	03	50	50	100	1
6	ETC/PLC	BAD24306x	ETC/PLC	TD & PSB: AIDS	3	0	0	0	03	50	50	100	3
7	UHV	BSCK24307	Social Connect and Responsibility	Any Department	1	0	0	0	01	100	---	100	1
8	AEC/ SEC	BAD24358X	Ability Enhancement Course/Skill Enhancement Course - III	TD & PSB: AIDS	1	0	0	0	01	50	50	100	1
					0	0	2	0	02				
9	MC	BNSK24359	National Service Scheme (NSS)	NSS coordinator	0	0	2	0		100	---	100	0
		BPEK24359	Physical Education (PE) (Sports and Athletics)	Physical Education Director									
		BYOK24359	Yoga	Yoga Teacher									
		BLAK24359	Liberal Arts	Prominent NGO									
									Total	**550**	**350**	**900**	**20**

PCC: Professional Core Course, **PCCL**: Professional Core Course laboratory, **UHV**: Universal Human Value Course, **MC**: Mandatory Course (Non-credit), **AEC**: Ability Enhancement Course, **SEC**: Skill Enhancement Course, **L:** Lecture, **T**: Tutorial, **P**: Practical **S= SDA**: Skill Development Activity, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation. K : This letter in the course code indicates common to all the stream of engineering. ESC: Engineering Science Course, ETC: Emerging Technology Course, PLC: Programming Language Course

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Emerging Technology Course /Programming Language Course (ETC/PLC)			
BAD24306A	Data Science and Statistics	BAD24306C	Computer Organization and Architecture
BAD24306B	Fuzzy logic and Decision making	BAD24306D	Introduction to Internet of Things
Ability Enhancement Course/Skill Enhancement Course - III			
BAD24358A	Unix Shell Programming	BAD24358C	PHP Programming
BAD24358B	Data Analytics using Excel	BAD24358D	MERN

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B.E. in Artificial Intelligence and Data Science

Scheme of Teaching and Examinations 2025

IV SEMESTER

Sl. No	Course and Course Code		Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	BSC	BMATS24401	Probability and Graph Theory	TD & PSB: MAT	3	0	0	0	03	50	50	100	3
2	IPCC	BAD24402	Machine Learning - 1	TD & PSB: AIDS	3	0	2	0	03	50	50	100	4
3	PCC	BAD24403	Design and Analysis of Algorithms	TD & PSB: AIDS	3	0	0	0	03	50	50	100	3
4	PCC	BAD24404	Computer Networks	TD & PSB: AIDS	3	0	0	0	03	50	50	100	3
5	PCCL	BADL24405	Algorithms Laboratory	TD & PSB: AIDS	0	0	2	0	03	50	50	100	1
6	ETC/PLC	BAD24406X	ETC/PLC	TD & PSB: AIDS	3	0	0	0	03	50	50	100	3
7	AEC/ SEC	BAD24457X	Ability Enhancement Course/Skill Enhancement Course- IV	TD & PSB: AIDS	1	0	0	0	01	50	50	100	1
					0	0	2	0	02				
8	BSC	BBOK24407	Biology For Engineers	TD & PSB: BT, CHE	1	0	0	0	01	50	50	100	1
9	UHV	BUHK24408	Universal human values course	Any Department	1	0	0	0	01	50	50	100	1
10	MC	BNSK24459	National Service Scheme (NSS)	NSS coordinator	0	0	2	0		100	---	100	0
		BPEK24459	Physical Education (PE) (Sports and Athletics)	Physical Education Director									
		BYOK24459	Yoga	Yoga Teacher									
		BLAK24459	Liberal Arts	Prominent NGO									
									Total	**550**	**450**	**1000**	**20**

PCC: Professional Core Course, **PCCL**: Professional Core Course laboratory, **UHV**: Universal Human Value Course, **MC**: Mandatory Course (Non-credit), **AEC**: Ability Enhancement Course, **SEC**: Skill Enhancement Course, **L:** Lecture, **T**: Tutorial, **P**: Practical **S= SDA**: Skill Development Activity, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation. K: This letter in the course code indicates common to all the stream of engineering.

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Emerging Technology Course /Programming Language Course (ETC/PLC)			
BAD24406A	Image Processing	BAD24406C	Object Oriented Programming with C++
BAD24406B	Introduction to Data Mining	BAD24406D	Object Oriented Programming with Java
Ability Enhancement Course / Skill Enhancement Course – IV			
BAD24457A	Data Analytics with R	BAD24457C	Optimization Technique
BAD24457B	Project Management with GIT	BAD24457D	Mastering Data Visualization

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Department: **DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**		
Semester: **3**	Course Code: **BMATS24301**	Contact Hrs /week: **4**
Course Description: **DISCRETE MATHEMATICS**		No. of Credits:**3** L : T : P : S = **3:0:0:0**
Course Category: **BSC**		Total no. of Hours = **40**
CIE: **50 Marks**	SEE: **50 Marks**	Exam Hours: **03**
Course Pre-requisites: Basic algebra and number theory, Fundamental concepts of functions and relations, Introductory set theory and probability concepts from high school mathematics		

1. PREAMBLE ABOUT THE COURSE

This course provides a foundation in discrete mathematical structures that are vital to computer science, information technology, and applied mathematics. The course covers set theory, logic, counting principles, relations, functions, and probability with emphasis on reasoning, proof techniques, and combinatorial problem-solving. Through structured learning and problem-oriented approaches, students will build the mathematical foundation required for algorithm design, data structures, and theoretical computer science.

2. COURSE LEVEL OBJECTIVES

CLO1	Apply set theory and probability concepts**.**
CLO2	Construct and evaluate logical statements**.**
CLO3	Use counting principles and combinatorial techniques**.**
CLO4	Analyze and classify relations and functions.
CLO5	Identify and manipulate different types of functions

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Apply set theory, counting principles, and basic probability concepts to model and solve problems in computer science, including algorithm analysis and data representation.	PO1, PO2, PO5	L3	WK1, WK2, WK3,WK6	8
CO2	Construct and evaluate logical statements using truth tables, rules of inference, and quantifiers to develop valid	PO1, PO2, PO5	L3	WK1, WK2, WK3,WK6	8

	proofs and verify program correctness.				
CO3	Solve combinatorial problems using counting techniques, permutations, combinations, and mathematical induction to support algorithm design and complexity analysis.	PO1, PO2, PO5	L2	WK1, WK2, WK3,WK6	8
CO4	Analyze relations and their properties using matrices and graphs, and interpret equivalence and partial order relations using Hasse diagrams and partitions in discrete structures.	PO1, PO2, PO5	L4	WK1, WK2, WK3,WK6.	8
CO5	Apply function theory, generating functions, and recurrence relations to model computational processes and analyze recursive algorithms.	PO1, PO2, PO5	L3	WK1, WK2, WK3,WK6	8

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	Sets and Subsets, Set Operations and the Laws of Set Theory, Counting and Venn Diagrams. Probability, Axioms of probability, Conditional probability, Bayes theorem.	CO1	8
II	Fundamentals of Logic: Basic Connectives and Truth Tables, Logic Equivalence, The Laws of Logic Logical Implication: Rules of Inference, Quantifiers, Definitions, and the Proofs of Theorems.	CO2	8
III	Fundamental Principles of Counting: The Rules of Sum and Product, Permutations, Combinations: The Binomial Theorem, Combinations with Repetition. The Well Ordering Principle: Mathematical Induction, Recursive Definitions.	CO3	8
IV	Relations and Functions: Cartesian Products and Relations, Properties of Relations, Computer Recognition: Zero-One Matrices and Directed Graphs, Partial Orders: Hasse Diagrams, Equivalence Relations and Partitions.	CO4	8
V	Functions: Plain and One-to-One, Onto Functions. Function Composition and Inverse Functions. Generating function and first order recurrence relation.	CO5	8

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Discrete and Combinatorial Mathematics	Ralph P. Grimaldi	Pearson Education	5th	All modules
2	Higher Engineering Mathematics	B. S. Grewal	Khanna Publishers	44th	All modules
3	Discrete Mathematics and its Applications	Kenneth H. Rosen	McGraw Hill	6th	All modules
4	Advanced Engineering Mathematics	E. Kreyszig	John Wiley & Sons	10th	All modules
	Probability, Statistics and Random Processes with Queueing Theory and Queueing Networks	T Veerarajan	Tata Mc-Graw Hill Co	4^{th}	All modules

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCS/WEB RESOURCE

1. https://nptel.ac.in/courses
2. https //swayam.gov.in/nptel onlinecourses.nptel.ac.in/
3. https://academicearth.org/online-college-courses/
4. https://elearning.vtu.ac.in/

7. EVALUATION METHODOLOGY

a) Continuous Internal Evaluation (CIE) = 50 marks
b) Semester End Examination (SEE) = 50 marks
Total = 100 marks

CIE Framework:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

The laboratory assessment would be restricted to only the CIE evaluation.

Continuous Internal Evaluation (CIE):

Two Tests are to be conducted for 40 marks each. The average of the two tests are taken for computation of CIE. The CIE would also include assignment evaluation for 10 marks.

Typical Evaluation pattern for integrated courses is shown in the Table below

Component		Marks	Total Marks
CIE	CIE Test-1	**40**	**50**
	CIE Test-2	**40**	
	Assignment	**10**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

8. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → / COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	1			1						
CO2	3	1			1						
CO3	3	1			1						
CO4	3	1			1						
CO5	3	1			1						

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

9. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → / COs ↓	PSO1	PSO2
CO1	2	
CO2	2	
CO3	2	
CO4	2	
CO5	2	

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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Department: **DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**		
Semester: **3**	Course Code: **BAD24302**	Contact Hrs /week: **3**
Course Description: **OPERATING SYSTEMS**		No. of Credits:**4** L : T : P : S = **3:0:2:0**
Course Category: **IPCC**		Total no. of Hours = **52**
CIE: **50 Marks**	SEE: **50 Marks**	Exam Hours: **03**
Course Pre-requisites: Basic understanding of computer architecture and organization, Understanding of memory management and process concepts		

1. PREAMBLE ABOUT THE COURSE

This subject introduces the fundamental concepts of operating systems, including process management, memory handling, file systems, and concurrency. Students will explore real-world OS mechanisms and their roles in system performance. The lab provides hands-on practice in implementing basic OS functionalities. It builds a solid understanding of system-level software. The course lays a foundation for advanced system programming and resource management. Real-time scenarios and simulations are emphasized.

2. COURSE LEVEL OBJECTIVES

CLO1	To understand the OS services, types of OS and different computing environments.
CLO2	To understand the concept of processes, IPC and multithreading models.
CLO3	To understand scheduling algorithms to compute various scheduling criteria
CLO4	To understand methods for handling deadlock and solve memory management problems using page replacement algorithms.

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Identify the operating system structures and services, and recognize the concepts of process management.	PO1,PO2,PO3,PO4, PO9,PO11,PSO1	L2	WK1, WK2, WK6	08
CO2	Demonstrate multithreaded programming and interpret	PO1,PO2,PO3,PO4, PO9,PO11,PSO1	L3	WK1, WK2, WK6	08

	process synchronization techniques.				
CO3	Examine the optimization of resource utilization using different scheduling algorithms.	PO1,PO2,PO3,PO4, PO9,PO11,PSO1	L4	WK1, WK2, WK6	08
CO4	Distinguish the methods for handling deadlock and compare memory management strategies.	PO1,PO2,PO3,PO4, PO9,PO11,PSO1	L4	WK1, WK2, WK6	08
CO5	Contrast different techniques for management of memory & file resources.	PO1,PO2,PO3,PO4, PO9,PO11,PSO1	L4	WK1, WK2, WK6	07

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	**Introduction to OS:** What Operating Systems Do, Computer-System Organization, Computer-System Architecture, Operating-System Operations, Resource Management, Computing Environments. **Operating-System Services:** User and Operating-System Interface, System Calls, Operating-System Design and Implementation, Operating-System Structure, **Process Management and Threads:** Processes, Process Concept	CO1	08
II	**Process Management and Threads:** Process Scheduling, Operations on Processes, Interprocess Communication, IPC in Shared-Memory Systems, IPC in Message-Passing Systems. **Threads:** Overview, Multithreading Models. **Process Synchronization:** Synchronization: The critical section problem; Peterson's solution; Synchronization hardware; Semaphores; Classical problems of synchronization; Monitors.	CO2	08
III	**CPU Scheduling:** Basic Concepts, Scheduling Criteria, Scheduling Algorithms (First Come First Serve, Shortest Job First, Shortest Remaining Time First, Priority Scheduling, Round Robin).	CO3	08
IV	**Deadlocks:** Deadlock Characterization, Methods for Handling Deadlocks, Deadlock Prevention, Deadlock Avoidance (Safe State, Banker's Algorithm), Deadlock Detection, Recovery from Deadlock.	CO4	08
V	**Memory Management:** Main Memory management- Contiguous Memory Allocation, Segmentation, Paging, Virtual Memory Hardware -TLB, Page Replacement Algorithms (FIFO, LRU, Optimal Page Replacement). **File System: File system:** File concept; Access methods; Directory structure; File system mounting; File sharing; Protection	CO5	07

Lab Programs:

Sl. No.	Experiments
1	Implement the fork() and exec() system call using C programming
2	Implement the wait(), exit() and abort() system call using C programming
3	Simulate Inter Process Communication techniques: Messages Queues, and Shared Memory using C Programming
4	Simulate solutions to Producer – Consumer Process Synchronization Problems using C Programming
5	Simulate the following CPU scheduling algorithm using C Programming i) FCFS ii) SJF iii) SRTF iv) Round Robin v) Priority
6	Simulate Deadlock detection through Banker's Algorithm using C
7	Simulate Deadlock Avoidance through Banker's Safety Algorithm
8	Simulate Deadlock Avoidance through Banker's Resource Request Algorithm
9	Simulate Contiguous Memory Allocation for i) First Fit ii) Best Fit iii) Worst Fit
10	Simulate the following Page Replacement Algorithms i) FIFO ii) LRU iii) Optimal Page Replacement

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Operating System Concepts	Abraham Silberschatz, Peter B. Galvin, Greg Gagn,	Wiley	9th Edition.	All modules
2	Operating Systems	William Stallings	Pearson Education	5th Edition	All modules
3	Operating Systems	Ramez Elmasri, A Carrick, David Levine	McGrawHill		All modules
4	Modern Operating System	Andrew S. Tanenbaum	PHI		All modules

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCS/WEB RESOURCE

- Operating system overview https://www.tutorialspoint.com/operating_system/os_overview.html
- Lecture notes on Operating System https://www.bput.ac.in › lecture-notes-download
- Operating System https://en.wikipedia.org/wiki/Operating_system
- https://www.youtube.com/watch?v=vBURTt97EkA&list=PLBlnK6fEyqRiVhbXDGLXDk_OQAeuVcp2O
- .https://www.youtube.com/watch?v=a2B69vCtjOU&list=PL3-wYxbt4yCjpcfUDzTgD_ainZ2K3MUZ&index=2
- https://www.coursera.org/learn/os-power-user
- https://www.udacity.com/course/introduction-to-operating-systems--ud923

7. EVALUATION METHODOLOGY

a) Continuous Internal Evaluation (CIE) = 50 marks
b) Semester End Examination (SEE) = 50 marks
Total = 100 marks

CIE Framework:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

The laboratory assessment would be restricted to only the CIE evaluation.

Continuous Internal Evaluation (CIE):

Two Tests are to be conducted for 40 marks each. The average of the Two tests are taken for computation of CIE on a scale of 30, the CIE would also include laboratory evaluation for 20 marks. The laboratory marks of 20 would comprise of 10 marks for regular laboratory assessment to include lab observation. 10 marks would be exclusive for laboratory internal assessment test to be conducted at the end of the semester.

Typical Evaluation pattern for integrated courses is shown in the Table below

Component		Marks	Total Marks
CIE	CIE Test-1	**30**	**50**
	CIE Test-2	**30**	
	Laboratory	**20**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

8. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → / COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3	2				2			1
CO2	3	3	3	2				2			1
CO3	3	3	3	2				2			1
CO4	3	3	3	2				2			1
CO5	3	3	3	2				2			1

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

9. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → / COs ↓	PSO1	PSO2
CO1	3	
CO2	3	
CO3	3	
CO4	3	
CO5	3	

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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Department: **DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**		
Semester: **3**	Course Code: **BAD24303**	Contact Hrs /week: **3**
Course Description: **DATA SCIENCE WITH PYTHON**		No. of Credits:**4** L : T : P : S = **3:0:2:0**
Course Category: **IPCC**		Total no. of Hours = **52**
CIE: **50 Marks**	SEE: **50 Marks**	Exam Hours: **03**
Course Pre-requisites: Basic programming knowledge, Familiarity with data structures (lists, arrays, dictionaries), Understanding of fundamental math concepts (algebra, statistics)		

1. PREAMBLE ABOUT THE COURSE

This subject focuses on using Python as a tool for data analysis and scientific computing. It includes libraries like NumPy, pandas, Matplotlib, and scikit-learn. The lab integrates theoretical concepts with real-world data operations. Students learn preprocessing, visualization, and model development. Emphasis is on solving analytical problems through coding. The course bridges programming and statistics for data insights.

2. COURSE LEVEL OBJECTIVES

CLO1	To build a strong foundation to understand advanced python packages for data science.
CLO2	To understand daily tasks that data scientists tackle.
CLO3	To gain skills needed to implement machine learning, AI, and predictive analytics algorithms.
CLO4	To understand the access to a wide variety of data analysis and data science libraries.
CLO5	To meet industry demand for experts with Python skills.

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Identify the fundamentals of NumPy and ndarrays.	PO1,PO2,PO3,PO5,PO6 PO8,PO9,PO10, PO11,PSO1, PSO1	L2	WK5, WK6	08
CO2	Apply the essential features of Pandas to extract and manipulate relevant data.	PO1,PO2,PO3,PO5,PO6 PO8, PO9,PO10, PO11,PSO1, PSO1	L3	WK5, WK6	08

CO3	Analyze statistical data and represent the results using appropriate graphical methods.	PO1,PO2,PO3,PO5,PO6 PO8,PO9,PO10, PO11,PSO1, PSO1	L4	WK5, WK6	08
CO4	Analyze and evaluate techniques used in data preparation and wrangling to ensure data quality and consistency.	PO1,PO2,PO3,PO5,PO6 PO8,PO9,PO10, PO11,PSO1, PSO1	L4	WK5, WK6	08
CO5	Examine real-world data to apply suitable preprocessing techniques, including for time-series data.	PO1,PO2,PO3,PO5,PO6 PO8,PO9,PO10, PO11,PSO1, PSO1	L4	WK5, WK6	07

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	**Basics of Numpy Arrays:** NumPy Array Attributes The NumPy nd array, A Multidimensional Array Object, Creating nd arrays, Data Types for nd arrays, Arithmetic with NumPy Arrays, Basic Indexing and Slicing, Boolean Indexing, Fancy Indexing, Transposing Arrays and Swapping Axes, Reshaping of Arrays, Aggregations, Universal Functions: Fast Element-Wise Array Functions, Array-Oriented Programming with Arrays, Expressing Conditional Logic as Array Operations, Mathematical and Statistical Methods, Methods for Boolean Arrays, Sorting, Unique and Other Set Logic, File Input and Output with Arrays, Linear Algebra, Pseudorandom Number Generation, Example: Random Walks.	CO1	08
II	**Pandas:** Installing and using Pandas, Introducing Pandas Objects, Operating on data in pandas. **Introduction to pandas Data Structures:** Series, DataFrame, Index Objects Essential Functionality, Reindexing, Dropping Entries from an Axis, Indexing, Selection, and Filtering, Integer Indexes, Arithmetic and Data Alignment, Function Application and Mapping, Sorting and Ranking, Axis Indexes with Duplicate Labels. **Combining Datasets:** Concat, Append, Merge and Join. Working with Time Series	CO2	08
III	**Plotting and Visualization:** Figures and Subplots, Charts using plot(), pie chart, violin plot, scatter plot, histogram, bar chart, area plot, Quiver plot, Mesh grid, contour plot, Colors, Markers, and Line Styles, Ticks, Labels, and Legends, Annotations and Drawing on a Subplot, Saving Plots to File, matplotlib Configuration.	CO3	08

	Plotting with pandas and seaborn: Three-Dimensional Plotting in Matplotlib, Python Visualization Tools for categorical Variables and Continuous Variables.		
IV	**Data Cleaning and Preparation:** Handling Missing Data, Filtering Out Missing Data, Filling in Missing Data, Data Transformation, Removing Duplicates, Transforming Data Using a Function or Mapping, Replacing Values, Renaming Axis Indexes, Discretization and Binning, Detecting and Filtering Outliers, Computing Indicator/Dummy Variables. **Data Wrangling:** Join, Combine, and Reshape: Combining and Merging Datasets, Database-Style Data Frame Joins, Merging on Index, Concatenating Along an Axis, Combining Data with Overlap, Reshaping and Pivoting, Reshaping with Hierarchical Indexing, Pivoting "Long" to "Wide"Format, Pivoting "Wide"to "Long"Format.	CO4	08
V	**Data Preprocessing:** Datasets and Partitions, Underfitting in Machine Learning, Overfitting in Machine Learning, Cross-Validation, Normalization, Data Scaling, Data Integration Outliers' removal. **Time Series Data**: Introduction to time series, time series in pandas, time series decomposition and resampling.	CO5	07

Lab Programs:

Sl. No.	Experiments
1	a) Write a Python program to create a one-dimensional NumPy array, a two-dimensional array, and a three-dimensional array. Print their attributes like shape, size, and data type. b) Write a python program to find mean, median, minimum, maximum, standard deviation, cumulative sum and cumulative product for the following array elements 1,2,3,4,5,6,7,8,9,10 using Numpy array statistical methods
2	a) Write a Python program to create a 3x4 array and then reshape it into a 2x6 array. Also, demonstrate the transpose of the original array b) Given a 3x3 matrix, extract: • The first row • The last column • The middle element
3	a) Write a python program for indexing, selection and filtering in pandas series and data frames. b) Write a python program to create pandas data frame from list of list
4	a) Create a DataFrame with student names and their scores in 3 subjects. Access data using .loc[] and .iloc[]. b) Create a Pandas DataFrame and sort it by column values and index labels.
5	Write a Python program to: • Concatenate two DataFrames. • Append one DataFrame to another. • Merge two DataFrames based on a common column. • Perform a left join between two DataFrames

<table>
<tr><td>6</td><td>a) Write a program to create bar graph for the given data: data = {'AUDI':23, 'BMW':17, 'FORD':35, 'TESLA':29, 'JAGUAR':12, 'MERCEDES':41}
b) Write a program to create area plot on the given data: x = range (1,6);
y1=[1,4,6,8,9]; y2=[2,2,7,10,12]; y3=[3.5,0,1.4,6,1]</td></tr>
<tr><td>7</td><td>Merge two DataFrames based on a common column using merge(). Perform different types of joins:
Inner Join
Outer Join
Left Join
Right Join</td></tr>
<tr><td>8</td><td>a) Write a program to demonstrate discretization and binning
b) Convert a long-format DataFrame to wide format</td></tr>
<tr><td>9</td><td>Create a Pandas DataFrame with some missing (NaN) values. Use different techniques to handle missing data:
Drop rows with missing values.
Drop columns with missing values.
Fill missing values with the column mean/median.</td></tr>
<tr><td>10</td><td>Write a python program to sort the following data according to descending order of name<table><tr><td>Name</td><td>Age</td><td>Designation</td></tr><tr><td>Sanjeev</td><td>37</td><td>Manager</td></tr><tr><td>Keshav</td><td>42</td><td>Clerk</td></tr><tr><td>Rahul</td><td>38</td><td>Accountant</td></tr></table></td></tr>
</table>

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Python Data Science handbook	Jake Vander Plas	O'Reilly		All Modules
2	Python for Data Analysis	Wes McKinney	O'Reilly.	2nd Edition	All Modules
3	Data Analytics using Python	Bharti Motwani	Wiley		All Modules
4	Introduction to Python Programming	Gowrishankar S, Veena A	CRC Press/Taylor & Francis	1st Edition	All Modules
5	Hands-On Machine Learning with Scikit	AurelienGeron	O'Reilly Media	2nd Edition	All Modules

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCS/WEB RESOURCE

- Automate The Boring Stuff with Python https://automatetheboringstuff.com/
- Python 3 Tutorial https://www.tutorialspoint.com/python3/python_tutorial.pdf
- Python 3 for Absolute Beginners http://index of.es/Python/Python%203%20for%20Absolute%20Beginners.pdf
- https://www.coursera.org/learn/python-for-applied-data-science-ai
- https://www.edx.org/course/python-basics-for-data-science
- https://cognitiveclass.ai/courses/python-for-data-science

7. EVALUATION METHODOLOGY

a) Continuous Internal Evaluation (CIE) = 50 marks
b) Semester End Examination (SEE) = 50 marks
Total = 100 marks

CIE Framework:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

The laboratory assessment would be restricted to only the CIE evaluation.

Continuous Internal Evaluation (CIE):

Two Tests are to be conducted for 40 marks each. The average of the two tests are taken for computation of CIE on a scale of 30, the CIE would also include laboratory evaluation for 20 marks. The laboratory marks of 20 would comprise of 10 marks for regular laboratory assessment to include lab observation. 10 marks would be exclusive for laboratory internal assessment test to be conducted at the end of the semester.

Typical Evaluation pattern for integrated courses is shown in the Table below

Component		Marks	Total Marks
CIE	CIE Test-1	**30**	**50**
	CIE Test-2	**30**	
	Laboratory	**20**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

8. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → / COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3		2	1		2	2	2	2
CO2	3	3	3		2	1		2	2	2	2
CO3	3	3	3		2	1		2	2	2	2
CO4	3	3	3		2	1		2	2	2	2
CO5	3	3	3		2	1		2	2	2	2

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

9. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → / COs ↓	PSO1	PSO2
CO1	2	2
CO2	2	2
CO3	2	2
CO4	2	2
CO5	2	2

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

*****

Department: **DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**		
Semester: **3**	Course Code: **BAD24304**	Contact Hrs /week: **3**
Course Description: **DATA STRUCTURES AND ITS APPLICATIONS**		No. of Credits:**3** L : T : P : S = **3:0:0:0**
Course Category: **PCC**		Total no. of Hours = **39**
CIE: **50 Marks**	SEE: **50 Marks**	Exam Hours: **03**
Course Pre-requisites: Basic knowledge of programming concepts, understanding of fundamental algorithms (sorting, searching).		

1. PREAMBLE ABOUT THE COURSE

This course covers essential data structures like arrays, stacks, queues, linked lists, trees, and graphs. It emphasizes algorithm efficiency and real-time applications. Topics focus on memory management and abstract data types. The subject develops skills in problem solving and logic building. Real-world cases like scheduling and pathfinding are discussed. It strengthens the foundation for algorithm design.

2. COURSE LEVEL OBJECTIVES

CLO1	Understand the fundamental concepts of data structures and their importance in algorithm design and problem-solving.
CLO2	Implement various linear data structures such as arrays, linked lists, stacks, and queues for efficient data manipulation.
CLO3	Ability to analyze Binary search trees, Balanced binary search trees.
CLO4	Analyze, evaluate and choose appropriate data structure and algorithmic technique to solve real-world problems

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Apply the concepts of Stacks to solve a problem.	PO1,PO2,PO3,PO4,PO5 PO8,PO11,PSO1, PSO2	L2	WK1, WK2, WK4	8
CO2	Demonstrate the implementation and application of queue data structures, including their variations, to solve real-world problems	PO1,PO2,PO3,PO4,PO5 PO8,PO11,PSO1, PSO2	L2	WK1, WK2, WK4	8
CO3	Investigate the various types of lists and their application in real world.	PO1,PO2,PO3,PO4,PO5 PO8,PO11,PSO1, PSO2	L2	WK1, WK2, WK4	8

CO4	Analyze and implement binary tree structures to optimize searching, traversal, and hierarchical data representation.	PO1,PO2,PO3,PO4,PO5 PO8,PO11,PSO1, PSO2	L2	WK1, WK2, WK4	8
CO5	Design and develop efficient algorithms using advanced data structures like hash tables, heaps, and balanced trees.	PO1,PO2,PO3,PO4,PO5 PO8,PO11,PSO1, PSO2	L2	WK1, WK2, WK4	7

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	**Introduction:** Introduction to Data Structures, Types of Data Structures, Linear & non-linear Data Structures **Stacks:** Stack definitions & concepts, Representing stacks in C, Operations on stacks, Applications of Stacks: Infix to Postfix, Infix to Prefix, Postfix expression evaluation **Recursion:** Introduction to Recursion, Factorial function, Binary search, Towers of Hanoi problem, GCD of two numbers, Tail End recursion.	CO1	08
II	**Queues**: Representation of queue and its operations operations, circular queues. Priority Queue **Dynamic Memory allocation:** malloc(), calloc(),free(), realloc() **Linked Lists:** Definition and terminology, Singly Linked List (SLL), Various operations on SLL: insertion, deletion and display, Multiplication of two polynomial using SLL, Header Node	CO2	08
III	**Circular Singly Linked List (CSLL):** Definition, Various operations on CSLL: insertion, deletion and display, Application: Addition of long positive integers. **Doubly Linked List (DLL)** Definition, Various operations on DLL: insertion, deletion and display, Applications: Sparse matrix **Trees:** Definition, Terminology, Binary Trees (BT), Binary Search Trees (BST): Insertion, Deletion, and Traversals: Preorder, Postorder and Inorder.	CO3	08
IV	**Expression Trees (ET)**: Definition and Construction of Expression Tree **Threaded Binary Tree:** Types and application. **Heap:** Definition, Construction, Applications of Heap: Priority Queue	CO4	08
V	**Balanced tree:** AVL trees, B tree, B+ tree, Splay tree. **Hashing:** Open Hashing, Closed Hashing, Collision and Collision Resolution Strategies.	CO5	07

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Data Structures using C and C++	Yedidyah Langsam Moshe J. Augenstein and Aaron M. Tenenbaum	PHI/Pearson.	2nd Edition, 2009	All Modules
2	Data Structures and Algorithm Analysis in C++,.	Mark Allen Weiss	Addison-Wesley, ISBN-13:	4th Revised Edition, 2013,	All Modules
3	Data Structures Using C	ReemaThareja	Oxford Higher Education	1st Edition, 2011	All Modules
4	Fundamentals of Data Structures,	Ellis Horowitz, SartajSahni	Illustrated Edition, Computer Science Press.		All Modules

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCS/WEB RESOURCE

- https://ds1-iiith.vlabs.ac.in/List%20of%20experiments.html
- https://ds2-iiith.vlabs.ac.in/List%20of%20experiments.html
- https://archive.nptel.ac.in/courses/106/102/106102064/
- https://www.youtube.com/watch?v=OAc2t3eE6eQ

7. EVALUATION METHODOLOGY

a) Continuous Internal Evaluation (CIE) = 50 marks
b) Semester End Examination (SEE) = 50 marks
Total = 100 marks

CIE Framework:

Scheme of Evaluation: (Integrated courses)

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Two Tests are to be conducted for 40 marks each. The average of the two tests are taken for computation of CIE. The CIE would also include assignment evaluation for 10 marks.

Typical Evaluation pattern for integrated courses is shown in the Table below

Component		Marks	Total Marks
CIE	CIE Test-1	40	50
	CIE Test-2	40	
	Assignment	10	
SEE	Semester End Examination	50	50
Grand Total			100

8. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → / COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3	1	2			1			2
CO2	3	3	3	1	2			1			2
CO3	3	3	3	1	2			1			2
CO4	3	3	3	1	2			1			2
CO5	3	3	3	1	2			1			2

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

9. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → / COs ↓	PSO1	PSO2
CO1	2	1
CO2	2	1
CO3	2	1
CO4	2	1
CO5	2	1

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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Department: **DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**		
Semester: **3**	Course Code: **BADL24305**	Contact Hrs /week: **2**
Course Description: **DATA STRUCTURES LABORATORY**		No. of Credits:**1** L : T : P : S = **0:0:2:0**
Course Category: **Lab**		Total no. of Hours = **13**
CIE: **50 Marks**	SEE: **50 Marks**	Exam Hours: **03**
Course Pre-requisites: Understanding of algorithm basics, Familiarity with a programming language (e.g., C, Java, or Python)		

1. PREAMBLE ABOUT THE COURSE

This lab enables students to implement fundamental data structures practically. Exercises include operations on arrays, linked lists, stacks, queues, trees, and graphs. Students gain hands-on coding experience in C/C++. The lab enhances logical thinking and debugging skills. Emphasis is on optimizing data handling techniques. It complements the theoretical concepts for better understanding.

2. COURSE LEVEL OBJECTIVES

CLO1	Understand the fundamental concepts of data structures and their importance in algorithm design and problem-solving.
CLO2	Implement various linear data structures such as arrays, linked lists, stacks, and queues for efficient data manipulation.
CLO3	Ability to analyze Binary search trees, Balanced binary search trees.
CLO4	Analyze, evaluate and choose appropriate data structure and algorithmic technique to solve real-world problems

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Apply the concepts of Stacks to solve a problem.	PO1,PO2,PO3,PO4,PO5 PO8,PO11,PSO1, PSO2	L3	WK2, WK6	3
CO2	Demonstrate the implementation and application of queue data structures,	PO1,PO2,PO3,PO4,PO5 PO8,PO11,PSO1, PSO2	L3	WK2, WK6	3

	including their variations, to solve real-world problems				
CO3	Investigate the various types of lists and their application in real world.	PO1,PO2,PO3,PO4,PO5 PO8,PO11,PSO1, PSO2	L5	WK2, WK6	3
CO4	Analyze and implement binary tree structures to optimize searching, traversal, and hierarchical data representation.	PO1,PO2,PO3,PO4,PO5 PO8,PO11,PSO1, PSO2	L5	WK2, WK6	2
CO5	Design and develop efficient algorithms using advanced data structures like hash tables, heaps, and balanced trees.	PO1,PO2,PO3,PO4,PO5 PO8,PO11,PSO1, PSO2	L5	WK2, WK6	2

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Sl. No.	Experiments/Programs
1	Develop a menu driven Program in C for the following operations on STACK of Integers (Array Implementation of Stack with maximum size MAX) a. Push an Element on to Stack b. Pop an Element from Stack c. Demonstrate Overflow and Underflow situations on Stack d. Display the status of Stack f. Exit Support the program with appropriate functions for each of the above operations
2	Develop a Program in C for converting an Infix Expression to Postfix Expression. Program should support for both parenthesized and free parenthesized expressions with the operators: +, -, *, /, % (Remainder), ^ (Power) and alphanumeric operands
3	Develop a Program in C to evaluate of Suffix expression with single digit operands and operators: +, -, *, /, % and ^.
4	Develop recursive program in C to 32. To Find GCD of 2 numbers 33. To Solve the Tower of Hanoi Problem
5	Develop a menu driven Program in C for the following operations on QUEUE of Characters (Array Implementation of QUEUE with maximum size MAX) a. Enqueue an Element on to Queue

	b. Dequeue an Element from Queue c. Demonstrate Overflow and Underflow situations on Queue d. Display the status of Queue f. Exit Support the program with appropriate functions for each of the above operations
6	Implement a program to multiply two polynomials using singly linked list.
7	Design a doubly linked list to represent sparse matrix. Each node in the list can have the row and column index of the matrix element and the value of the element. Print the complete matrix as the output.
8	Write a C program to create Binary Tree and to traverse the tree using In-order, Preorder and Post order (recursively).
9	Write a C program to implement priority queue using Heap.
10	Write a C program to implement Hashing using Linear probing. Implement insertion, deletion, search and display.

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Data Structures using C and C++	Yedidyah Langsam Moshe J. Augenstein and Aaron M. Tenenbaum	2nd Edition, 2009	PHI/Pearson.	All Modules
2	Data Structures and Algorithm Analysis in C++,.	Mark Allen Weiss	Addison-Wesley, ISBN-13:	4th Revised Edition, 2013,	All Modules
3	Data Structures Using C	ReemaThareja	Oxford Higher Education	1st Edition, 2011	All Modules
4	Fundamentals of Data Structures,	Ellis Horowitz, SartajSahni	Illustrated Edition, Computer Science Press.		All Modules

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCS/WEB RESOURCE

- https://ds1-iiith.vlabs.ac.in/List%20of%20experiments.html
- https://ds2-iiith.vlabs.ac.in/List%20of%20experiments.html

- https://archive.nptel.ac.in/courses/106/102/106102064/
- https://www.youtube.com/watch?v=OAc2t3eE6eQ

7. EVALUATION METHODOLOGY

a) Continuous Internal Evaluation (CIE) = 50 marks
b) Semester End Examination (SEE) = 50 marks
Total = 100 marks

CIE Framework:

ASSESSMENT AND EVALUATION PATTERN		
	CIE	**SEE**
WEIGHTAGE	**50%**	**50%**
Record	10	**50**
Test	20	
Experiential Learning	20	NIL
Total Marks for the Course	**50**	**50**

8. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → / **COs ↓**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	3	3	3	1	2			1			2
CO2	3	3	3	1	2			1			2
CO3	3	3	3	1	2			1			2
CO4	3	3	3	1	2			1			2
CO5	3	3	3	1	2			1			2

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

9. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → / **COs ↓**	**PSO1**	**PSO2**
CO1	2	1
CO2	2	1
CO3	2	1
CO4	2	1
CO5	2	1

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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Department: **DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**		
Semester: **3**	Course Code: **BAD24306A**	Contact Hrs /week: **3**
Course Description: **DATA SCIENCE AND STATISTICS**		No. of Credits:**3** L : T : P : S = **3:0:0:0**
Course Category: **ETC/PLC**		Total no. of Hours = 39
CIE: **50 Marks**	SEE: **50 Marks**	Exam Hours: **03**
Course Pre-requisites: Basic knowledge of programming (preferably Python or R), Understanding of mathematics (algebra, probability, and calculus)		

1. PREAMBLE ABOUT THE COURSE

This subject combines statistical principles with modern data science tools. It covers descriptive and inferential statistics, hypothesis testing, and data visualization. Practical labs apply concepts using Python and statistical software. Students gain skills in exploratory data analysis and model validation. It builds a strong analytical mindset for data-driven decisions. Real-world datasets and case studies are explored.

2. COURSE LEVEL OBJECTIVES

CLO1	To understand the problems solvable with data science
CLO2	Ability to solve problems from a statistical perspective.
CLO3	To build the skills to create data analytical pipelines
CLO4	To bring the familiarity with the data science ecosystem and the various tools needed to continue developing as a data scientist.

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Identify key data science principles, classify data types, and summarize pre-processing techniques.	PO1,PO2,PO3, PO5, PO8,PO10,PO11,PSO,PSO2	L2	WK3, WK4	8

CO2	Apply advanced data mining concepts to extract meaningful information from data.	PO1,PO2,PO3,PO5, PO8,PO10,PO11,PSO,PSO2	L3	WK3, WK4	8
CO3	Analyze descriptive statistics by interpreting measures of central tendency, dispersion, and data visualization techniques.	PO1,PO2,PO3,PO5, PO8,PO10,PO11,PSO,PSO2	L4	WK3, WK4	8
CO4	Interpret and utilize probability distributions and statistical inference methods.	PO1,PO2,PO3,PO5, PO8,PO10,PO11,PSO,PSO2	L4	WK3, WK4	8
CO5	Demonstrate and interpret hypothesis testing using statistical methods	PO1,PO2,PO3,PO5, PO8,PO10,PO11,PSO,PSO2	L4	WK3, WK4	7

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	**Introduction to Data Science:** Evolution of Data Science, Data Science Roles, Lifecycle of Data Science, Representation of Data Science as a Venn Diagram, Technologies revolving around Data Science. **Types of Data:** Structured and Unstructured Data, Quantitative and Qualitative Data, Four Levels of data (Nominal, Ordinal, Interval, Ratio Level). **Data Pre-processing:** Asking interesting question, obtaining of data, Exploration of data, Modelling of data, Communication and visualization.	CO1	08
II	**Data Mining:** What is Data Mining? Types of Data Mining, Challenges of implementation in Data Mining, Advantages and Disadvantages, Applications of Data Mining. **Overview of Basic Data Mining Tasks:** Classification, Regression, Time Series Analysis, Prediction, Clustering, Sequence Discovery.	CO2	08
III	**Basics of Statistics:** Introduction to Statistics, Terminologies in Statistics, Measures ofcenter, variance and relative standing, Normalization of data using the z-score, Empirical rule, Categories in Statistics (Descriptive and Inferential Statistics). **Descriptive Statistics:** Data Objects and Attribute, Basic Statistical Description of Data (Measuring the Central Tendency	CO3	08

	of Data, Measuring the Dispersion of Data, Graphical Displays), Data Visualization Techniques, Measuring Data Similarity and Dissimilarity.		
IV	**Inferential Statistics:** Overview of Probability Distributions (Bernoulli, Binomial, Poisson, Chi-square, t-tail), Joint distribution of the Sample Mean and Sample Variance, Confidence Intervals, Bayesian Analysis of samples from Normal Distribution, Fisher Estimator, Central Limit Theorem.	CO4	08
V	Hypothesis Testing: Testing simple hypotheses, Uniform tests, Two-sided alternatives, tTest, F-Distribution, Bayes Test Procedures, Case studies based onHypothesis Testing.	CO5	07

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Principles of Data Science	Sinan Ozdemir, Sunil Kakade,	Packt Publishing Limited	2nd Edition	All Modules
2	Probability and Statistics	Morris H Degroot, Mark J Schervish	Pearson	4th Edition	All Modules
3	Data Mining Concepts and Techniques	Jiawei Han and Micheine Kamber, Morgan Kaufmann		3rd Edition	All Modules
4	Machine Learning:A probabilistic perspective	Murphy, KevinP	MIT Press		All Modules

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCS/WEB RESOURCE

- Learn Data Science: Open content for self-directed learning in Data Science: http://learnds.com/
- Foundations of Data Science: https://www.cs.cornell.edu/jeh/book.pdf
- Introduction to Mathematical Thinking: https://www.coursera.org/learn/mathematical-thinking
- IBM Data Science Professional Certificate: https://www.coursera.org/professional-certificates/ibm-datascience

7. EVALUATION METHODOLOGY

a) Continuous Internal Evaluation (CIE) = 50 marks
b) Semester End Examination (SEE) = 50 marks
Total = 100 marks

CIE Framework:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Two tests are to be conducted for 40 marks each. The average of the two tests are taken for computation of CIE. The CIE would also include assignment evaluation for 10 marks.

Typical Evaluation pattern for integrated courses is shown in the Table below

Component		Marks	Total Marks
CIE	CIE Test-1	**40**	**50**
	CIE Test-2	**40**	
	Assignment	**10**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

8. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → / COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3		2			2		2	2
CO2	3	3	3		2			2		2	2
CO3	3	3	3		2			2		2	2
CO4	3	3	3		2			2		2	2
CO5	3	3	3		2			2		2	2

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

9. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → / COs ↓	PSO1	PSO2
CO1	2	3
CO2	2	3
CO3	2	3
CO4	2	3
CO5	2	3

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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Department: **DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**		
Semester: **3**	Course Code: **BAD24306B**	Contact Hrs /week: **3**
Course Description: **FUZZY LOGIC AND DECISION MAKING**		No. of Credits:3 L : T : P : S = **3:0:0:0**
Course Category: **ETC/PLC**		Total no. of Hours = **39**
CIE: **50 Marks**	SEE: **50 Marks**	Exam Hours: **03**
Course Pre-requisites: Basic knowledge of mathematics (sets, relations, and logic), Understanding of classical/probabilistic logic and reasoning.		

1. PREAMBLE ABOUT THE COURSE

This subject introduces fuzzy sets, logic systems, and approximate reasoning. It explores decision-making under uncertainty and vagueness. Applications in control systems, AI, and expert systems are covered. The focus is on modeling real-life ambiguity in data. It enhances understanding of soft computing techniques. Theoretical grounding is provided for intelligent system design.

2. COURSE LEVEL OBJECTIVES

CLO1	Provide an understanding of the basic mathematical elements of the theory of fuzzy sets.
CLO2	Provide an emphasis on the differences and similarities between fuzzy sets and classical sets theories.
CLO3	Explain the concepts of fuzzy logic and decision systems.
CLO4	Enable students to Solve problems that are appropriately solved by fuzzy logic

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Outline the fundamental principles of fuzzy sets and fuzzy logic.	PO1,PO2,PO3, PO5, PO6,PO8,PO11,PSO1,PSO2	L2	WK4, WK5	08
CO2	Employ basic fuzzy inference and approximate reasoning concepts.	PO1,PO2,PO3, PO5, PO6,PO8,PO11,PSO1,PSO2	L3	WK4, WK5	08
CO3	Analyze and examine fuzzy classification	PO1,PO2,PO3, PO5, PO6,PO8,PO11,PSO1,PSO2	L4	WK4, WK5	08

	algorithms on real data.				
CO4	Examine and test the basic fuzzy system modeling methods.	PO1,PO2,PO3, PO5, PO6,PO8,PO11,PSO1,PSO2	L4	WK4, WK5	08
CO5	Analyze principles of fuzzy decision techniques to solve real-world problems.	PO1,PO2,PO3, PO5, PO6,PO8,PO11,PSO1,PSO2	L4	WK4, WK5	07

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	**Introduction to Fuzzy Logic, Classical Sets and Fuzzy Sets:** Classical Sets, Operations on Classical Sets, Properties of Classical (Crisp) Sets, Mapping of Classical Sets to Functions, Fuzzy Sets, Fuzzy Set Operations, Properties of Fuzzy Sets, Alternative Fuzzy Set Operations, Fuzzy Arithmetic.	CO1	08
II	**Classical Relations and Fuzzy Relations:** Cartesian Product, Crisp Relations, Cardinality of Crisp Relations, Operations on Crisp Relations, Properties of Crisp Relations, Composition, Fuzzy Relations, Cardinality of Fuzzy Relations, Operations on Fuzzy Relations, Properties of Fuzzy Relations, Fuzzy Cartesian Product and Composition, Tolerance and Equivalence Relations, Crisp Equivalence Relation, Crisp Tolerance Relation, Fuzzy Tolerance and Equivalence Relations, Value Assignments, Cosine Amplitude, Max–Min Method.	CO2	08
III	**Properties of Membership Functions, Fuzzification, and Defuzzification:** Features of the Membership Function, Various Forms, Fuzzification, Defuzzification to Crisp Sets, λ-Cuts for Fuzzy Relations, Defuzzification to Scalars. **Development of Membership Functions:** Membership Value Assignments, Intuition, Inference, Inductive Reasoning	CO3	08
IV	**Fuzzy Classification:** Classification by Equivalence Relations, Cluster Analysis, Cluster Validity, c-Means Clustering, Hard c-Means (HCM), Fuzzy c-Means (FCM), Classification Metric, Hardening the Fuzzy c-Partition, Similarity Relations from Clustering	CO4	08
V	**Decision-Making with Fuzzy Information and Applications of FS:** Fuzzy Synthetic Evaluation, Fuzzy Ordering, Nontransitive Ranking Preference and Consensus, Multi objective Decision Making, Fuzzy Bayesian Decision Method, Decision Making Under Fuzzy States and Fuzzy Actions. **Applications of Fuzzy Systems:** Fuzzy TOPSIS, Fuzzy AHP (Geometric and Mean method).	CO5	07

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Fuzzy Sets and Fuzzy Logic with Engineering Applications	Timothy J. Ross	Wiley	4th Edition	All Modules
2	Principles of Soft Computing	S. N Sivanandam, S.N Deepa	Wiley	3rd Edition	All Modules
3	Neuro-Fuzzy and Soft Computing	J.S. R. Jang, C.-T. Sun, and E. Mizutani	Prentice Hall.		All Modules
4	Fuzzy sets Fuzzy logic	Klir, G. J and Yuan B.B	Prentice Hall of India Pvt. Ltd., New Delhi.		All Modules

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCS/WEB RESOURCE

- Fuzzy Sets by Lotfi A. Zadeh
- https://www.udemy.com/course/fuzzy-logic/
- https://www.udemy.com/course/intro-to-fuzzy-logic-and-artificial-intelligence/
- https://onlinecourses.nptel.ac.in/noc20_ge09/preview
- https://www.coursera.org/lecture/children-literacy/fuzzy-logical-model-of-perception-ZT8ZJ

7. EVALUATION METHODOLOGY

a) Continuous Internal Evaluation (CIE) = 50 marks
b) Semester End Examination (SEE) = 50 marks
Total = 100 marks

CIE Framework:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Two tests are to be conducted for 40 marks each. The average of the two tests are taken for computation of CIE. The CIE would also include assignment evaluation for 10 marks.

Typical Evaluation pattern for integrated courses is shown in the Table below

Component		Marks	Total Marks
CIE	CIE Test-1	**40**	**50**
	CIE Test-2	**40**	
	Assignment	**10**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

8. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → / COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	3		3	2		2			2
CO2	3	2	3		3	2		2			2
CO3	3	2	3		3	2		2			2
CO4	3	2	3		3	2		2			2
CO5	3	3	3		3	2		2			2

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

9. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → / COs ↓	PSO1	PSO2
CO1	2	2
CO2	2	2
CO3	2	2
CO4	2	2
CO5	2	2

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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Department: **DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**		
Semester: **3**	Course Code: **BAD24306C**	Contact Hrs /week: **3**
Course Description: **COMPUTER ORGANISATION AND ARCHITECTURE**		No. of Credits:**3** L : T : P : S = **3:0:0:0**
Course Category: **ETC/PLC**		Total no. of Hours = **39**
CIE: **50 Marks**	SEE: **50 Marks**	Exam Hours: **03**
Course Pre-requisites: Basic understanding of digital electronics (logic gates, circuits), Knowledge of basic computer fundamentals (CPU, memory, input/output devices)		

1. PREAMBLE ABOUT THE COURSE

This subject explores CPU architecture, memory hierarchy, instruction cycles, and control units. Students learn how computers execute instructions at the hardware level. Emphasis is on internal data flow and design principles. Concepts like pipelining and addressing modes are introduced. It builds a base for systems and embedded programming. Performance metrics are analyzed.

2. COURSE LEVEL OBJECTIVES

CLO1	To understand basic structure of computer and instructions.
CLO2	To know input/output communications with processor.
CLO3	To analyse different memories.
CLO4	To understand basic arithmetic operations used in ALU design.
CLO5	To know the complete working of processing unit.

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Understand the basic structure of computers, functional units, instruction sequencing, and arithmetic operations.	PO1,PO2,PO3,PO4, PO6,PO8,PO11,PS01	L2	WK2, WK4	8
CO2	Apply assembly programming, addressing modes, and basic I/O operations including interrupts and DMA.	PO1,PO2,PO3,PO4, PO6,PO8,PO11,PS01	L3	WK2, WK4	8

CO3	Analyze the fundamental concepts of memory systems, including RAM, ROM, memory hierarchy, and virtual memory.	PO1,PO2,PO3,PO4, PO6,PO8,PO11,PS01	L4	WK2, WK4	8
CO4	Examine and implement efficient arithmetic operations such as fast addition, multiplication, and floating-point computations	PO1,PO2,PO3,PO4, PO6,PO8,PO11,PS01	L4	WK2, WK4	8
CO5	Analyze the Basic Processing Unit, instruction execution, bus organization, and control unit design.	PO1,PO2,PO3,PO4, PO6,PO8,PO11,PS01	L4	WK2, WK4	7

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	Basic structure of computers and instructions: Functional Units, Basic operational concepts, Performance, Number representation and arithmetic Operations, Number representation and arithmetic Operations, Character representation, Memory locations and addresses, Memory Operations, Instruction and instruction sequencing.	CO1	8
II	Assembly languages and input/output operations: Addressing modes, Assembly Languages, basic I/O Operations, Accessing I/O Devices, Interrupts, Direct Memory Access, Buses.	CO2	8
III	Memory Systems: Basic concepts, semiconductor RAM Memories, ROM Memories, Memory hierarchy, memory mappings and virtual memory.	CO3	8
IV	Arithmetic Operations: Addition and Subtraction of Signed Numbers, Design of Fast Adders, Multiplication of Signed Numbers, Fast Multiplication: Bit-Pair Recoding of Multipliers, Carry-Save Addition of Summands, Integer Division, Floating Point Numbers and Operations: Implementing Floating-Point Operations.	CO4	8
V	Basic Processing Unit: Some Fundamental Concepts, Execution of complete Instruction, Multiple bus organization, Hardwired Control and Microprogrammed control.	CO5	7

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Computer Organization	Carl Hamacher, ZvonkoVranesic, SafwatZaky	McGraw-Hill	6th Edition	All Modules
2	Computer Organization and Design	David A. Patterson, John L. Hennessy	The Hardware / Software Interface ARM Edition	4th Edition	All Modules
3	Computer Organization & Architecture	William Stallings	PHI	7th Edition	All Modules
4	Computer Systems Design and Architecture	Vincent P. Heuring& Harry F. Jordan	John Willey & Sons	2nd Edition	All Modules

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCS/WEB RESOURCE

- https://os.ecci.ucr.ac.cr/ci0114/material/Stallings/Computer-Organization-Architecture-11th.pdf
- https://engineering.futureuniversity.com/BOOKS%20FOR%20IT/%5BMostafa_Abd-El-Barr__Hesham_El-Rewini%5D_Fundamenta%28BookZZ.org%29.pdf
- https://unidel.edu.ng/focelibrary/books/Computer%20Organisation%20and%20Architecture%20by%20Smruti%20Ranjan%20Sarangi%20%28z-lib.org%29.pdf

7. EVALUATION METHODOLOGY

a) Continuous Internal Evaluation (CIE) = 50 marks
b) Semester End Examination (SEE) = 50 marks
Total = 100 marks

CIE Framework:
Semester End Examination (SEE):
SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**
The laboratory assessment would be restricted to only the CIE evaluation.
Continuous Internal Evaluation (CIE):
Two tests are to be conducted for 40 marks each. The average of the two tests are taken for computation of CIE. The CIE would also include assignment evaluation for 10 marks.
Typical Evaluation pattern for integrated courses is shown in the Table below

Component		Marks	Total Marks
CIE	CIE Test-1	**40**	**50**
	CIE Test-2	**40**	
	Assignment	**10**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

8. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → / COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3	2				2			1
CO2	3	3	3	2				2			1
CO3	3	3	3	2				2			1
CO4	3	3	3	2				2			1
CO5	3	3	3	2				2			1

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

9. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → / COs ↓	PSO1	PSO2
CO1	3	
CO2	3	
CO3	3	
CO4	3	
CO5	3	

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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Department: **DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**		
Semester: **3**	Course Code: **BAD24306D**	Contact Hrs /week: **3**
Course Description: **INTRODUCTION TO INTERNET OF THINGS**		No. of Credits:**3** L : T : P : S = **3:0:0:0**
Course Category: **ETC/PLC**		Total no. of Hours = 39
CIE: **50 Marks**	SEE: **50 Marks**	Exam Hours: **03**
Course Pre-requisites: Basic knowledge of electronics and sensors, Exposure to microcontrollers (e.g., Arduino, Raspberry Pi)		

1. PREAMBLE ABOUT THE COURSE

This subject introduces IoT architecture, protocols, sensors, and communication models. It covers device integration and cloud connectivity. Applications in smart cities, healthcare, and industry are discussed. Students learn about data acquisition, security, and IoT standards. Emphasis is on real-world deployments and emerging trends. The course builds a foundation for intelligent connected systems.

2. COURSE LEVEL OBJECTIVES

CLO1	Understand about the fundamentals of Internet of Things and its building blocks along with their characteristics
CLO2	Understand the recent application domains of IoT in everyday life.
CLO3	Gain insights about the current trends of Associated IOT technologies and IOT Analytics
CLO4	Understand the applications of IoT in various domains

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Identify network types, layered models, components and the evolution of IoT.	PO1, PO2,PO3, PO5, PO8,PO9,PO10, PO11,PSO1,PSO2	L2	WK5, WK6, WK8	08
CO2	Apply knowledge of sensor and actuator types, characteristics, and considerations to design IoT sensing and actuation systems	PO1, PO2,PO3, PO5, PO8,PO9,PO10, PO11,PSO1,PSO2	L3	WK5, WK6, WK8	08

CO3	Analyze IoT processing topologies and device design considerations to optimize processing and offloading strategies.	PO1, PO2,PO3, PO5, PO8,PO9,PO10, PO11,PSO1,PSO2	L3	WK5, WK6, WK8	08
CO4	Apply cloud computing concepts, including virtualization, cloud models, and Sensor-Cloud, and interpret agricultural IoT case studies.	PO1, PO2,PO3, PO5, PO8,PO9,PO10, PO11,PSO1,PSO2	L3	WK5, WK6, WK8	08
CO5	Analyze case studies of vehicular and healthcare IoT, and examine emerging trends and the role of IoT analytics.	PO1, PO2,PO3, PO5, PO8,PO9,PO10, PO11,PSO1,PSO2	L4	WK5, WK6, WK8	07

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	**Basics of Networking:** Introduction, Network Types, layered network models. **Emergence of IoT:** Introduction, Evolution of IoT, Enabling IoT and the Complex Interdependence of Technologies, IoT Networking Components	CO1	08
II	**IoT Sensing and Actuation:** Introduction, Sensors, Sensor Characteristics, Sensorial Deviations, Sensing Types, Sensing Considerations, Actuators, Actuator Types, Actuator Characteristics.	CO2	08
III	**IoT Processing Topologies and Types:** Data Format, Importance of Processing in IoT, Processing Topologies, IoT Device Design and Selection Considerations, Processing Offloading.	CO3	08
IV	**Associated IoT Technologies Cloud Computing:** Introduction, Virtualization, Cloud Models, Service-Level Agreement in Cloud Computing, Cloud Implementation, Sensor-Cloud: Sensors-as-a-Service. IoT Case Studies Agricultural IoT – Introduction and Case Studies	CO4	08
V	**IoT Case Studies and Future Trends Vehicular IoT:** Introduction Healthcare IoT – Introduction, Case Studies IoT Analytics – Introduction	CO5	07

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Introduction to IoT	Sudip Misra, Anandarup Mukherjee, Arijit Roy	Cambridge University Press		All Modules
2	Introduction to Industrial Internet of Things and Industry	S. Misra, C. Roy, and A. Mukherjee	CRC	3rd Edition	All Modules
3	Internet of Things (A Hands-on-Approach)	Vijay Madisetti and Arshdeep Bahga		1st Edition	All Modules

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCS/WEB RESOURCE

- https://nptel.ac.in/noc/courses/noc19/SEM1/noc19-cs31/

7. EVALUATION METHODOLOGY

a) Continuous Internal Evaluation (CIE) = 50 marks
b) Semester End Examination (SEE) = 50 marks
Total = 100 marks

CIE Framework:
Semester End Examination (SEE):
SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**
Continuous Internal Evaluation (CIE):
Two Tests are to be conducted for 40 marks each. The average of the two tests are taken for computation of CIE. The CIE would also include assignment evaluation for 10 marks.
Typical Evaluation pattern for integrated courses is shown in the Table below

Component		Marks	Total Marks
CIE	CIE Test-1	**40**	**50**
	CIE Test-2	**40**	
	Assignment	**10**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

8. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → / COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3		2			2	2	2	2
CO2	3	3	3		2			2	2	2	2
CO3	3	3	3		2			2	2	2	2
CO4	3	3	3		2			2	2	2	2
CO5	3	3	3		2			2	2	2	2

Correlation Weightage: 1 – Low, 2 – Moderate, 3 – High

9. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → / COs ↓	PSO1	PSO2
CO1	2	2
CO2	2	2
CO3	2	2
CO4	2	2
CO5	2	2

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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Department: Science & Humanities		
Semester: **3**	Course Code: **BSCK24307**	Contact Hrs /week:**2**
Course Description: **SOCIAL CONNECT & RESPONSIBILITY**		No. of Credits: **1** L : T : P : S = **0:0:2:0**
Course Category: **UHV**		Total no. of Hours = **15**
CIE: **100 Marks**	SEE:	Exam Hours:

1. PREAMBLE ABOUT THE COURSE

The Social Connect & Responsibility course aims to nurture social awareness, civic responsibility, and environmental sensitivity among students. Through activities like tree plantation, heritage walks, organic farming, and community engagement, students gain hands-on experience in understanding societal needs and contributing to sustainable solutions. The course fosters empathy, teamwork, and leadership, encouraging students to connect classroom learning with real-world impact.

2. COURSE LEVEL OBJECTIVES

CLO1	Provide a formal platform for students to communicate and connect to the surrounding.
CLO2	Create a responsible connection with the society.
CLO3	Understand the community in general in which they work.
CLO4	Identify the needs and problems of the community and involve them in problem – solving.
CLO5	Develop among themselves a sense of social & civic responsibility & utilize their knowledge in finding practical solutions to individual and community problems.
CLO6	Develop competence required for group-living and sharing of responsibilities & gain skills in mobilizing community participation to acquire leadership qualities and democratic attitudes.

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description
CO1	Communicate and connect to the surrounding.
CO2	Create a responsible connection with the society.
CO3	Involve in the community in general in which they work.

CO4	Notice the needs and problems of the community and involve them in problem – solving.
CO5	Develop among themselves a sense of social & civic responsibility & utilize their knowledge in finding practical solutions to individual and community problems.
CO6	Develop competence required for group-living and sharing of responsibilities & gain skills in mobilizing community participation to acquire leadership qualities and democratic attitudes.

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description
I	Plantation and adoption of a tree: Plantation of a tree that will be adopted for four years by a group of BE / B.Tech students. (ONE STUDENT ONE TREE) They will also make an excerpt either as a documentary or a photo blog describing the plant's origin, its usage in daily life, its appearance in folklore and literature - – Objectives, Visit, case study, report, outcomes.
II	Heritage walk and crafts corner: Heritage tour, knowing the history and culture of the city, connecting to people around through their history, knowing the city and its craftsman, photo blog and documentary on evolution and practice of various craft forms - – Objectives,Visit, case study, report, outcomes.
III	Organic farming and waste management: Usefulness of organic farming, wet waste management in neighboring villages, and implementation in the campus – Objectives,Visit, case study, report, outcomes.
IV	Water conservation: Knowing the present practices in the surrounding villages and implementation in the campus, documentary or photoblog presenting the current practices – Objectives, Visit, case study, report, outcomes.
V	Food walk: City's culinary practices, food lore, and indigenous materials of the region used in cooking – Objectives, Visit, case study, report, outcomes.

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Department: **DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**		
Semester: **3**	Course Code: **BAD24358A**	Contact Hrs /week: **2**
Course Description: **UNIX SHELL PROGRAMMING**		No. of Credits:**1** L : T : P : S = **0:0:2:0**
Course Category: **AEC**		Total no. of Hours = **13**
CIE: **50 Marks**	SEE: **50 Marks**	Exam Hours: **02**
Course Pre-requisites: Basic knowledge of operating systems and command-line interfaces, Familiarity with file system structure and basic commands in UNIX		

1. PREAMBLE ABOUT THE COURSE

This course teaches Unix/Linux environment and shell scripting. Topics include file handling, filters, process control, and shell customization. Lab sessions provide practical experience in writing bash scripts. Students automate tasks and manage system operations. The course sharpens system-level programming skills. It bridges OS concepts with command-line operations.

2. COURSE LEVEL OBJECTIVES

CLO1	Learn the fundamentals of UNIX architecture, commands, shell scripting, and server management.
CLO2	Gain knowledge of file system operations, file management commands, compression techniques, and file permissions in Unix/Linux environments.
CLO3	Understand file linking concepts and process control mechanisms, including process attributes, states, and job management in Unix/Linux.
CLO4	Learn the fundamentals of shell scripting, including shell interpretation, variables, commands, execution methods, and script automation.

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Apply basic UNIX commands to interact with the system and demonstrate understanding of its	PO1,PO2,PO3,PO4, PO8,PO9 PO10,PO11,PSO1	L3	WK6, WK8	6

	features and architecture.				
CO2	Apply UNIX file handling and permission commands to manage files and control access in a multi-user environment.	PO1,PO2,PO3,PO4, PO8,PO9 PO10,PO11,PSO1	L3	WK6, WK8	4
CO3	Develop shell scripts by applying knowledge of UNIX commands to automate tasks and solve basic problems.	PO1,PO2,PO3,PO4, PO8,PO9 PO10,PO11,PSO1	L3	WK6, WK8	3

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Sl No.	Module Description	Mapped COs	No. of Hours
1	**Topics**: UNIX architecture, kernel & shell, Types of shells (Bourne, C, Korn, Bash), Basic UNIX commands: ls, pwd, cd, touch, echo **To practice on UNIX commands:** man, echo, passwd, uname, who, date, cal, banner, tty, pwd, cd, ls, cat , touch, clear, more, wc.	1,2	2
2	**Topics**: To practice UNIX commands on Vi Editor. Writing a shell script.	1,2	1
3	**Topics**: File handling in UNIX: mkdir, rmdir, cat, cp, mv, **Lab Program:** a) Write a shell script to display the current working directory, list all files and display current date and time. b) Write a shell script to create a directory, create a file in it and copy the file to another directory.	1,2	1
4	**Topics:** File types and permissions, chmod, chown, chgrp, umask, File viewing commands: cat, more, less, head, tail **Lab Program:** a) Write a shell script that accepts two file names as arguments, checks if the permissions for these files are identical and if the permission are identical, output common permission and otherwise output each file name followed by its permissions.	1,2,3	1

	b) Shell script to count the number of files and directories in a given path.		
5	**Topics:** Variables and quoting, Read, command-line arguments $0, $1, etc **Lab Program:** a) Shell script to accept a name from user and greet them with a message. b) Shell script to add two numbers passed as command-line arguments	1,2,3	1
6	**Topics:** if, if-else, if-elif-else, test and [ ] expressions Lab Program: a) Shell script to check if a number is even or odd. b) Shell script to check whether a file exists and is readable/writeable/executable.	1,2,3	1
7	**Topics:** While, until, for loops, break, continue **Lab Program:** a) Shell script to print the multiplication table of a given number. b) Shell script to find factorial of a number using a while loop.	1,2,3	1
8	**Topics:** Case statement, Menu-driven programs **Lab Program:** a) Shell script to perform basic arithmetic operations using case. b) Shell script for a menu-driven program to list files, view current directory, and exit.	1,2,3	1
9	**Topics**: String manipulation: length, substring, comparison, File input/output redirection **Lab Program:** a) Shell script to check whether a string is a palindrome. b) Shell script to count number of lines, words, and characters in a file.	1,2,3	1
10	**Topics:** String manipulation: length, substring, comparison, File input/output redirection **Lab Program:** a) Shell script to check whether a string is a palindrome. b) Shell script to count number of lines, words, and characters in a file.	1,2,3	1
11	**Topics:** grep, cut, sort, uniq, tr, Using pipes (|) and redirection **Lab Program:** a) Shell script to extract usernames from /etc/passwd using grep.	1,2,3	1

	b) Shell script to remove duplicate lines from a file using sort and uniq.		
12	**Topics:** Shell scripts a) Write a shell script that accept one or more filenames as argument and convert all of them to uppercase, provided they exist in current directory. b) Write a shell script that displays all the links to a file specified as the first argument to the script. The second argument, which is optional, can be used to specify in which the search is to begin. If this second argument is not present, the search is to begin in current working directory. In either case, the starting directory as well as all its subdirectories at all levels must be searched. The script need not include any error checking.	1,2,3	1

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	UNIX Concepts and Applications	Sumitabha Das	Tata McGraw Hill	4 th Edition	All Modules
2	UNIX & Shell Programming	M.G.Venkatesh Murthy	Pearson Education.	Second Impression	All Modules
3	Linux Command Line and Shell Scripting Bible	Richard Blum, Christine Bresnahan	Wiley,2014	2nd	All Modules
4	The Complete Reference UNIX	Kenneth Rosen, Douglas Host, Rachel Klee, James Farber, Richard Rosinski	Tata McGRAW-HILL Edition	Second Edition, 6th Reprint	All Modules

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCS/WEB RESOURCE

- https://www.youtube.com/watch?v=ffYUfAqEamY
- https://www.youtube.com/watch?v=Q05NZiYFcD0
- https://www.youtube.com/watch?v=8GdT53KDIyY
- https://www.youtube.com/watch?app=desktop&v=3Pga3y7rCgo
- https://nptel.ac.in/courses/117106113
- https://infyspringboard.onwingspan.com/

7. EVALUATION METHODOLOGY

a) Continuous Internal Evaluation (CIE) = 50 marks
b) Semester End Examination (SEE) = 50 marks
Total = 100 marks

ASSESSMENT AND EVALUATION PATTERN		
	CIE	**SEE**
WEIGHTAGE	**50%**	**50%**
Record	25	**50**
Test	25	
Total Marks for the Course	**50**	**50**

8. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → / **COs ↓**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	3	1	2		2						2
CO2	3	1	2		2						2
CO3	3	1	2		2						2

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

9. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → / **COs ↓**	**PSO1**	**PSO2**
CO1	2	1
CO2	2	1
CO3	2	1

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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Department: **DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**		
Semester: **3**	Course Code: **BAD24358B**	Contact Hrs /week: **2**
Course Description: **DATA ANALYTICS USING EXCEL**		No. of Credits:**1** L : T : P : S = **0:0:2:0**
Course Category: **AEC**		Total no. of Hours = **13**
CIE: **50 Marks**	SEE: **50 Marks**	Exam Hours: **02**
Course Pre-requisites: Fundamentals of Microsoft Excel, Mathematics/Statistics Fundamentals		

1. PREAMBLE ABOUT THE COURSE

This course introduces data analysis through Excel tools and functions. It includes pivot tables, charts, statistical formulas, and dashboards. Lab exercises emphasize practical data interpretation and decision-making. Students learn to transform raw data into actionable insights. The course is suitable for business and non-programming backgrounds. Emphasis is on user-friendly analytics

2. COURSE LEVEL OBJECTIVES

CLO1	To Apply analysis techniques to datasets in Excel
CLO2	Learn how to use Pivot Tables and Pivot Charts to streamline your workflow in Excel
CLO3	Understand and identify the principles of data analysis
CLO4	Become adept at using Excel functions and techniques for analysis
CLO5	Build presentation ready dashboards in Excel

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Use advanced functions and productivity tools to assist in developing worksheets.	PO1,PO2,PO3,PO5,PO8 PO9,PO11,PSO1, PSO2	L2	WK2, WK4, WK6	3
CO2	Understand how to import data and format data for data analysis	PO1,PO2,PO3,PO5,PO8 PO9,PO11,PSO1, PSO2	L3	WK2, WK4, WK6	3

CO3	Implement data lists using Outline and PivotTable features.	PO1,PO2,PO3,PO5,PO8 PO9,PO11,PSO1, PSO2	L4	WK2, WK4, WK6	3
CO4	Analyze data consolidation techniques to compile and report results across multiple worksheets	PO1,PO2,PO3,PO5,PO8 PO9,PO11,PSO1, PSO2	L4	WK2, WK4, WK6	2
CO5	Implement Macros and Autofilter to solve the given real world scenario.	PO1,PO2,PO3,PO5,PO8 PO9,PO11,PSO1, PSO2	L4	WK2, WK4, WK6	2

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Sl. No.	EXPERIMENTS
1	**Getting Started with Excel:** Creation of spread sheets, Insertion of rows and columns, Drag & Fill, use of Aggregate functions.
2	**Working with Data:** Importing data, Data Entry & Manipulation, Sorting & Filtering.
3	**Working with Data:** Data Validation, Pivot Tables & Pivot Charts.
4	**Data Analysis Process:** Conditional Formatting, What-If Analysis, Data Tables, Charts & Graphs. **Data Analysis Process:**
5	**Cleaning Data with Text Functions:** use of UPPER and LOWER, TRIM function, Concatenate.
6	**Cleaning Data Containing Date and Time Values:** use of DATEVALUE function, DATEADD and DATEDIF, TIMEVALUE functions.
7	**Conditional Formatting:** formatting, parsing, and highlighting data in spreadsheets during data analysis.
8	**Working with Multiple Sheets:** work with multiple sheets within a workbook is crucial for organizing and managing data, perform complex calculations and create comprehensive reports.
9	**Create worksheet with following fields:** Empno, Ename, Basic Pay(BP), Travelling Allowance(TA), Dearness Allowance(DA), House Rent Allowance(HRA), Income Tax(IT), Provident Fund(PF), Net Pay(NP). Use appropriate formulas to calculate the above scenario. Analyse the data using appropriate chart and report the data.
10	**Create worksheet on Inventory Management:** Sheet should contain Product code, Product name, Product type, MRP, Cost after % of discount, Date of purchase. Use appropriate formulas to calculate the above scenario. Analyze the data using appropriate chart and report the data.

11	**Create worksheet on Sales analysis of Merchandise Store:** data consisting of Order ID, Customer ID, Gender, age, date of order, month, online platform, Category of product, size, quantity, amount, shipping city and other details. Use of formula to segregate different categories and perform a comparative study using pivot tables and different sort of charts.
12	Generation of report & presentation using Auto filter & macro.

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Data Analysis with Microsoft Excel	Berk & Carey	Cengage Learning,	Third Edition.	All Modules
2	Microsoft Excel 2019: Data Analysis And Business Modeling	Wayne L. Winston	PHI		All Modules

6. EVALUATION METHODOLOGY

a) Continuous Internal Evaluation (CIE) = 50 marks
b) Semester End Examination (SEE) = 50 marks
Total = 100 marks

ASSESSMENT AND EVALUATION PATTERN		
	CIE	**SEE**
WEIGHTAGE	**50%**	**50%**
Record	10	**50**
Test	20	
Experiential Learning	20	NIL
Total Marks for the Course	**50**	**50**

7. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → / COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	3	2		2			1	2		2
CO2	2	3	2		2			1	2		2
CO3	2	3	2		2			1	2		2
CO4	2	3	2		2			1	2		2
CO5	2	3	2		2			1	2		2

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

8. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → / COs ↓	PSO1	PSO2
CO1	2	3
CO2	2	3
CO3	2	3
CO4	2	3
CO5	2	3

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

*****

Department: **DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**		
Semester: **3**	Course Code: **BAD24358C**	Contact Hrs /week: **2**
Course Description: **PHP PROGRAMMING**		No. of Credits:**1** L : T : P : S = **0:0:2:0**
Course Category: **AEC**		Total no. of Hours = **13**
CIE: **50 Marks**	SEE: **50 Marks**	Exam Hours: **02**
Course Pre-requisites: Basic understanding of HTML and CSS, Knowledge of web browsers and how websites work		

1. PREAMBLE ABOUT THE COURSE

This subject introduces server-side scripting with PHP and MySQL integration. It covers form handling, sessions, cookies, and dynamic content creation. Lab work involves building basic web applications. Students learn about secure coding and web interaction. It supports backend development fundamentals. Real-world applications like CMS and e-commerce are explored

2. COURSE LEVEL OBJECTIVES

CLO1	To introduce the PHP syntax, elements, and control structures
CLO2	To make use of PHP Functions and File handling
CLO3	To illustrate the concept of PHP arrays and OOPs

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Recognize basic concepts of PHP to develop web program	PO1,PO2,PO3,PO4,PO5,PO8 PO9,PO11,PSO1, PSO2	L2	WK3	3
CO2	Implement programs in PHP involving control structures	PO1,PO2,PO3,PO4,PO5,PO8 PO9,PO11,PSO1, PSO2	L3	WK3	3
CO3	Implement programs to handle structured	PO1,PO2,PO3,PO4,PO5,PO8 PO9,PO11,PSO1, PSO2	L3	WK3	3

	data (object) and data items (array)				
CO4	Execute programs to access and manipulate contents of files	PO1,PO2,PO3,PO4,PO5,PO8 PO9,PO11,PSO1, PSO2	L3	WK3	2
CO5	Demonstrate super-global arrays and regular expressions to solve real world problems.	PO1,PO2,PO3,PO4,PO5,PO8 PO9,PO11,PSO1, PSO2	L3	WK3	2

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Sl. No.	EXPERIMENTS
1	a. Develop a PHP program to calculate areas of Triangle and Rectangle. b. Develop a PHP program to calculate Compound Interest
2	Demonstrating the various forms to concatenate multiple strings Develop program(s) to demonstrate concatenation of strings: (i) Strings represented with literals (single quote or double quote) (ii) Strings as variables (iii) Multiple strings represented with literals (single quote or double quote) and variables (iv) Strings and string variables containing single quotes as part string contents (v) Strings containing HTML segments having elements with attributes
3	a. Develop a PHP Program(s) to check given number is: (i) Odd or even (ii) Divisible by a given number (N) (iii) Square of another number b. Develop a PHP Program to compute the roots of a quadratic equation by accepting the coefficients. Print the appropriate messages.
4	a. Develop a PHP program to find the square root of a number by using the newton's algorithm. b. Develop a PHP program to generate Floyd's triangle.
5	a. Develop a PHP application that reads a list of numbers and calculates mean and standard deviation. b. Develop a PHP application that reads scores between 0 and 100 (possibly including both 0 and 100) and creates a histogram array whose elements contain the number of scores between 0 and 9, 10 and 19, etc. The last "box" in the histogram should include scores between 90 and 100. Use a function to generate the histogram.

6	a. Develop PHP program to demonstrate the date() with different parameter options. b. Develop a PHP program to generate the Fibonacci series using a recursive function.
7	Develop a PHP program to accept the file and perform the following 76. Print the first N lines of a file 77. Update/Add the content of a file
8	Develop a PHP program to read the content of the file and print the frequency of occurrence of the word accepted by the user in the file
9	Develop a PHP program to filter the elements of an array with key names. Sample Input Data: 1st array: ('c1' => 'Red', 'c2' => 'Green', 'c3' => 'White', c4 => 'Black') 2nd array: ('c2', 'c4') Output: Array ([c1] => Red [c3] => White)
10	Develop a PHP program that illustrates the concept of classes and objects by reading and printing employee data, including Emp_Name, Emp_ID, Emp_Dept, Emp_Salary, and Emp_DOJ.
11	a. Develop a PHP program to count the occurrences of Aadhaar numbers present in a text. b. Develop a PHP program to find the occurrences of a given pattern and replace them with a text.
12	Develop a PHP program to read the contents of a HTML form and display the contents on a browser.

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Programming in HTML and PHP	Devid R brooks	Springer International Publishing		All Modules

6. EVALUATION METHODOLOGY

a) Continuous Internal Evaluation (CIE) = 50 marks
b) Semester End Examination (SEE) = 50 marks
Total = 100 marks

ASSESSMENT AND EVALUATION PATTERN		
	CIE	**SEE**
WEIGHTAGE	**50%**	**50%**
Record	10	**50**
Test	20	
Experiential Learning	20	NIL
Total Marks for the Course	**50**	**50**

7. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → / **COs ↓**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	2	2	2	3	2			2	2		2
CO2	2	2	2	3	2			2	2		2
CO3	2	2	2	3	2			2	2		2
CO4	2	2	2	3	2			2	2		2
CO5	2	2	2	3	2			2	2		2

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

8. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → / **COs ↓**	**PSO1**	**PSO2**
CO1	2	1
CO2	2	1
CO3	2	1
CO4	2	1
CO5	2	1

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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Department: **DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**		
Semester: **3**	Course Code: **BAD24358D**	Contact Hrs /week: **2**
Course Description: **MERN**		No. of Credits:**1** L : T : P : S = **0:0:2:0**
Course Category: **AEC**		Total no. of Hours = **13**
CIE: **50 Marks**	SEE: **50 Marks**	Exam Hours: **02**
Course Pre-requisites: Basic knowledge of HTML, CSS, and JavaScript, Understanding of client-server architecture		

1. PREAMBLE ABOUT THE COURSE

This subject covers the full-stack JavaScript development using MongoDB, Express, React, and Node.js. Students learn to build scalable web applications from frontend to backend. Labs focus on real-time projects and component-based development. Emphasis is on REST APIs, routing, and database interaction. It prepares students for full-stack roles. Industry-standard frameworks and tools are used.

2. COURSE LEVEL OBJECTIVES

CLO1	Understand and apply critical web development languages and tools to create dynamic and responsive web application
CLO2	To build server-side applications using Node.js and Express
CLO3	Develop user interfaces with React.js,
CLO4	Manage data using MongoDB, and integrate these technologies to create full stack apps

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Apply the fundamentals of MongoDB, such as data modelling, CRUD operations, and basic queries to	PO1,PO2,PO3,PO5,PO6,PO8 PO9,PO11,PSO1, PSO2	L3	WK4, WK5, WK6	3

	solve given problem.				
CO2	Implement constructs of Express.js, including routing, software and constructing RESTful APIs to solve real world problems.	PO1,PO2,PO3,PO5,PO6,PO8 PO9,PO11,PSO1, PSO2	L3	WK4, WK5, WK6	3
CO3	Sketch scalable and efficient RESTful APIs using NodeJS.	PO1,PO2,PO3,PO5,PO6,PO8 PO9,PO11,PSO1, PSO2	L3	WK4, WK5, WK6	3
CO4	Examine applications using React, including components, state, props, and JSX syntax.	PO1,PO2,PO3,PO5,PO6,PO8 PO9,PO11,PSO1, PSO2	L4	WK4, WK5, WK6	2
CO5	Interpret the APIs and routing.	PO1,PO2,PO3,PO5,PO6,PO8 PO9,PO11,PSO1, PSO2	L3	WK4, WK5, WK6	2

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Sl. No.	EXPERIMENTS
1	Using MongoDB, create a collection called transactions in database usermanaged (drop if it already exists) and bulk load the data from a json file, transactions.json b. Upsert the record from the new file called transactions_upsert.json in Mongodb.
2	Query MongoDB with Conditions: [Create appropriate collection with necessary documents to answer the query] a. Find any record where Name is Somu b. Find any record where total payment amount (Payment.Total) is 600. c. Find any record where price (Transaction.price) is between 300 to 500. d. Calculate the total transaction amount by adding up Payment.Total in all records.
3	a. Write a program to check request header for cookies. b. Write node.js program to print a car object property, delete the second property and get length of the object.

4	a. Read the data of a student containing usn, name, sem, year_of_admission from node js and store it in the mongodb b. For a partial name given in node js, search all the names from mongodb student documents created in Question(a)
5	Implement all CRUD operations on a File System using Node JS
6	Develop the application that sends fruit name and price data from client side to Node.js server using Ajax
7	Develop an authentication mechanism with email_id and password using HTML and Express JS (POST method)
8	Develop two routes: find_prime_100 and find_cube_100 which prints prime numbers less than 100 and cubes less than 100 using Express JS routing mechanism
9	Develop a React code to build a simple search filter functionality to display a filtered list based on the search query entered by the user.
10	Develop a React code to collect data from rest API.

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Pro MERN Stack: Full Stack Web App Development with Mongo, Express, React, and Node	Vasan Subramanian	PHI	1st Edition	All Modules
2	MERN Quick Start Guide	Eddy Wilson Iriarte Koroliova	Packt Publishing		All Modules

6. EVALUATION METHODOLOGY

a) Continuous Internal Evaluation (CIE) = 50 marks
b) Semester End Examination (SEE) = 50 marks
Total = 100 marks

ASSESSMENT AND EVALUATION PATTERN		
	CIE	**SEE**
WEIGHTAGE	**50%**	**50%**
Record	10	**50**
Test	20	
Experiential Learning	20	NIL
Total Marks for the Course	**50**	**50**

7. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → / COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	2	2		1	1		2	2		2
CO2	2	2	2		1	1		2	2		2
CO3	2	2	2		1	1		2	2		2
CO4	2	2	2		1	1		2	2		2
CO5	2	2	2		1	1		2	2		2

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

8. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → / COs ↓	PSO1	PSO2
CO1	2	1
CO2	2	1
CO3	2	1
CO4	2	1
CO5	2	1

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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Department: **Science and Humanities**		
Semester: **3 to 6**	Course Code: **BNSK24359/459/559/659**	Contact Hrs /week: **1**
Course Description: **NATIONAL SERVICE SCHEME (NSS)**		No. of Credits: **0** L : T : P : S = **0:0:2:0**
Course Category: **MC**		Total no. of Hours = **24**
CIE: **100 Marks**		

COURSE LEVEL OBJECTIVES

CLO1	Understand the community in general in which they work.
CLO2	Identify the needs and problems of the community and involve them in problem – solving
CLO3	Develop among themselves a sense of social & civic responsibility & utilize their knowled in finding practical solutions to individual and community problems.
CLO4	Develop competence required for group-living and sharing of responsibilities & gain skills in mobilizing community participation to acquire leadership qualities and democratic attitudes.
CLO5	Develop capacity to meet emergencies and natural disasters & practice national integration and social harmony in general.

COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description
CO1	Understand the importance of his / her responsibilities towards society.
CO2	Analyse the environmental and societal problems/issues and will be able to design solutions for the same.
CO3	Evaluate the existing system and to propose practical solutions for the same for sustainable development.
CO4	Implement government or self-driven projects effectively in the field.
CO5	Develop capacity to meet emergencies and natural disasters & practice national integration and social harmony in general.

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

SYLLABUS

Module No.	Module Description
I	**National Service Scheme (NSS) – Contents** 1. Organic farming, Indian Agriculture (Past, Present and Future) Connectivity for marketing. 2. Waste management– Public, Private and Govt organization, 5 R's. 3. Setting of the information imparting club for women leading to contribution in social and economic issues. 4. Water conservation techniques – Role of different stakeholders– Implementation. 5. Preparing an actionable business proposal for enhancing the village income and approach for implementation. 6. Helping local schools to achieve good results and enhance their enrolment in Higher/ technical/ vocational education. 7. Developing Sustainable Water management system for rural areas and implementation approaches. 8. Contribution to any national level initiative of Government of India. For eg. Digital India, Skill India, Swatch Bharat, Atmanirbhar Bharath, Make in India, Mudra scheme, Skill development programs etc. 9. Spreading public awareness under rural outreach programs.(minimum5 programs). 10. Social connect and responsibilities. 11. Plantation and adoption of plants. Know your plants. 12. Organize National integration and social harmony events /workshops /seminars. (Minimum 02 programs). 13. Govt. school Rejuvenation and helping them to achieve good infrastructure.

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Publisher
1	NSS Course Manual	Published by NSS Cell, VTU Belagavi
2	Government of Karnataka, NSS cell, activities reports and its manual.	
3	Government of India, NSS cell, Activities reports and its manual.	

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Department: **Science and Humanities**		
Semester: **3 to 6**	Course Code: **BPEK24359/459/559/659**	Contact Hrs /week: **2**
Course Description: **PHYSICAL EDUCATION (SPORTS & ATHLETICS) – I**		No. of Credits: **0** L : T : P : S = **0:0:2:0**
Course Category: **MC**		Total no. of Hours = **24**
CIE: **100 Marks**		

1. SYLLABUS

Module No.	Module Description	No. of Hours
I	A. Lifestyle B. Health & Wellness C. Pre-Fitness test.	4
II	A. Warming up (Free Hand exercises) B. Strength – Push-up / Pull-ups C. Speed – 30 Mtr Dash	4
III	1. Kabaddi – Hand touch, Toe Touch, Thigh Hold, Ankle hold and Bonus. 2. Kho-Kho – Giving Kho, Single Chain, Pole dive, Pole turning, 3-6 Up.	16

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Department: **Science and Humanities**		
Semester: **3 to 6**	Course Code:**BYOK24359/459/559/659**	Contact Hrs /week: **02**
Course Description: **YOGA**		No. of Credits: 0 L : T : P : S = **0:0:2:0**
Course Category: **MC**		Total no. of Hours = **24**
CIE: **100**		

1. SYLLABUS

Course Title	Content
lntroduction of Yoga, Aim and Objectives of yoga, Prayer	Yoga, its meaning, definitions. Different schools of yoga, importance of prayer
Brief introduction of yogic practices for common man	Yogic practices for common man to promote positive health.
Rules and regulations	Rules to be followed during yogic practices by practitioner.
Misconceptions of yoga	Yoga its misconceptions
Suryanamaskara	Suryanamaskar prayer and its meanitrg, Need, importance and benefits of Suryanamaskar 12 count, 2 rounds.
Different types of Asanas Sitting 1. Padmasana 2. Vajrasana Standing 1. Vrikshana 2. Trikonasana Prone line 1. Bhujangasana 2. Shalabhasana Supine line 1. utthitadvipadasana 2. Ardhahalasana	Asana, Need, importance of Asana. Different types of asana. Asana its meaning by name, technique, precautionary measures and benefits.

Department: **Science and Humanities**		
Semester: **3 to 6**	Course Code: **BMUK359/459/559/659**	Contact Hrs /week: **2**
Course Description: **MUSIC**		No. of Credits: 0 L : T : P : S = **0:0:2:0**
Course Category: **MC**		Total no. of Hours = **24**
CIE: **100 Marks**		

1. COURSE LEVEL OBJECTIVES

1. Identify the major traditions of Indian music, both through notations and aurally.
2. Analyse the compositions with respect to musical and lyrical content.
3. Demonstrate an ability to use music technology appropriately in a variety of setting.

2. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description
CO1	Discus the Indian system of music and relate it to other genres (Cognitive Do main)
CO2	Experience the emotions of composer and develop empathy (Affective Domain)
CO3	Respond to queries on various patterns in a composition (Psycho Motor Domain)

3. SYLLABUS

Module No.	Module Description	No. of Hours
I	Preamble: Contents of the curriculum intend to promote music as language to develop on analytical, Creative, and intuitive Understanding. For this the student through study and direct participation in improvisation. Origin of the Indian Music: Evolution of the Indian music system, Understanding of Shruthi, Nada, Swara. Laya, Raga, Tala, Mela.	3
II	Compositions: Introduction to the types of composition in Carnatic Music Swarajathi, Varna, Krithi, and Thillana, Notation System.	3
III	Composers: Biography and Contributions of Purandaradasa, Thyagaraja.	3

IV	Music Instruments: Classification and construction of string instruments, percussion instruments, Idiophones (Ghana Vaadya), Examples of each class of Instruments.	3
V	Abhyasa Gana: Singing the swara exercises (Sarale Varase Only), Botation writing for Sarale Varase and Suladi Saptha Tala (Only in Mayamalavagowla Raga), Singing 4 Geethe in Malahari, and one jathi Swara, One Krithi in a Mela raga.	4

4. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

Sl. No.	Name of the Book	Author(s)	Publisher	Edition
1	Theory of Music	Vidushi Vasantha Madhavi	Prism Publication	2007
2	Karnataka Sangeetha Dharpana	T Sachidevi and T Sharadha (Thirumalai Sisters)	Shreenivaas Prakaashana	Vol, 1 2018
3	Classical Music of India: A Practical Gulge	Lakshminarayana Subramaniam, Viji Subramanaim	Tranqueber	2018
4	History of South Indian (Carnatic) Music	R Rangaramanuja Ayyangar	Vipanci Charitable Trust,	Third edition 2019
5	The Story of Indian Music and Its Instruments: A Study of the Present and a Record of the Past	Ethel Rosenthal	Pilgrims Publishing	2007

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Department: **DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**		
Semester: **4**	Course Code: **BMATS24401**	Contact Hrs /week: **4**
Course Description: **PROBABILITY AND GRAPH THEORY**		No. of Credits:**3** L : T : P : S = **3:0:0:0**
Course Category: **BSC**		Total no. of Hours = **40**
CIE: **50 Marks**	SEE: **50 Marks**	Exam Hours: **03**
Course Pre-requisites: A fundamental understanding of calculus and linear algebra, Basic knowledge of set theory and matrix operations,Introductory familiarity with probability concepts and high school-level statistics.		

1. PREAMBLE ABOUT THE COURSE

This course is designed to equip students with essential tools from **statistics, probability theory, stochastic processes**, and **graph theory** that form the backbone of data analysis, decision-making, and computational modelling in engineering and scientific domains. The course begins with foundational techniques in data fitting and correlation, progresses through theoretical and applied probability models, and extends to stochastic behaviour analysis and hypothesis testing. The final module introduces students to key concepts in graph theory, enabling them to model complex structures like networks, circuits, and hierarchical data. By integrating classical mathematical techniques with modern applications, this course aims to prepare students to apply these tools in engineering contexts, research problems, and real-world systems modelling.

2. COURSE LEVEL OBJECTIVES

CLO1	Apply statistical techniques such as least squares fitting, correlation, and regression to analyze and interpret data.
CLO2	Evaluate probability models involving discrete and continuous random variables for a variety of engineering and scientific applications.
CLO3	Analyze joint and conditional distributions, and understand the behaviour of stochastic processes and Markov chains.
CLO4	Conduct statistical hypothesis testing using sampling theory and various test statistics (t, chi-square, F) to make informed decisions.
CLO5	Construct and examine graphs and trees, including Euler and Hamiltonian paths, and use these tools in problems involving sorting, coding, and network structures.

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Analyze and interpret data using statistical techniques such as curve fitting, correlation, regression, and error estimation to support decision-making in computing and data science.	PO1, PO2, PO5	L4	WK1, WK2, WK3,WK6	8

CO2	Apply discrete and continuous probability distributions to model uncertainty in computer systems and support probabilistic algorithm design	PO1, PO2, PO5	L3	WK1, WK2, WK3,WK6	8
CO3	Evaluate joint, marginal, and conditional distributions, and model dynamic systems using stochastic processes and Markov chains in algorithmic contexts.	PO1, PO2, PO5	L3	WK1, WK2, WK3,WK6	8
CO4	Perform hypothesis testing using sampling distributions and statistical tests (t, χ^2, F) to draw conclusions from sample data in experimental and research applications.	PO1, PO2, PO5	L4	WK1, WK2, WK3,WK6.	8
CO5	Apply graph theory concepts including Euler and Hamiltonian paths, planar graphs, and tree structures to design and analyze efficient algorithms and data structures..	PO1, PO2, PO5	L3	WK1, WK2, WK3,WK6	8

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	Statistics: Introduction, Principles of least squares, fitting of a straight line, second degree parabola, . Karl Pearson's coefficient of correlation, Regression analysis standard error of estimate, rank correlation	CO1	8
II	Random variable, Discrete and continuous random variables, Probability distributions: Binomial, Poisson, exponential, uniform and Normal distributions.	CO2	8
III	Joint distributions, Marginal and conditional distributions, Covariance, Correlation. Stochastic processes, probability vector, stochastic matrices, fixed points, regular stochastic matrices, Markov chains, higher transition probability.	CO3	8
IV	Sampling, Sampling distributions, standard error, test of hypothesis for means and proportions, student's t-distribution, chi-square distribution as a test of goodness of fit, F- test.	CO4	8
V	Graphs, Subgraphs, Complements, and Graph Isomorphism, Vertex Degree, Euler Trails and Circuits. Planar Graphs, Hamiltonian paths and Cycles. Trees, Rooted Trees, Trees and Sorting, Weighted Trees and Prefix Codes.	CO5	8

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Higher Engineering Mathematics	B.S. Grewal	Khanna Publishers	44th	All modules
2	Higher Engineering Mathematics	B.V. Ramana	Tata McGraw-Hill		All modules
3	Advanced Engineering Mathematics	E. Kreyszig	John Wiley & Sons	10th	All modules
4	A Textbook of Engineering Mathematics	N.P.Bali and Manish Goyal	Laxmi Publications	6th	All modules
5	Probability, Statistics and Random Processes with Queueing Theory and Queueing Networks	T Veerarajan	Tata Mc-Graw Hill Co	4th	All modules

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCS/WEB RESOURCE

1. https://nptel.ac.in/courses
2. https //swayam.gov.in/nptel onlinecourses.nptel.ac.in/
3. https://academicearth.org/online-college-courses/
4. https://elearning.vtu.ac.in/

7. EVALUATION METHODOLOGY

a) Continuous Internal Evaluation (CIE) = 50 marks
b) Semester End Examination (SEE) = 50 marks
Total = 100 marks

CIE Framework:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

The laboratory assessment would be restricted to only the CIE evaluation.

Continuous Internal Evaluation (CIE):

Two Tests are to be conducted for 40 marks each. The average of the two tests are taken for computation of CIE. The CIE would also include assignment evaluation for 10 marks.

Typical Evaluation pattern for integrated courses is shown in the Table below

Component		Marks	Total Marks
CIE	CIE Test-1	**40**	**50**
	CIE Test-2	**40**	
	Assignment	**10**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

8. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → / COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	1			1						
CO2	3	1			1						
CO3	3	1			1						
CO4	3	1			1						
CO5	3	1			1						

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

9. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → / COs ↓	PSO1	PSO2
CO1	2	
CO2	2	
CO3	2	
CO4	2	
CO5	2	

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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Department: **DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**		
Semester: **4**	Course Code: **BAD24402**	Contact Hrs /week: **3**
Course Description: **MACHINE LEARNING - 1**		No. of Credits:**4** L : T : P : S = **3:0:2:0**
Course Category: **IPCC**		Total no. of Hours = **52**
CIE: **50 Marks**	SEE: **50 Marks**	Exam Hours: **03**
Course Pre-requisites: Strong background in statistics (probability distributions, hypothesis testing, regression), Basic knowledge of linear algebra and calculus.		

1. PREAMBLE ABOUT THE COURSE

This subject bridges statistics and machine learning, covering regression, classification, and clustering. Labs involve model implementation using Python tools. Topics include performance metrics and validation techniques. Emphasis is on building interpretable models and handling real-world datasets. Students gain practical ML experience with statistical reasoning. It lays the groundwork for advanced AI applications

2. COURSE LEVEL OBJECTIVES

CLO1	Examine the data for various features, properties, characteristics and assessment of the problem they represent.
CLO2	Learn methods to transform raw data into a form that is ready for application of algorithms.
CLO3	Become conversant with types of Machine Learning Algorithms, their applicability and Inductive Bias.
CLO4	Familiarize with techniques for Dimensionality Reduction and Computational Efficiency.

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Understand the data pre-processing techniques used in the data science.	PO1,PO2,PO3,PO4, PO5, PO6, PO9, PO11, PSO1,PSO2	L2	WK4, WK5	8
CO2	Exploring various techniques to handle missing and noisy data.	PO1,PO2,PO3,PO4, PO5, PO6, PO9, PO11, PSO1,PSO2	L2	WK4, WK5	8

CO3	Apply supervised learning techniques on real-world data using regression algorithms and demonstrate their implementation and outcomes	PO1,PO2,PO3,PO4, PO5, PO6, PO9, PO11, PSO1,PSO2	L3	WK4, WK5	8
CO4	Apply supervised learning techniques on real-world data using classification algorithms and demonstrate their implementation and effectiveness	PO1,PO2,PO3,PO4, PO5, PO6, PO9, PO11, PSO1,PSO2	L3	WK4, WK5	8
CO5	Implement machine learning models to classify data in real-world applications and analyze their performance using appropriate evaluation metrics.	PO1,PO2,PO3,PO4, PO5, PO6, PO9, PO11, PSO1,PSO2	L3	WK4, WK5	7

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	**Introduction to Machine Learning:** Basic steps of ML, Perspectives and Issues, Designing learning systems, Concepts of hypotheses. **Datasets and Partitions, Data Pre-processing and Scaling:** Different Preprocessing techniques, Data Integration, Outlier removal, artifact removal, Applying Data Transformations, Scaling Training and Test Data the Same Way, Data Normalization, Data Transformation techniques.	CO1	8
II	**Dealing With Missing Values:** Assumptions and Missing Data Mechanisms, Simple approaches to missing Data, Dealing with Noisy Data: Identifying Noise, Types of Noise Data, Noise filtering at data level. **Data Reduction:** Curse of Dimensionality, PCA, LDA, Data sampling, Binning	CO2	8
III	**Feature Engineering:** Feature Extraction, Feature Ranking, Best Features, Feature Selection	CO3	8
IV	**Introduction to Supervised learning - Regression Algorithms:** Linear Regression, Polynomial Regression, Lasso, Ridge and Elastic nets Regression, Regularization methods, Categorical Variables in Regression, Loss functions, Risk functions. **Use Case:** Relationship between Buying Intention and Awareness of Electric Vehicles, Application of Technology Acceptance Model in Cloud Computing, Impact of Social Networking Websites on Quality of Recruitment, Transportation optimization, Applications in Smart phones.	CO4	8

V	**Supervised Learning:** Classification Algorithms: Supervised Machine Learning Algorithms: Sample Datasets, logistic regression, k-Nearest Neighbors (Regression and Classification) **Linear Models:** Naive Bayes, Decision Trees. **Use Case:** Prediction of Customer buying Intension due to Digital Marketing, Measuring Acceptability of a New Product, Predicting phishing websites, loan categorization, Diagnosis and Treatment of Diseases, Security applications	CO5	7

Lab Programs:

Sl. No.	Lab Programs
1	Write a program to implement different data imputations in Machine Learning using Python.
2	Write a program to implement to implement different feature scaling techniques using python
3	Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets
4	Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions.
5	For the iris dataset, Implement Logistic Regression and Linear Regression. Plot the following graphs: Accuracy and Loss values per iteration.
6	Implement ID3 decision tree algorithm using Python
7	For the diabetics dataset implement Random Forest classifier.
8	Extract features and perform text classification from unstructured text using Python
9	Write a program to implement Word2Vec and produce the word embedding using Python.
10	For the given dataset, develop the recommendation system using PCA.

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Data preprocessing in Data Mining‖	Salvador García, JuliánLuengo Francisco Herrera	Springer		All Modules
2	Introduction to Machine Learning with Python	Sarah Guido, Andreas C. Müller	O‘ Reilly	1st Edition 2017	All Modules
3	Bharti Motwani, _Data Analytics using Python		Wiley		All Modules
4	Fundamentals of Machine Learning for Predictive Data Analytics: Algorithms	John D. Kelleher, Brian Mac Namee, and Aoife D'Arcy,	The MIT Press, 2015		All Modules

5	Introduction to Machine Learning	Ethem Alpaydin	PHI Learning	2nd Edition, 2019	All Modules

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCS/WEB RESOURCE

1. Building Machine Learning Systems with Python http://totoharyanto.staff.ipb.ac.id/files/2012/10/Building-Machine-Learning-Systems-with-Python-RichertCoelho.pdf
2. Foundations of Machine Learning https://cs.nyu.edu/~mohri/mlbook/
3. Understanding Machine Learning: From Theory to Algorithms
https://www.cs.huji.ac.il/w~shais/UnderstandingMachineLearning/understanding-machine-learning-theoryalgorithms.pdf
4. https://www.coursera.org/learn/machine-learning
5. https://www.udemy.com/course/what-is-machine learning/?ranMID=39197&ranEAID=JVFxdTr9V80&ranSiteID=JVFxdTr9V80-cIV9JiZ_AJo5kC9cS9TbrQ&LSNPUBID=JVFxdTr9V80&utm_source=aff-campaign&utm_medium=udemyads

7. EVALUATION METHODOLOGY

a) Continuous Internal Evaluation (CIE) = 50 marks
b) Semester End Examination (SEE) = 50 marks
Total = 100 marks

Semester End Examination (SEE):
SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**
The laboratory assessment would be restricted to only the CIE evaluation.

Continuous Internal Evaluation (CIE):
Two Tests are to be conducted for 40 marks each. The average of the two tests are taken for computation of CIE on a scale of 30, the CIE would also include laboratory evaluation for 20 marks. The laboratory marks of 20 would comprise of 10 marks for regular laboratory assessment to include lab observation. 10 marks would be exclusive for laboratory internal assessment test to be conducted at the end of the semester.

Typical Evaluation pattern for integrated courses is shown in the Table below

Component		Marks	Total Marks
CIE	CIE Test-1	**30**	**50**
	CIE Test-2	**30**	
	Laboratory	**20**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

8. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → / COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	3	3	3	2			2		3
CO2	3	2	3	3	3	2			2		3
CO3	3	2	3	3	3	2			2		3
CO4	3	2	3	3	3	2			2		3
CO5	3	2	3	3	3	2			2		3

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

9. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → / COs ↓	PSO1	PSO2
CO1	2	3
CO2	2	3
CO3	2	3
CO4	2	3
CO5	2	3

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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Department: **DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**		
Semester: **4**	Course Code: **BAD24403**	Contact Hrs /week: **3**
Course Description: **DESIGN AND ANALYSIS OF ALGORITHMS**		No. of Credits:**3** L : T : P : S = **3:0:0:0**
Course Category: **PCC**		Total no. of Hours = **39**
CIE: **50 Marks**	SEE: **50 Marks**	Exam Hours: **03**
Course Pre-requisites: Strong understanding of data structures (arrays, linked lists, trees, graphs), Knowledge of basic mathematics (discrete mathematics, combinatorics, probability)		

1. PREAMBLE ABOUT THE COURSE

This course focuses on algorithmic techniques like divide-and-conquer, dynamic programming, and greedy methods. Time and space complexity analysis is a key topic. It teaches optimization and efficient problem-solving. Real-world case studies like sorting and searching are discussed. Students enhance logic-building and mathematical rigor. The course is core to computer science foundations.

2. COURSE LEVEL OBJECTIVES

CLO1	To learn mathematical background for analysis of algorithm
CLO2	Analyze the asymptotic performance of algorithms.
CLO3	To understand the concept of designing an algorithm.
CLO4	Synthesize efficient algorithms in common engineering design situations.

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Understand the fundamental concepts of algorithms, explore asymptotic notations and apply brute force technique	PO1,PO2,PO3,PO4, PO5, PO8, PO11,PSO1	L2	WK2, WK4	08
CO2	Apply Divide-and-Conquer and Decrease-and-Conquer techniques to design efficient algorithmic solutions for given problems.	PO1,PO2,PO3,PO4, PO5, PO8, PO11,PSO1	L3	WK2, WK4	08

CO3	Analyze problems to select and apply Dynamic Programming and Transform-and-Conquer techniques for optimizing solutions and enhancing algorithmic efficiency.	PO1,PO2,PO3,PO4, PO5, PO8, PO11,PSO1	L4	WK2, WK4	08
CO4	Evaluate and design efficient solutions for optimization problems using the Greedy Technique, assessing their effectiveness and applicability	PO1,PO2,PO3,PO4, PO5, PO8, PO11,PSO1	L5	WK2, WK4	08
CO5	Evaluate the effectiveness of Backtracking and Branch and Bound techniques in solving complex combinatorial and optimization problems, and justify their appropriate use.	PO1,PO2,PO3,PO4, PO5, PO8, PO11,PSO1	L5	WK2, WK4	07

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	**Introduction:** Notion of algorithm, Fundamentals of Algorithmic Problem Solving, Fundamentals of the Analysis of Algorithmic Efficiency: Analysis frame work, Asymptotic Notations and Basic Efficiency Classes, Mathematical Analysis of Non-recursive and Recursive Algorithms. **Brute Force**: Selection Sort and Bubble Sort.	CO1	08
II	**Divide and Conquer:** Merge sort, Quicksort, Multiplication of long integers, Strassen's Matrix multiplication, Max-Min Problem **Decrease and Conquer:** Insertion Sort, Depth First Search, Breadth First Search, Topological Sorting, Applications of DFS and BFS.	CO2	08
III	**Transform and Conquer:** Presorting,Heapsort, Problem reduction. **Space and Time Tradeoffs:** Sorting by Counting, Naive String Matching, Input Enhancement in String Matching: Horspool's and Boyer-Moore algorithm.	CO3	08
IV	**Dynamic Programming:** Computing a Binomial Coefficient, Warshall's and Floyd's Algorithms, The Knapsack Problem and Memory Functions. **Greedy Technique:** Prim's Algorithm, Kruskal's Algorithm, Dijkstra's Algorithm, Huffman Trees and codes.	CO4	08
V	**Backtracking :** N-Queen's Problem, Sum of Subset Problem. **Branch-and-Bound:** Travelling Sales Person problem,0/1 Knapsack problem	CO5	07

	NP and NP-Complete Problems : Basic concepts, nondeterministic algorithms, P, NP, NP-Complete, and NP-Hard classes		

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Introduction to the Design and Analysis of Algorithms	Anany Levitin	Pearson Education	3rd Edition	All Modules
2	Introduction to Algorithms	Cormen T.H., Leiserson C.E., Rivest R.L., Stein C.	PHI	3rd Edition	All Modules
3	Computer Algorithms	Horowitz E., Sahani S., Rajasekharan S	Galgotia Publications	2nd Edition	All Modules

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCS/WEB RESOURCE

- http://www.facweb.iitkgp.ac.in/~sourav/daa.html
- https://freevideolectures.com/course/2281/design-and-analysis-of-algorithms
- https://www.youtube.com/watch?v=4R8dJCSfyKU&list=PLtg1mdkLERgnS8XNGU4irXk7dRuji61Z
- https://nptel.ac.in/courses/106101060/
- https://www.coursera.org/specializations/algorithms

7. EVALUATION METHODOLOGY

a) Continuous Internal Evaluation (CIE) = 50 marks
b) Semester End Examination (SEE) = 50 marks
Total = 100 marks

CIE Framework:
Semester End Examination (SEE):
SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):
Two Tests are to be conducted for 40 marks each. The average of the two tests are taken for computation of CIE. The CIE would also include assignment evaluation for 10 marks.

Typical Evaluation pattern for courses is shown in the Table below

Component		Marks	Total Marks
CIE	CIE Test-1	40	50
	CIE Test-2	40	
	Assignment	10	
SEE	Semester End Examination	50	50
Grand Total			100

8. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → / COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3	2	2			1			2
CO2	3	3	3	2	2			1			2
CO3	3	3	3	2	2			1			2
CO4	3	3	3	2	2			1			2
CO5	3	3	3	2	2			1			2

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

9. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → / COs ↓	PSO1	PSO2
CO1	2	
CO2	2	
CO3	2	
CO4	3	
CO5	2	

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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Department: **DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**		
Semester: **4**	Course Code: **BAD24404**	Contact Hrs /week: **3**
Course Description: **COMPUTER NETWORKS**		No. of Credits:**3** L : T : P : S = **3:0:0:0**
Course Category: **PCC**		Total no. of Hours = **39**
CIE: **50 Marks**	SEE: **50 Marks**	Exam Hours: **03**
Course Pre-requisites: Foundation in computer basics, including operating systems, and basic network concepts		

1. PREAMBLE ABOUT THE COURSE

Sequence of bits or symbols transmitted at the beginning of a message or packet to signal the start of a communication frame. Its primary purpose is to synchronize the sender and receiver's clocks, ensuring that both are operating at the same timing for accurate data transmission. The preamble prepares the receiver for the incoming data and may include a known pattern to help detect errors early. It typically ends with a Start Frame Delimiter (SFD**)**, indicating the beginning of the actual data. This mechanism is essential in protocols like Ethernet and Wi-Fi, where it helps establish proper communication, reduces errors, and improves overall efficiency.

2. COURSE LEVEL OBJECTIVES

CLO1	Comprehend the transmission technique of digital data between two or more computers and a computer network that allows computers to exchange data
CLO2	Explain with the basics of data communication and various types of computer networks
CLO3	Demonstrate Medium Access Control protocols for reliable and noisy channels.
CLO4	Expose wireless and wired LANs.

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Understand the fundamental components of data communication systems.	PO1,PO2,PO3,PO4, PO5, PO6, PO9, PO11, PSO1,PSO2	L2	WK2, WK4	08
CO2	Apply digital-to-digital and analog-to-digital conversion techniques, including line coding and PCM, to design	PO1,PO2,PO3,PO4, PO5, PO6, PO9, PO11, PSO1,PSO2	L3	WK2, WK4	08

	basic communication system models.				
CO3	Apply error detection and correction techniques such as block coding, cyclic codes, and checksum to ensure reliable data communication.	PO1,PO2,PO3,PO4, PO5, PO6, PO9, PO11, PSO1,PSO2	L3	WK2, WK4	08
CO4	Apply media access control methods and perform IPv4 addressing and subnetting using classful and CIDR techniques in network configurations	PO1,PO2,PO3,PO4, PO5, PO6, PO9, PO11, PSO1,PSO2	L3	WK2, WK4	08
CO5	Demonstrate the application of wired and wireless LAN technologies, such as Ethernet standards and IEEE 802.11, in designing and configuring local area networks	PO1,PO2,PO3,PO4, PO5, PO6, PO9, PO11, PSO1,PSO2	L3	WK2, WK4	07

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	Introduction: Data Communications, Networks, Network Types, Internet History, Standards and Administration, Networks Models: Protocol Layering, TCP/IP Protocol suite, The OSI model, Introduction to Physical Layer-1: Data and Signals, Digital Signals, Transmission Impairment, Data Rate limits, Performance.	CO1	08
II	Digital Transmission: Digital to digital conversion (Only Line coding: Polar, Bipolar and Manchester coding). Physical Layer-2: Analog to digital conversion (only PCM), Transmission Modes, Analog Transmission: Digital to analog conversion.	CO2	08
III	Error Detection and Correction: Introduction, Block coding, Cyclic codes, Checksum,Framing.	CO3	08
IV	Media Access control: Random Access, Controlled Access and Channelization, IPv4 Addressing and subnetting: Classful and CIDR addressing.	CO4	08
V	Wired LANs Ethernet: Ethernet Protocol, Standard Ethernet, Fast Ethernet, Gigabit Ethernet and 10 Gigabit Ethernet, Wireless LANs: Introduction, IEEE 802.11 Project and Bluetooth.	CO5	07

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Data Communications and Networking ,	Behrouz A. Forouzan	Tata McGraw-Hill, 2013.	5th Edition	All Modules
2	Communication Networks - Fundamental Concepts and Key architectures	Alberto Leon-Garcia and Indra Widjaja	Tata McGraw-Hill, 2004	2nd Edition	All Modules
3	Computer Networks – A Systems Approach	Larry L. Peterson and Bruce S. Davie	Elsevier, 2007	4th Edition	All Modules
4	Computer and Communication Networks	Nader F. Mir	Pearson Education, 2007.		All Modules

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCS/WEB RESOURCE

- https://archive.nptel.ac.in/courses/106/105/106105082/
- https://onlinecourses.nptel.ac.in/noc22_ee61/preview
- http://kcl.digimat.in/nptel/courses/video/106105082/L34.html
- https://www.youtube.com/playlist?list=PLUtfVcb-iqn8dG1-Cn7NTEdILR3hRVgcN

7. EVALUATION METHODOLOGY

a) Continuous Internal Evaluation (CIE) = 50 marks
b) Semester End Examination (SEE) = 50 marks
Total = 100 marks

CIE Framework:
Semester End Examination (SEE):
SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):
Two Tests are to be conducted for 40 marks each. The average of the two tests are taken for computation of CIE. The CIE would also include assignment evaluation for 10 marks.
Typical Evaluation pattern for courses is shown in the Table below

Component		Marks	Total Marks
CIE	CIE Test-1	**40**	**50**
	CIE Test-2	**40**	
	Assignment	**10**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

8. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → / COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	3	3	3	2			2		3
CO2	3	2	3	3	3	2			2		3
CO3	3	2	3	3	3	2			2		3
CO4	3	2	3	3	3	2			2		3
CO5	3	2	3	3	3	2			2		3

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

9. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → / COs ↓	PSO1	PSO2
CO1	2	2
CO2	2	2
CO3	2	2
CO4	2	2
CO5	2	2

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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GLOBAL ACADEMY OF TECHNOLOGY

Autonomous Institution Affiliated to Visveswaraya Technological University
Approved by UGC, AICTE and Govt of Karnataka

Department: **DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**		
Semester: **4**	Course Code: **BADL24405**	Contact Hrs /week: **2**
Course Description: **ALOGRITHMS LABORATORY**		No. of Credits: **1** L : T : P : S = **0:0:2:0**
Course Category: **PCCL**		Total no. of Hours = **13**
CIE: **50 Marks**	SEE: **50 Marks**	Exam Hours: **03**
Course Pre-requisites:Strong understanding of programming concepts (preferably in C, C++, Java, or Python), Familiarity with data structures (arrays, stacks, queues, linked lists, trees)		

1. PREAMBLE ABOUT THE COURSE

This lab provides practical implementation of various algorithmic techniques. Students apply sorting, searching, graph, and optimization algorithms. Programming in C/C++ is emphasized. It develops logic and debugging skills. Real-world problem solving through code is practiced. It complements the DAA theory course.

2. COURSE LEVEL OBJECTIVES

CLO1	Applying brute-force and divide-and-conquer paradigms
CLO2	Investigating design techniques for graph traversal.
CLO3	Demonstrate the greedy technique, dynamic programming paradigm to solve problems
CLO4	Illustrate the Backtracking algorithm design paradigms

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Apply brute-force and divide-and-conquer paradigms to solve computational problems effectively.	PO1,PO2,PO3, PO4,PO5, PO8, PO11,PSO1	L3	WK2, WK4	4
CO2	Analyze and investigate various design techniques used for efficient graph traversal.	PO1,PO2,PO3, PO4,PO5, PO8, PO11,PSO1	L5	WK2, WK4	3
CO3	Demonstrate the application of greedy technique and dynamic programming	PO1,PO2,PO3, PO4,PO5, PO8, PO11,PSO1	L5	WK2, WK4	3

	paradigms to solve computational problems effectively.				
CO4	Illustrate the use of Backtracking algorithm design paradigm to solve complex computational problems.	PO1,PO2,PO3, PO4,PO5, PO8, PO11,PSO1	L3-L5	WK2, WK4	3

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Sl. No.	Experiments/Programs
1	Sort a given set of n integer elements using bubble Sort method and compute its time complexity.
2	Sort a given set of n integer elements using Merge Sort method and compute its time complexity.
3	Sort a given set of n integer elements using Quick Sort method and compute its time complexity.
4	Write a program to check whether a given unweighted graph is connected or not using BFS method.
5	Demonstrate how to obtain the Topological ordering of vertices in a given digraph using DFS
6	Sort a given set of n integer elements using Heap Sort method and compute its time complexity.
7	Write a program to implement Horspool's String matching algorithm.
8	Implement 0/1 Knapsack problem using Dynamic Programming Memory Functions technique.
9	Find Minimum Cost Spanning Tree for a given weighted graph using Prims algorithm.
10	Implement Single Source Shortest Path algorithm
11	Write a Program to solve the sum of Subset problem using Back Tracking.
12	Demonstrate the working of back tracking approach for solving N-Queen's problem.

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Introduction to the Design and Analysis of Algorithms	Anany Levitin	Pearson Education	3rd Edition	All Modules
2	Introduction to Algorithms	Cormen T.H., Leiserson C.E., Rivest R.L., Stein C	PHI	3rd Edition, 2010	All Modules
3	Computer Algorithms	Horowitz E., Sahani S., Rajasekharan S.,	Galgotia Publications	2nd Edition, 2006	All Modules

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCS/WEB RESOURCE

- https://nptel.ac.in/courses/106/106/106106136/
- https://nptel.ac.in/courses/106/106/106106094/

7. EVALUATION METHODOLOGY

ASSESSMENT AND EVALUATION PATTERN		
	CIE	**SEE**
WEIGHTAGE	**50%**	**50%**
Record	10	**50**
Test	20	
Experiential Learning	20	NIL
Total Marks for the Course	**50**	**50**

8. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → / **COs ↓**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	3	3	3	1	3			2			2
CO2	3	3	3	1	3			2			2
CO3	3	3	3	1	3			2			2
CO4	3	3	3	1	3			2			2
CO5	3	3	3	1	3			2			2

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

9. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → / **COs ↓**	**PSO1**	**PSO2**
CO1	2	
CO2	2	
CO3	2	
CO4	2	
CO5	2	

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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Department: **DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**		
Semester: **4**	Course Code: **BAD24406A**	Contact Hrs /week: **3**
Course Description: **IMAGE PROCESSING**		No. of Credits:**3** L : T : P : S = **3:0:0:0**
Course Category: **ETC/PLC**		Total no. of Hours = **39**
CIE: **50 Marks**	SEE: **50 Marks**	Exam Hours: **03**
Course Pre-requisites: Basic knowledge of mathematics (linear algebra, matrices, calculus, probability), Understanding of digital signal processing fundamentals		

1. PREAMBLE ABOUT THE COURSE

This subject introduces digital image fundamentals, transformations, filtering, and segmentation. Labs involve implementing enhancement and recognition techniques. Applications in medical imaging and surveillance are discussed. Tools like OpenCV are used for practical exposure. Students learn to process, analyze, and interpret images. It bridges signal processing and computer vision.

2. COURSE LEVEL OBJECTIVES

CLO1	To develop insight into the fundamental concepts of Digital image processing.
CLO2	To evaluate the techniques followed in image enhancements.
CLO3	To illustrate the techniques involved in image compression algorithms.
CLO4	To illustrate the techniques involved in image segmentation algorithms.

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Understand the core principles and foundational concepts of Digital Image Processing	PO1,PO2,PO3,PO4, PO6,PO9,PO10,PO11, PS01,PSO2	L2	WK5, WK6	08
CO2	Understand the fundamental transformation algorithms involved in the formation of digital images	PO1,PO2,PO3,PO4, PO6,PO9,PO10,PO11, PS01,PSO2	L2	WK5, WK6	08

CO3	Demonstrate the ability to differentiate between image enhancement and image compression techniques by applying fundamental concepts.	PO1,PO2,PO3,PO4, PO6,PO9,PO10,PO11, PS01,PSO2	L3	WK5, WK6	08
CO4	Apply image segmentation techniques to develop a comprehensive understanding of their principles and applications.	PO1,PO2,PO3,PO4, PO6,PO9,PO10,PO11, PS01,PSO2	L3	WK5, WK6	08
CO5	Apply image enhancement, compression, and segmentation algorithms in practical scenarios.	PO1,PO2,PO3,PO4, PO6,PO9,PO10,PO11, PS01,PSO2	L3	WK5, WK6	07

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	Introduction, Fundamental steps in image processing, Components of an Image Processing System, Digital Image Fundamentals, Elements of visual perception, Image model, Sampling and quantization, Relationship between pixels	CO1	08
II	Image Formation: Introduction, Geometric Model, Photometric Model. Digitalization: Introduction, Sampling, Quantization, Digital Image, Elements of Digital Geometry.	CO2	08
III	Image Enhancement: Enhancement by point processing, Sample intensity transformation, Histogram processing, Image subtraction, Image averaging, Spatial filtering, Smoothing filters, Sharpening filters, Frequency domain: Low-Pass, High-Pass, Homomorphic filtering.	CO3	08
IV	Image Compression: Coding redundancy, Inter-pixel redundancy, Fidelity criteria, Image compression models, Error-free compression, Variable length coding, Bit-plane coding, Loss-less predicative coding, Lossy compression, Image compression standards, Fractal Compression, Real-Time image transmission, JPEG and MPEG.	CO4	08
V	ImagT:egmentation: Detection of discontinuities, Edge linking and boundary detection, Thresholding, Region oriented segmentation, Use of motion in segmentation, Spatial techniques, Frequency domain techniques, Spatial Operations and Transformations Spatially dependent transform template and convolution, Window operations, 2- Dimensional geometric transformations.	CO5	07

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Digital Image Processing	R. Gonzalez and R. E. Wood	Prentice Hall of India	4th Edition	All Modules
2	Digital Image Processing and Analysis	B. Chanda and D. Dutta Majumder	Prentice Hall of India	2nd Edition	All Modules
3	Introductory Computer Vision and Image Procession	Andrian Low	McGrawHill		All Modules
4	Pattern Recognition-Statistical, Structural and neural approach	Robert Schalkoff	John Willey & Sons	4th Edition	All Modules
5	Digital Image Processing	W.K. Pratt	McGraw Hill		All Modules

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCS/WEB RESOURCE

1. Principles of Digital Image Processing, Wilhelm Burger http://omercetin.com.tr/DERS/IP/Kitap/Principles%20of%20digital%20image%20processing.p df
2. Image Processing, Analysis and Machine Vision, Milan Sonka https://kgut.ac.ir/useruploads/1550563201478ety.pdf
3. Introductory Digital Image Processing, John R Jensen https://media.oiipdf.com/pdf/f11c7ea9-28a4-42c8-8854-21a2f96a6338.pdf

7. EVALUATION METHODOLOGY

a) Continuous Internal Evaluation (CIE) = 50 marks
b) Semester End Examination (SEE) = 50 marks
Total = 100 marks

CIE Framework:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

The laboratory assessment would be restricted to only the CIE evaluation.

Continuous Internal Evaluation (CIE):

Two Tests are to be conducted for 40 marks each. The average of the two tests are taken for computation of CIE. The CIE would also include assignment evaluation for 10 marks.

Typical Evaluation pattern for integrated courses is shown in the Table below

Component		Marks	Total Marks
CIE	CIE Test-1	**40**	**50**
	CIE Test-2	**40**	
	Assignment	**10**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

8. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → / COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	2	2		2			2	2	2
CO2	3	3	2	2		2			2	2	2
CO3	3	3	2	2		2			2	2	2
CO4	3	3	2	2		2			2	2	2
CO5	3	3	2	2		2			2	2	2

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

9. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → / COs ↓	PSO1	PSO2
CO1	3	1
CO2	3	1
CO3	3	1
CO4	3	1
CO5	3	1

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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Department: **DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**		
Semester: **4**	Course Code: **BAD24406B**	Contact Hrs /week: **3**
Course Description: **INTRODUCTION TO DATA MINING**		No. of Credits: **3** L : T : P : S = **3:0:0:0**
Course Category: **ETC/PLC**		Total no. of Hours = **39**
CIE: **50 Marks**	SEE: **50 Marks**	Exam Hours: **03**
Course Pre-requisites: Basic programming skills (preferably in Python, R, or Java), Understanding of data structures and algorithms, Basic knowledge of statistics and probability		

1. PREAMBLE ABOUT THE COURSE

This course explores techniques for extracting meaningful patterns from large datasets. It includes classification, clustering, association rules, and anomaly detection. Students learn about data pre-processing and model evaluation. Emphasis is on knowledge discovery and practical insights. It builds skills relevant to business intelligence and analytics. Real-time applications and case studies are emphasized

2. COURSE LEVEL OBJECTIVES

CLO1	To learn about data mining Concepts
CLO2	To study the different data mining techniques
CLO3	Study large item sets and basic algorithms for association rule mining
CLO4	Learn about similarity and distance measures, outlier detection

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Understand and explain the fundamental concepts and methodologies of data mining.	PO1, PO2,PO3, PO5, PO8,PO9,PO11,PSO1,PSO2	L2	WK4, WK5	08
CO2	Apply statistical and machine learning techniques to interpret and analyze data mining results.	PO1, PO2, PO3, PO5, PO8,PO9,PO11,PSO1,PSO2	L3	WK4, WK5	08

CO3	Analyze and apply classification, clustering, and association rule mining techniques through hands-on experience.	PO1, PO2, PO3, PO5, PO8,PO9,PO11,PSO1,PSO2	L4	WK4, WK5	08
CO4	Analyze real-world problems and apply appropriate data mining techniques to extract meaningful insights.	PO1, PO2, PO3, PO5, PO8,PO9,PO11,PSO1,PSO2	L4	WK4, WK5	08
CO5	Examine and investigate advanced topics in data mining to enhance subject mastery..	PO1, PO2, PO3, PO5, PO8,PO9,PO11,PSO1,PSO2	L4	WK4, WK5	07

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	**Basic Data Mining Tasks:** Data Mining Versus Knowledge Discovery in Data Bases Data Mining Issues, Data Mining Matrices, Social Implications of Data Mining, Data Mining from Data Base Perspective	CO1	08
II	**Data Mining Techniques: A** Statistical Perspective on data mining, Similarity Measures, Decision Trees, Neural Networks, Genetic Algorithms.	CO2	08
III	**Classification:** Introduction, Statistical, Based Algorithms, Distance Based Algorithms Decision.	CO3	08
IV	**Clustering Tree:** Based Algorithms, Neural Network Based Algorithms, Rule Based Algorithms, Combining Techniques: Introduction, Similarity and Distance Measures Outliers, Hierarchical Algorithms. Partitioned Algorithms.	CO4	08
V	**Association Rules:** Introduction, Large Item Sets, Basic Algorithms, Parallel & Distributed Algorithms, Comparing Approaches, Incremental Rules, Advanced Association Rules Techniques, Measuring the Quality of Rules.	CO5	07

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Data Mining Concepts & Techniques	Jiawei Han & Micheline Kamber	The Morgan Kaufmann Series in Data Management Systems	3rd Edition.	All Modules
2	Data Mining Introductory and Advanced Topics	Margaret H.Dunbam	Pearson Education 2003	3rd Edition	All Modules
3	Data Mining: Concepts and Techniques,	Jiawei Han, Micheline Kamber, Jian Pei		3rd Edition,	All Modules

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCS/WEB RESOURCE

- https://www.geeksforgeeks.org/data-mining/
- https://onlinecourses.nptel.ac.in/noc21_cs06/preview
- https://nptel.ac.in/courses/106105174/

7. EVALUATION METHODOLOGY

a) Continuous Internal Evaluation (CIE) = 50 marks
b) Semester End Examination (SEE) = 50 marks
Total = 100 marks

CIE Framework:
Semester End Examination (SEE):
SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):
Two Tests are to be conducted for 40 marks each. The average of the two tests are taken for computation of CIE. The CIE would also include assignment evaluation for 10 marks.
Typical Evaluation pattern for integrated courses is shown in the Table below

Component		Marks	Total Marks
CIE	CIE Test-1	**40**	**50**
	CIE Test-2	**40**	
	Assignment	**10**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

8. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → / COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3		2			2	2		2
CO2	3	3	3		2			2	2		2
CO3	3	3	3		2			2	2		2
CO4	3	3	3		2			2	2		2
CO5	3	3	3		2			2	2		2

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

9. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → / COs ↓	PSO1	PSO2
CO1	2	2
CO2	2	2
CO3	2	2
CO4	2	2
CO5	2	2

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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Department: **DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**		
Semester: **4**	Course Code: **BAD24406C**	Contact Hrs /week: **3**
Course Description: **Object Oriented Programming with C++**		No. of Credits:**3** L : T : P : S = **3:0:0:0**
Course Category: **ETC/PLC**		Total no. of Hours = **39**
CIE: **50 Marks**	SEE: **50 Marks**	Exam Hours: **03**
Course Pre-requisites: Basic understanding of programming concepts (variables, loops, functions), Knowledge of basic data structures (arrays, structures, pointers)		

1. PREAMBLE ABOUT THE COURSE

This course introduces OOP concepts like classes, inheritance, and polymorphism in C++. Lab sessions involve real-time problem solving and application building. Emphasis is on encapsulation and modular code design. Students gain skills in writing reusable, maintainable code. It prepares them for software development roles. Object-oriented thinking is developed.

2. COURSE LEVEL OBJECTIVES

CLO1	Understanding about object oriented programming and Gain knowledge about the capability to store information together in an object.
CLO2	Understand the capability of a class to rely upon another class and functions.
CLO3	Understand about constructors which are special type of functions.
CLO4	Create and process data in files using file I/O functions
CLO5	Use the generic programming features of C++ including Exception handling

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Understand the principles of object-oriented programming and the concept of encapsulating related information within objects.	PO1,PO2,PO3, PO5,PO9,PO11,PS01	L2	WK3, WK4	08
CO2	Apply the concept of class dependencies by demonstrating how one	PO1,PO2,PO3, PO5,PO9,PO11,PS01	L3	WK3, WK4	08

	class relies on another class and its functions.				
CO3	Interpret usage of constructors as specialized functions within object-oriented programming..	PO1,PO2,PO3, PO5,PO9,PO11,PS01	L3	WK3, WK4	08
CO4	Apply file I/O functions to perform creation, reading, and modification of data within files.	PO1,PO2,PO3, PO5,PO9,PO11,PS01	L3	WK3, WK4	08
CO5	Demonstrate generic programming features of C++, including exception handling, to develop reliable and efficient programs.	PO1,PO2,PO3, PO5,PO9,PO11,PS01	L3	WK3, WK4	07

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	Introduction to Object Oriented Programming: Computer programming background- C++ overview. First C++ Program - Basic C++ syntax, Object Oriented Programming: What is an object, Classes, methods and messages, abstraction and encapsulation, inheritance, abstract classes, polymorphism.	CO1	08
II	Functions in C++: Tokens – Keywords – Identifiers and constants – Operators in C++ – Scope resolution operator – Expressions and their types – Special assignment expressions – Function prototyping – Call by reference – Return by reference – Inline functions -Default arguments – Function overloading.	CO2	08
III	Inheritance & Polymorphism: Derived class Constructors, destructors-Types of InheritanceDefining Derived classes, Single Inheritance, Multiple, Hierarchical Inheritance, Hybrid Inheritance.	CO3	08
IV	I/O Streams: C++ Class Hierarchy- File Stream-Text File Handling- Binary File Handling during file operations.	CO4	08
V	Exception Handling: Introduction to Exception - Benefits of Exception handling- Try and catch blockThrow statement- Pre-defined exceptions in C++	CO5	07

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Programming with ANSI C++	Bhushan Trivedi	Oxford Press	4th Edition	All Modules
2	Object Oriented Programming in C++	Robert Lafore (Author), Waite Group (Author)	SAMS publication.	4th edition	All Modules
3	C++ Primer	Stanley B. Lippman, Josée Lajoie, and Barbara E. Moo		5th Edition	All Modules

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCS/WEB RESOURCE

- Basics of C++ - https://www.youtube.com/watch?v=BClS40yzssA
- Functions of C++ - https://www.youtube.com/watch?v=p8ehAjZWjPw
- https://www.w3schools.com/cpp/cpp_intro.asp
- https://www.edx.org/course/introduction-to-c-2

7. EVALUATION METHODOLOGY

a) Continuous Internal Evaluation (CIE) = 50 marks
b) Semester End Examination (SEE) = 50 marks
Total = 100 marks

CIE Framework:
Semester End Examination (SEE):
SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**
The laboratory assessment would be restricted to only the CIE evaluation.

Continuous Internal Evaluation (CIE):
Two Tests are to be conducted for 40 marks each. The average of the two tests are taken for computation of CIE. The CIE would also include assignment evaluation for 10 marks.
Typical Evaluation pattern for integrated courses is shown in the Table below

Component		Marks	Total Marks
CIE	CIE Test-1	**40**	**50**
	CIE Test-2	**40**	
	Assignment	**10**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

8. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → / COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3		3				1		2
CO2	3	3	3		3				1		2
CO3	3	3	3		3				1		2
CO4	3	3	3		3				1		2
CO5	3	3	3		3				1		2

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

9. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → / COs ↓	PSO1	PSO2
CO1	2	
CO2	2	
CO3	2	
CO4	2	
CO5	2	

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

*****

Department: **DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**		
Semester: **4**	Course Code: **BAD24406D**	Contact Hrs /week: **3**
Course Description: **OBJECT ORIENTED PROGRAMMING WITH JAVA**		No. of Credits:**3** L : T : P : S = **3:0:0:0**
Course Category: **ETC/PLC**		Total no. of Hours = **39**
CIE: **50 Marks**	SEE: **50 Marks**	Exam Hours: **03**
Course Pre-requisites: Familiarity with procedural programming (any language like C, C++), Knowledge of basic data structures (arrays, strings)		

1. PREAMBLE ABOUT THE COURSE

These subject covers core Java concepts like objects, interfaces, exceptions, and collections. Labs focus on GUI development, file handling, and threading. Students learn to build platform-independent applications. The course emphasizes industry practices and design patterns. It bridges frontend and backend development. OOP concepts are reinforced with Java's robust framework.

2. COURSE LEVEL OBJECTIVES

CLO1	Introduces Object Oriented Programming concepts. Learn fundamental features of Java Programming
CLO2	Setup Java JDK environment to create, debug and run Java Programs To understand in detail about classes, and inheritance.
CLO3	Learn Object Oriented concepts using Java programs.
CLO4	Apply the concepts of multiprogramming to develop Java programs
CLO5	To gain knowledge on: packages, multithreaded programming and exceptions and develop robust java programs.

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Understand core Java programming concepts and the process of developing, debugging, and executing programs using modern development tools.	PO1,PO2,PO3,PO5, PO9,PO11,PS01	L2	WK3, WK4	08

CO2	Apply object-oriented programming concepts in Java to develop functional programs.	PO1,PO2,PO3,PO5, PO9,PO11,PS01	L3	WK3, WK4	08
CO3	Analyze and implement reusable Java programs by effectively utilizing interfaces and packages.	PO1,PO2,PO3,PO5, PO9,PO11,PS01	L4	WK3, WK4	08
CO4	Analyze and apply packages and exception handling to improve Java program structure and reliability.	PO1,PO2,PO3,PO5, PO9,PO11,PS01	L4	WK3, WK4	08
CO5	Demonstrate the creation of threads and implementation of thread synchronization in Java programs.	PO1,PO2,PO3,PO5, PO9,PO11,PS01	L4	WK3, WK4	07

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	**An Overview of OOP with Java:** Object-Oriented Programming (Two Paradigms, Abstraction, The Three OOP Principles), Using Blocks of Code, Lexical Issues (Whitespace, Identifiers, Literals, Comments, Separators, The Java Keywords), Member functions and data, objects and functions**,** The Java Buzzwords. **Data types, variables and Arrays:** The primitive types, a closer look at Literals, Variables, Type conversion and casting, Automatic type promotion in Expressions, Arrays. **Operators:** Arithmetic operators, The Bitwise operators, Relational operators, Boolean Logical operators, Assignment operator, The? operator, Operator precedence **Control Statements:** Java's selection statements, iteration statements, Jump statements	CO1	08
II	**Introducing Classes:** Classes fundamentals; Declaring objects; Introducing methods, Constructors, Destructors, this keyword, garbage collection **Methods and Classes:** Overloading Methods, Argument Passing, Returning Objects, Recursion, Access Control, understanding static, Introducing final, Inner Classes.	CO2	08
III	**Inheritance:** Inheritance Basics, Using super, Creating a Multilevel Hierarchy, When Constructors Are Executed, Method Overriding, Dynamic Method Dispatch (run-time polymorphism), Using Abstract Classes, Using final with Inheritance. **Interfaces:** Interfaces, Default Interface Methods, Use static Methods in an Interface,Private Interface Methods.	CO3	08
IV	**Packages:** Packages, Packages and Member Access, Importing Packages. **Exceptions:** Exception-Handling Fundamentals, Exception Types, Uncaught	CO4	08

	Exceptions, Using try and catch, Multiple catch Clauses, Nested try Statements, throw, throws, finally, Java's Built-in Exceptions, Creating Your Own Exception Subclasses.		
V	**Multithreaded Programming:** The Java Thread Model, The Main Thread, creating a Thread, Creating Multiple Threads, Using isAlive() and join(), Thread Priorities, Synchronization, Interthread Communication.	CO5	07

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Java: A beginner's guide	Herbert Schildt	McGraw-Hill Education	11th Edition	All Modules
2	Programming with Java	E Balagurusamy		7th Edition	All Modules
3	Head First Java	Kathy Sierra & Bert Bates	Oreilly	2nd Edition	All Modules
4	Effective java	oshua Bloch	John Willey & Sons	3rd Edition	All Modules

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCS/WEB RESOURCE

- https://java-programming.mooc.fi/part-1
- https://education.oracle.com/java-se-programming-i-mooc
- https://onlinecourses.nptel.ac.in/noc22_cs47

7. EVALUATION METHODOLOGY

a) Continuous Internal Evaluation (CIE) = 50 marks
b) Semester End Examination (SEE) = 50 marks
Total = 100 marks

CIE Framework:
Semester End Examination (SEE):
SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**
The laboratory assessment would be restricted to only the CIE evaluation.

Continuous Internal Evaluation (CIE):
Two Tests are to be conducted for 40 marks each. The average of the two tests are taken for computation of CIE. The CIE would also include assignment evaluation for 10 marks.

Typical Evaluation pattern for integrated courses is shown in the Table below

Component		Marks	Total Marks
CIE	CIE Test-1	40	50
	CIE Test-2	40	
	Assignment	10	
SEE	Semester End Examination	50	50
Grand Total			100

8. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → / COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3		3				1		2
CO2	3	3	3		3				1		2
CO3	3	3	3		3				1		2
CO4	3	3	3		3				1		2
CO5	3	3	3		3				1		2

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

9. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → / COs ↓	PSO1	PSO2
CO1	2	
CO2	2	
CO3	2	
CO4	2	
CO5	2	

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

*****

Department: **DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**		
Semester: **4**	Course Code: **BAD24457A**	Contact Hrs /week: **2**
Course Description: **DATA ANALYTICS WITH R**		No. of Credits:**1** L : T : P : S = **0:0:2:0**
Course Category: **AEC**		Total no. of Hours = **13**
CIE: **50 Marks**	SEE: **50 Marks**	Exam Hours: **02**
Course Pre-requisites: Knowledge of data structures like vectors, matrices, and data frames, Familiarity with statistics and data interpretation		

1. PREAMBLE ABOUT THE COURSE

This subject teaches statistical analysis and data visualization using R. Labs include data cleaning, modeling, and graphical representation. Topics like linear models and clustering are explored. Students apply statistical techniques to real-world datasets. Emphasis is on scripting and reproducible research. It supports roles in data science and analytics.

2. COURSE LEVEL OBJECTIVES

CLO1	To Gain the knowledge of R Programming Concepts
CLO2	To Explain the concepts of Data Visualization
CLO3	To Explain the concept of Statistics in R.
CLO4	To Work with R charts and Graphs

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Understand the fundamental data structures of R Programming including vectors, lists, matrices and data frames.	PO1,PO2,PO3,PO4,PO5, PO9,PO11,PSO1, PSO2	L2	WK2, WK4, WK6	3
CO2	Demonstrate the use of arrays, lists, data frames string and date functions in R to solve practical data related tasks.	PO1,PO2,PO3,PO4,PO5, PO9,PO11,PSO1, PSO2	L3	WK2, WK4, WK6	3

CO3	Analyze the key components of Data Preparation and examine their impact using real world examples.	PO1,PO2,PO3,PO4,PO5, PO9,PO11,PSO1, PSO2	L5	WK2, WK4, WK6	3
CO4	Apply the Graphical Packages in R to create effective visual representations of data for meaningful interpretations.	PO1,PO2,PO3,PO4,PO5, PO9,PO11,PSO1, PSO2	L5	WK2, WK4, WK6	2
CO5	Apply various Statistical Analysis Techniques to examine data and extract meaningful insights.	PO1,PO2,PO3,PO4,PO5, PO9,PO11,PSO1, PSO2	L5	WK2, WK4, WK6	2

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Sl. No.	EXPERIMENTS
1	Demonstrate the steps for installation of R and R Studio. Perform the following: a) Assign different type of values to variables and display the type of variable. Assign different types such as Double, Integer, Logical, Complex and Character and understand the difference between each data type. b) Demonstrate Arithmetic and Logical Operations with simple examples. c) Demonstrate generation of sequences and creation of vectors. d) Demonstrate Creation of Matrices e) Demonstrate the Creation of Matrices from Vectors using Binding Function. f) Demonstrate element extraction from vectors, matrices and arrays
2	Assess the Financial Statement of an Organization being supplied with 2 vectors of data: Monthly Revenue and Monthly Expenses for the Financial Year. You can create your own sample data vector for this experiment) Calculate the following financial metrics: a. Profit for each month. b. Profit after tax for each month (Tax Rate is 30%). c. Profit margin for each month equals to profit after tax divided by revenue. d. Good Months – where the profit after tax was greater than the mean for the year. e. Bad Months – wh11ere the profit after tax was less than the mean for the year. f. The best month – where the profit after tax was max for the year. g. The worst month – where the profit after tax was min for the year.
3	Develop a program to create two 3 X 3 matrices A and B and perform the following operations a) Transpose of the matrix b) addition c) subtraction d) multiplication
4	Develop a program to find the factorial of given number using recursive function calls
5	Develop an R Program using functions to find all the prime numbers up to a specified number by the method of Sieve of Eratosthenes

<table>
<tr><td>6</td><td>The built-in data set mammals contain data on body weight versus brain weight. Develop R commands to:
a) Find the Pearson and Spearman correlation coefficients. Are they similar?
b) Plot the data using the plot command.
c) Plot the logarithm (log) of each variable and see if that makes a difference</td></tr>
<tr><td>7</td><td>Develop R program to create a Data Frame with following details and do the following operations
<table><tr><th>itemCode</th><th>itemCategory</th><th>itemPrice</th></tr><tr><td>1001</td><td>Electronics</td><td>700</td></tr><tr><td>1002</td><td>Desktop Supplies</td><td>300</td></tr><tr><td>1003</td><td>Office Supplies</td><td>350</td></tr><tr><td>1004</td><td>USB</td><td>400</td></tr><tr><td>1005</td><td>CD Drive</td><td>800</td></tr></table>a) Subset the Data frame and display the details of only those items whose price is greater than or equal to 350.
b) Subset the Data frame and display only the items where the category is either “Office Supplies” or “Desktop Supplies”
c) Create another Data Frame called “item-details” with three different fields itemCode, ItemQtyonHand and ItemReorderLvl and merge the two frames</td></tr>
<tr><td>8</td><td>Let us use the built-in dataset air quality which has Daily air quality measurements in New York, May to September 1973. Develop R program to generate histogram by using appropriate arguments for the following statements.
a) Assigning names, using the air quality data set.
b) Change colors of the Histogram
c) Remove Axis and Add labels to Histogram
d) Change Axis limits of a Histogram
e) Add Density curve to the histogram</td></tr>
<tr><td>9</td><td>Design a data frame in R for storing about 20 employee details. Create a CSV file named “input.csv” that defines all the required information about the employee such as id, name, salary, start_date, dept. Import into R and do the following analysis.
a) Find the total number rows & columns
b) Find the maximum salary
c) Retrieve the details of the employee with maximum salary
d) Retrieve all the employees working in the IT Department.
e) Retrieve the employees in the IT Department whose salary is greater than 20000 and write these details into another file “output.csv”</td></tr>
<tr><td>10</td><td>Using the built in dataset mtcars which is a popular dataset consisting of the design and fuel consumption patterns of 32 different automobiles. The data was extracted from the 1974 Motor Trend US magazine, and comprises fuel consumption and 10 aspects of automobile design and performance for 32 automobiles (1973-74 models). Format A data frame with 32 observations on 11 variables : [1] mpg Miles/(US) gallon, [2] cyl Number of cylinders [3] disp Displacement (cu.in.), [4] hp Gross horsepower [5] drat Rear axle ratio,[6] wt Weight (lb/1000) [7] qsec 1/4 mile time, [8] vs V/S, [9] am Transmission (0 = automatic, 1 = manual), [10] gear Number of forward gears, [11] carb Number of carburetors
Develop R program, to solve the following:
a) What is the total number of observations and variables in the dataset?
b) Find the car with the largest hp and the least hp using suitable functions
c) Plot histogram / density for each variable and determine whether continuous variables are normally distributed or not. If not, what is their skewness?
d) What is the average difference of gross horse power(hp) between automobiles with 3 and 4 number of cylinders(cyl)? Also determine the difference in their standard deviations.
e) Which pair of variables has the highest Pearson correlation</td></tr>
</table>

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	R Programming: An Approach to Data Analytics	G. Sudhamathy and C. Jothi Venkateswaran	MJP Publishers 2019	Third Edition.	All Modules
2	An Introduction to R, Notes on R: A Programming Environment for Data Analysis and Graphics	W. N. Venables, D.M. Smith and the R Development Core Team			All Modules

6. EVALUATION METHODOLOGY

a) Continuous Internal Evaluation (CIE) = 50 marks
b) Semester End Examination (SEE) = 50 marks
Total = 100 marks

ASSESSMENT AND EVALUATION PATTERN		
	CIE	**SEE**
WEIGHTAGE	**50%**	**50%**
Record	10	**50**
Test	20	
Experiential Learning	20	NIL
Total Marks for the Course	**50**	**50**

7.COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → / COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3	3	3				1		1
CO2	3	3	3	3	3				1		1
CO3	3	3	3	3	3				1		1
CO4	3	3	3	3	3				1		1
CO5	3	3	3	3	3				1		1

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

8. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → / COs ↓	PSO1	PSO2
CO1	2	3
CO2	2	3
CO3	2	3
CO4	2	3
CO5	2	3

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

*****

Department: **DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**		
Semester: **4**	Course Code: **BAD24457B**	Contact Hrs /week: **2**
Course Description: **PROJECT MANAGEMENT WITH GIT**		No. of Credits:**1** L : T : P : S = **0:0:2:0**
Course Category: **AEC**		Total no. of Hours = **13**
CIE: **50 Marks**	SEE: **50 Marks**	Exam Hours: **02**
Course Pre-requisites: Familiarity with command-line interface (CLI) operations, Knowledge of version control concepts (commits, branches, merges)		

1. PREAMBLE ABOUT THE COURSE

This course introduces software project planning, version control, and agile practices. Git tools and workflows are emphasized in the lab. Students learn collaborative development, branching, and issue tracking. Emphasis is on real-world software team environments. It prepares for industry-level code management. Documentation and reporting skills are also developed.

2. COURSE LEVEL OBJECTIVES

CLO1	To familiar with basic command of Git
CLO2	To create and manage branches
CLO3	To understand how to collaborate and work with Remote Repositories
CLO4	To familiar with version controlling commands

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Demonstrate how to execute basic Git commands to manage and track changes in a repository.	PO1,PO2,PO3,PO4,PO5, PO8,PO11,PSO1, PSO2	L3	WK4, WK6, WK8	3
CO2	Evaluate and manage Git branches by selecting appropriate branching strategies and justifying their use for effective collaboration and version control.	PO1,PO2,PO3,PO4,PO5, PO8,PO11,PSO1, PSO2	L5	WK4, WK6, WK8	3

CO3	Apply Git commands to Collaborate with others by managing remote repositories.	PO1,PO2,PO3,PO4,PO5, PO8,PO11,PSO1, PSO2	L5	WK4, WK6, WK8	3
CO4	Apply Git commands to create and manage Git Tags, handle releases and perform advanced git operations.	PO1,PO2,PO3,PO4,PO5, PO8,PO11,PSO1, PSO2	L5	WK4, WK6, WK8	2
CO5	Analyze the Git commit history to identify necessary modifications and apply appropriate commands to rewrite or reorganize the history for clarity and accuracy	PO1,PO2,PO3,PO4,PO5, PO8,PO11,PSO1, PSO2	L5	WK4, WK6, WK8	2

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Sl. No.	EXPERIMENTS
1	**Setting Up and Basic Commands** Initialize a new Git repository in a directory. Create a new file and add it to the staging area and commit the changes with an appropriate commit message.
2	**Creating and Managing Branches** Create a new branch named "feature-branch." Switch to the "master" branch. Merge the "feature-branch" into "master."
3	**Creating and Managing Branches** Write the commands to stash your changes, switch branches, and then apply the stashed changes.
4	**Collaboration and Remote Repositories** Clone a remote Git repository to your local machine.
5	**Collaboration and Remote Repositories** Fetch the latest changes from a remote repository and rebase your local branch onto the updated remote branch.
6	**Collaboration and Remote Repositories** Write the command to merge "feature-branch" into "master" while providing a custom commit message for the merge.
7	**Git Tags and Releases** Write the command to create a lightweight Git tag named "v1.0" for a commit in your local repository.
8	**Advanced Git Operations** Write the command to cherry-pick a range of commits from "source-branch" to the current branch.
9	**Analysing and Changing Git History** Given a commit ID, how would you use Git to view the details of that specific commit,including the author, date, and commit message?
10	**Analysing and Changing Git History** Write the command to list all commits made by the author "JohnDoe" between "2023-01-01" and "2023-12-31."

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Version Control with Git	Prem Kumar Ponuthorai, Jon Loeliger	O'Reilly Media, Inc 2022	Third Edition.	All Modules
2	Pro Git book	Scott Chacon and Ben Straub	Apress		All Modules

6. EVALUATION METHODOLOGY

a) Continuous Internal Evaluation (CIE) = 50 marks
b) Semester End Examination (SEE) = 50 marks
Total = 100 marks

ASSESSMENT AND EVALUATION PATTERN		
	CIE	**SEE**
WEIGHTAGE	**50%**	**50%**
Record	10	**50**
Test	20	
Experiential Learning	20	NIL
Total Marks for the Course	**50**	**50**

7. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → / COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3	3	3			1			1
CO2	3	3	3	3	3			1			1
CO3	3	3	3	3	3			1			1
CO4	3	3	3	3	3			1			1
CO5	3	3	3	3	3			1			1

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

8. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → / COs ↓	PSO1	PSO2
CO1	2	1
CO2	2	1
CO3	2	1
CO4	2	1
CO5	2	1

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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Department: **DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**		
Semester: **4**	Course Code: **BAD24457C**	Contact Hrs /week: **2**
Course Description: **OPTIMIZATION TECHNIQUE**		No. of Credits:**1** L : T : P : S = **1:0:0:0**
Course Category: **AEC**		Total no. of Hours = **13**
CIE: **50 Marks**	SEE: **50 Marks**	Exam Hours: **02**
Course Pre-requisites:Basic knowledge of mathematics (linear algebra, calculus, and probability), Understanding of problem-solving and logical reasoning skills.		

1. PREAMBLE ABOUT THE COURSE

This subject focuses on linear, nonlinear, and dynamic optimization methods. Students learn to model and solve real-life decision problems. Topics include simplex method, duality, and LPP. Applications in engineering, logistics, and finance are explored. Emphasis is on algorithmic thinking. The course develops analytical and mathematical skills.

2. COURSE LEVEL OBJECTIVES

CLO1	Appreciate the importance of linear algebra in computer science and allied engineering science.
CLO2	Gain the knowledge of linear algebra tools and concepts to implement them in their core domain.
CLO3	Improve their mathematical thinking and acquire skills required for sustained lifelong learning.

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Apply the concepts of vector calculus to solve the given problem	PO1,PO2,PO3,PO4,PO5, PO7,PO11,PSO1, PSO2	L3	PO1, PO2, PO4	03
CO2	Apply the concepts of partial differentiation in machine learning and deep neural networks.	PO1,PO2,PO3,PO4,PO5, PO7,PO11,PSO1, PSO2	L4	PO1, PO2, PO4	03
CO3	Analyze the convex optimization algorithms and their importance in	PO1,PO2,PO3,PO4,PO5, PO7,PO11,PSO1, PSO2	L4	PO1, PO2, PO4	03
	computer science & engineering.				

CO4	Apply the optimization algorithms to solve the problem.	PO1,PO2,PO3,PO4,PO5, PO7,PO11,PSO1, PSO2	L4	PO1, PO2, PO4	02
CO5	Analyze the advanced optimization algorithms for machine learning.	PO1,PO2,PO3,PO4,PO5, PO7,PO11,PSO1, PSO2	L4	PO1, PO2, PO4	02

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	**VECTOR CALCULUS:** Functions of several variables, Differentiation and partial differentials, gradients of vector-valued functions, gradients of matrices, useful identities for computing gradients, linearization and multivariate Taylor series.	CO1	08
II	**APPLICATIONS OF VECTOR CALCULUS**: Back propagation and automatic differentiation, gradients in a deep network, The Gradient of Quadratic Cost, Descending the Gradient of Cost, The Gradient of Mean Squared Error.	CO2	08
III	Convex Optimization-1: Local and global optima, convex sets and functions separating hyperplanes, application of Hessian matrix in optimization, Optimization using gradient descent, Sequential search 3point search and Fibonacci search.	CO3	08
IV	Convex Optimization-2: Unconstrained optimization -Method of steepest ascent/descent,NR method, Gradient descent, Mini batch gradient descent, Stochastic gradient descent.	CO4	08
V	Advanced Optimization: Momentum-based gradient descent methods: Adagrad, RMSprop and Adam Non-Convex Optimization: Convergence to Critical Points, Saddle Point methods.	CO5	07

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Mathematics for Machine learning	Marc Peter Deisennroth, A. Aldo Faisal, Cheng Soon Ong	Cambridge University Press.		All Modules
2	Convex Optimization: Algorithms and Complexity, Foundations and Trends in Optimization	S. Bubeck, 2015			All Modules

6. EVALUATION METHODOLOGY

a) Continuous Internal Evaluation (CIE) = 50 marks
b) Semester End Examination (SEE) = 50 marks
Total = 100 marks

Continuous Internal Evaluation (CIE):
Two Tests are to be conducted for 40 marks each. The average of the two tests are taken for computation of CIE. The CIE would also include assignment evaluation for 10 marks.
Typical Evaluation pattern for courses is shown in the Table below

Component		Marks	Total Marks
CIE	CIE Test-1	**40**	**50**
	CIE Test-2	**40**	
	Assignment	**10**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

7. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → / COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	2	3	2	2		2				2
CO2	2	2	3	2	2		2				2
CO3	2	2	3	2	3		2				2
CO4	2	2	3	3	3		2				2
CO5	2	2	3	3	3		2				2

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

8. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → / COs ↓	PSO1	PSO2
CO1		1
CO2		1
CO3		1
CO4		1
CO5		1

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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Department: **DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**		
Semester: **4**	Course Code: **BAD24457D**	Contact Hrs /week: 2
Course Description: **MASTERING DATA VISUALIZATION**		No. of Credits:**1** L : T : P : S = **0:0:2:0**
Course Category: **AEC**		Total no. of Hours = 13
CIE: **50 Marks**	SEE: **50 Marks**	Exam Hours: **02**
Course Pre-requisites: Basic knowledge of data structures, fundamental statistics, and Excel or similar spreadsheet tools. Knowledge of data types, charts, and visual elements.		

1. PREAMBLE ABOUT THE COURSE

This course equips students with foundational data visualization skills using Microsoft Excel and Power BI. Through hands-on practice with real-world datasets, students learn data cleaning, basic analysis, and the creation of interactive charts, dashboards, and reports. The course emphasizes practical application and effective communication of insights aligned with industry requirements.

2. COURSE LEVEL OBJECTIVES

CLO1	Understand the fundamentals of data visualization and data storytelling.
CLO2	Illustrate the basic data analysis and visualization using Microsoft Excel.
CLO3	Design interactive visualizations and dashboards using Power BI.
CLO4	Analyze and communicate insights derived from data.

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Understand and apply fundamental data handling, sorting, and filtering techniques using Microsoft Excel.	PO1, PO2, PO3, PO4, PO5, O11,PSO1,PSO2	L3	WK5, WK6	3
CO2	Develop and interpret basic charts and visual summaries in Excel to identify data trends	PO1, PO2, PO3, PO4, PO5, PO11,PSO1,PSO2	L3	WK5, WK6	3

CO3	Design and implement comprehensive data cleaning, modeling, and interactive visualizations in Power BI Desktop to enable actionable insights and support data-driven decision-making."	PO1, PO2, PO3, PO4, PO5,PO11,PSO1,PSO2	L3	WK5, WK6	3
CO4	Strategically analyze complex datasets and translate insights into interactive dashboards that drive business decisions and inform organizational strategy.	PO1, PO2, PO3, PO4, PO5,PO11,PSO1,PSO2	L4	WK5, WK6	4

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Sl. No.	EXPERIMENTS
1.	Import, explore, and summarize CSV data in Excel using sorting, filtering, and tabular summaries.
2.	Apply arithmetic and logical formulas along with conditional formatting on Excel data.
3.	Visualize sales data in Excel using bar, line, and pie charts and interpret patterns.
4.	Set up Power BI Desktop, import datasets, and explore its interface and basic structure.
5.	Clean and transform datasets in Power BI using Power Query by handling duplicates, nulls, and columns.
6.	Create relationships and simple data models in Power BI to understand table connections.
7.	Use DAX to create calculated columns, measures, and perform basic aggregations in Power BI.
8.	Build visualizations in Power BI using charts, tables, and slicers with proper formatting.
9.	Design interactive Power BI dashboards with calculated fields, slicers, and drill-down features.
10.	Explore a dataset, identify trends and outliers, create basic visuals, and present insights.

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No	Name of the Book	Author(s)	Publisher	Edition	Exercise Covered
1	Microsoft Excel 2019: Data Analysis & Business Modeling	Wayne N.Winston	Microsoft Press	6th Edition	1,2 and 3
2	Microsoft Power BI Cookbook: Creating Business Intelligence Solutions of Analytical Data Models, Reports, and Dashboards	Brett Powell	Packt Publishing	1st Edition	4,5,6,7,8,9 and 10

6. EVALUATION METHODOLOGY

a) Continuous Internal Evaluation (CIE) = 50 marks
b) Semester End Examination (SEE) = 50 marks
Total = 100 marks

ASSESSMENT AND EVALUATION PATTERN		
	CIE	**SEE**
WEIGHTAGE	**50%**	**50%**
Record	10	**50**
Test	20	
Experiential Learning	20	NIL
Total Marks for the Course	**50**	**50**

7. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → / **COs ↓**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	2	2	3	2	2						2
CO2	2	2	3	2	2						2
CO3	2	2	3	2	3						2
CO4	2	2	3	2	3						2

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

8. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → / **COs ↓**	**PSO1**	**PSO2**
CO1	2	3
CO2	2	3
CO3	2	3
CO4	2	3

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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Department: **SCIENCE AND HUMANITIES**		
Semester: **4**	Course Code: **BBOK24407**	Contact Hrs /week: **2**
Course Description: **BIOLOGY FOR ENGINEERS**		No. of Credits:**1** L : T : P : S = **1:0:0:0**
Course Category: **BSC**		Total no. of Hours = **13**
CIE: **50 Marks**	SEE: **50 Marks**	Exam Hours: **01**
Course Pre-requisites: Foundation in computer basics, including operating systems, and basic network concepts		

1. PREAMBLE ABOUT THE COURSE

Biology for Engineers bridges life sciences with engineering principles. It empowers students to apply biological concepts to innovate in technology and healthcare. Understanding biological systems enhances sustainable design and bio-inspired solutions. This course fosters interdisciplinary thinking for real-world problem-solving.

2. COURSE LEVEL OBJECTIVES

CLO1	To familiarize the students with the basic biological concepts and their engineering applications.
CLO2	To enable the students with an understanding of biodesign principles to create novel devices and structures.
CLO3	To provide the students an appreciation of how biological systems can be re-designed as substitute products for natural systems.
CLO4	To motivate the students to develop interdisciplinary vision of biological engineering.

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Elucidate the basic biological concepts via relevant industrial applications and case studies.	PO1,PO2, PO7, PSO1,PSO2	L3	WK1, WK3, WK3	5
CO2	Evaluate the principles of design and development, for exploring novel bioengineering projects.	PO1,PO2, PO7, PSO1,PSO2	L3	WK1, WK3, WK3	5

CO3	Understand and apply biological concepts and emerging technologies such as tissue engineering, bioprinting, biosensing, and AI for solving real-world engineering problems.	PO1,PO2, PO7, PSO1,PSO2	L3	WK1, WK3, WK3	5

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	**Cell Basic Unit of Life** Introduction. Structure and functions of a cell. Stem cells and their application. Biomolecules: Properties and functions of Carbohydrates, Nucleic acids, proteins, lipids. Importance of special biomolecules: Properties and functions of enzymes, vitamins and hormones.	CO1	5
II	**Adaptation of Anatomical Principles for Bioengineering Design** Brain as a CPU system. Eye as a Camera system. Heart as a pump system. Lungs as purification system. Kidney as a filtration system.	CO2	5
III	**Trends In Bioengineering:** Muscular and Skeletal Systems as scaffolds, scaffolds and tissue engineering, Bioprinting techniques and materials. Electrical tongue and electrical nose in food science, DNA origami and Biocomputing, Bioimaging and Artificial Intelligence for disease diagnosis. Bioconcrete. Bioremediation. Biomining.	CO3	5

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Biology for Engineers	Thyagarajan S., Selvamurugan N., Rajesh M.P., Nazeer R.A., Thilagaraj W., Barathi S., and Jaganthan M.K.,	Tata McGraw-Hill, New Delhi, 2012		All Modules
2	Human Physiology	Stuart Fox, Krista Rompolski	McGraw-Hill eBook	16th Edition, 2022	All Modules
3	Biology for Engineers	Arthur T. Johnson	CRC Press, Taylor and Francis, 2011		All Modules

4	Biology for Engineers	Sohini Singh and Tanu Allen,	Vayu Education of India, New Delhi, 2014		All Modules
	Biomimetics: Nature-Based Innovation	Yoseph Bar-Cohen	2012, CRC Press	1st edition	All Modules

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCS/WEB RESOURCE

- https://nptel.ac.in/courses/121106008
- https://freevideolectures.com/course/4877/nptel-biology-engineers-other-non-biologists
- https://ocw.mit.edu/courses/20-020-introduction-to-biological-engineering-design-spring-2009
- https://ocw.mit.edu/courses/20-010j-introduction-to-bioengineering-be-010j-spring-2006
- https://www.coursera.org/courses?query=biology
- https://onlinecourses.nptel.ac.in/noc19_ge31/preview
- https://www.classcentral.com/subject/biology
- https://www.futurelearn.com/courses/biology-basic-concepts

7. EVALUATION METHODOLOGY

a) Continuous Internal Evaluation (CIE) = 50 marks
b) Semester End Examination (SEE) = 50 marks
Total = 100 marks

CIE Framework:
Semester End Examination (SEE):
SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):
Two Tests are to be conducted for 30 marks each. The average of the two tests are taken for computation of CIE and Assignment carries 20 marks.

Typical Evaluation pattern for courses is shown in the Table below

Component		Marks	Total Marks
CIE	CIE Test-1	**30**	**50**
	CIE Test-2	**30**	
	Assignment	**20**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

8. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → / COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2					3				
CO2	3	2					3				
CO3	3	2					3				

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

9. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → / COs ↓	PSO1	PSO2
CO1	2	2
CO2	2	2
CO3	2	2
CO4	2	2
CO5	2	2

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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Department: **SCIENCE AND HUMANITIES**		
Semester: **4**	Course Code: **BUHK408**	Contact Hrs /week: **01**
Course Description: **UNIVERSAL HUMAN VALUES (UHV)**		No. of Credits:**01** L : T : P : S = **1:0:0:0**
Course Category: **UHV**		Total no. of Hours = **13**
CIE: **50 Marks**	SEE: **50 Marks**	Exam Hours: **02**

1. COURSE LEVEL OBJECTIVES

CLO1	To help the students appreciate the essential complementarity between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
CLO2	To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way.
CLO3	To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behaviour and mutually enriching interaction with Nature.
CLO4	This course is intended to provide a much-needed orientation input in value education to the young enquiring minds.

2. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description
CO1	They would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.
CO2	They would have better critical ability.
CO3	They would also become sensitive to their commitment towards what they have understood (human values, human relationship and human society).
CO4	It is hoped that they would be able to apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.

3. SYLLABUS

Module No.	Module Description	No. of Hours
I	**Introduction to Value Education** Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education) Understanding Value Education, Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity – the Basic Human Aspirations, Happiness and Prosperity – Current Scenario, Method to Fulfil the Basic Human Aspirations	3
II	**Harmony in the Human Being** Understanding Human being as the Co-existence of the Self and the Body, Distinguishing between the Needs of the Self and the Body, The Body as an Instrument of the Self, Understanding Harmony in the Self, Harmony of the Self with the Body, Programme to ensure self-regulation and Health	3
III	**Harmony in the Family and Society** Harmony in the Family – the Basic Unit of Human Interaction, 'Trust' – the Foundational Value in Relationship, 'Respect' – as the Right Evaluation, Other Feelings, Justice in Human-to-Human Relationship, Understanding Harmony in the Society, Vision for the Universal Human Order	3
IV	**Harmony in the Nature/Existence** Understanding Harmony in the Nature, Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature, Realizing Existence as Co-existence at All Levels, The Holistic Perception of Harmony in Existence	3
V	**Implications of the Holistic Understanding – a Look at Professional Ethics** Natural Acceptance of Human Values, Definitiveness of (Ethical) Human Conduct, A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Competence in Professional Ethics Holistic Technologies, Production Systems and Management Models-Typical Case Studies, Strategies for Transition towards Value-based Life and Profession	3

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition
1	The Textbook A Foundation Course in Human Values and Professional Ethics	R R Gaur, R Asthana, G P Bagaria	Excel Books, New Delhi, 2019. ISBN 978-93-87034- 47-1	2nd Revised Edition
2	The Teacher‟s Manual for A Foundation Course in Human Values and Professional Ethics	R R Gaur, R Asthana, G		

3	Jeevan Vidya: Ek Parichaya	A Nagaraj, Jeevan Vidya Prakashan Amar kantak		1999
4	Human Values New	A.N. Tripathi,	Age Intl. Publishers, New Delhi	2004
5	The Story of My Experiments with Truth	Mohandas Karamchand Gandhi		

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Department: **SCIENCE AND HUMANITIES**		
Semester: **3 to 6**	Course Code: **BNSK24359/459/559/659**	Contact Hrs /week: 1
Course Description: **NATIONAL SERVICE SCHEME (NSS)**		No. of Credits: 0 L : T : P : S =**0:0:2:0**
Course Category: **MC**		Total no. of Hours = 24
CIE: **100 Marks**		

1. COURSE LEVEL OBJECTIVES

CLO1	Understand the community in general in which they work.
CLO2	Identify the needs and problems of the community and involve them in problem – solving
CLO3	Develop among themselves a sense of social & civic responsibility & utilize their knowled in finding practical solutions to individual and community problems.
CLO4	Develop competence required for group-living and sharing of responsibilities & gain skills in mobilizing community participation to acquire leadership qualities and democratic attitudes.
CLO5	Develop capacity to meet emergencies and natural disasters & practice national integration and social harmony in general.

2. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description
CO1	Understand the importance of his / her responsibilities towards society.
CO2	Analyse the environmental and societal problems/issues and will be able to design solutions for the same.
CO3	Evaluate the existing system and to propose practical solutions for the same for sustainable development.
CO4	Implement government or self-driven projects effectively in the field.
CO5	Develop capacity to meet emergencies and natural disasters & practice national integration and social harmony in general.

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

3. SYLLABUS

Module No.	Module Description
I	**National Service Scheme (NSS) – Contents** 1. Organic farming, Indian Agriculture (Past, Present and Future) Connectivity for marketing. 2. Waste management– Public, Private and Govt organization, 5 R's. 3. Setting of the information imparting club for women leading to contribution in social and economic issues. 4. Water conservation techniques – Role of different stakeholders– Implementation. 5. Preparing an actionable business proposal for enhancing the village income and approach for implementation. 6. Helping local schools to achieve good results and enhance their enrolment in Higher/ technical/ vocational education. 7. Developing Sustainable Water management system for rural areas and implementation approaches. 8. Contribution to any national level initiative of Government of India. For eg. Digital India, Skill India, Swatch Bharat, Atmanirbhar Bharath, Make in India, Mudra scheme, Skill development programs etc. 9. Spreading public awareness under rural outreach programs.(minimum5 programs). 10. Social connect and responsibilities. 11. Plantation and adoption of plants. Know your plants. 12. Organize National integration and social harmony events /workshops /seminars. (Minimum 02 programs). 13. Govt. school Rejuvenation and helping them to achieve good infrastructure.

4. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Publisher
1	NSS Course Manual	Published by NSS Cell, VTU Belagavi
2	Government of Karnataka, NSS cell, activities reports and its manual.	
3	Government of India, NSS cell, Activities reports and its manual.	

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Department: **SCIENCE AND HUMANITIES**		
Semester: **3 to 6**	Course Code: **BPEK24359/459/559/659**	Contact Hrs /week: **2**
Course Description: **PHYSICAL EDUCATION (SPORTS & ATHLETICS) – I**		No. of Credits: 0 L : T : P : S = **0:0:2:0**
Course Category: **MC**		Total no. of Hours = **24**
CIE: **100 Marks**		

1. SYLLABUS

Module No.	Module Description	No. of Hours
I	A. Lifestyle B. Health & Wellness C. Pre-Fitness test.	4
II	A. Warming up (Free Hand exercises) B. Strength – Push-up / Pull-ups C. Speed – 30 Mtr Dash	4
III	1. Kabaddi – Hand touch, Toe Touch, Thigh Hold, Ankle hold and Bonus. 2. Kho-Kho – Giving Kho, Single Chain, Pole dive, Pole turning, 3-6 Up.	16

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Department: **SCIENCE AND HUMANITIES**		
Semester: **3 to 6**	Course Code:BYOK24359/459/559/659	Contact Hrs /week: **02**
Course Description: **YOGA**		No. of Credits: 0 L : T : P : S = **0:0:2:0**
Course Category: **MC**		Total no. of Hours = **24**
CIE: **100**		

1. SYLLABUS

Course Title	Content
lntroduction of Yoga, Aim and Objectives of yoga, Prayer	Yoga, its meaning, definitions. Different schools of yoga, importance of prayer
Brief introduction of yogic practices for common man	Yogic practices for common man to promote positive health.
Rules and regulations	Rules to be followed during yogic practices by practitioner.
Misconceptions of yoga	Yoga its misconceptions
Suryanamaskara	Suryanamaskar prayer and its meanitrg, Need, importance and benefits of Suryanamaskar 12 count, 2 rounds.
Different types of Asanas Sitting 1. Padmasana 2. Vajrasana Standing 1. Vrikshana 2. Trikonasana Prone line 1. Bhujangasana 2. Shalabhasana Supine line 1. utthitadvipadasana 2. Ardhahalasana	Asana, Need, importance of Asana. Different types of asana. Asana its meaning by name, technique, precautionary measures and benefits.

Department: **SCIENCE AND HUMANITIES**		
Semester: **3 to 6**	Course Code: **BMUK359/459/559/659**	Contact Hrs /week: **2**
Course Description: **MUSIC**		No. of Credits: 0 L : T : P : S = **0:0:2:0**
Course Category: **MC**		Total no. of Hours = **24**
CIE: **100 Marks**		

1. COURSE LEVEL OBJECTIVES

1. Identify the major traditions of Indian music, both through notations and aurally.
2. Analyse the compositions with respect to musical and lyrical content.
3. Demonstrate an ability to use music technology appropriately in a variety of setting.

2. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description
CO1	Discus the Indian system of music and relate it to other genres (Cognitive Do main)
CO2	Experience the emotions of composer and develop empathy (Affective Domain)
CO3	Respond to queries on various patterns in a composition (Psycho Motor Domain)

3. SYLLABUS

Module No.	Module Description	No. of Hours
I	Preamble: Contents of the curriculum intend to promote music as language to develop on analytical, Creative, and intuitive Understanding. For this the student through study and direct participation in improvisation. Origin of the Indian Music: Evolution of the Indian music system, Understanding of Shruthi, Nada, Swara. Laya, Raga, Tala, Mela.	3
II	Compositions: Introduction to the types of composition in Carnatic Music Swarajathi, Varna, Krithi, and Thillana, Notation System.	3
III	Composers: Biography and Contributions of Purandaradasa, Thyagaraja.	3

IV	Music Instruments: Classification and construction of string instruments, percussion instruments, Idiophones (Ghana Vaadya), Examples of each class of Instruments.	3
V	Abhyasa Gana: Singing the swara exercises (Sarale Varase Only), Botation writing for Sarale Varase and Suladi Saptha Tala (Only in Mayamalavagowla Raga), Singing 4 Geethe in Malahari, and one jathi Swara, One Krithi in a Mela raga.	4

4. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

Sl. No.	Name of the Book	Author(s)	Publisher	Edition
1	Theory of Music	Vidushi Vasantha Madhavi	Prism Publication	2007
2	Karnataka Sangeetha Dharpana	T Sachidevi and T Sharadha (Thirumalai Sisters)	Shreenivaas Prakaashana	Vol, 1 2018
3	Classical Music of India: A Practical Gulge	Lakshminarayana Subramaniam, Viji Subramanaim	Tranqueber	2018
4	History of South Indian (Carnatic) Music	R Rangaramanuja Ayyangar	Vipanci Charitable Trust,	Third edition 2019
5	The Story of Indian Music and Its Instruments: A Study of the Present and a Record of the Past	Ethel Rosenthal	Pilgrims Publishing	2007

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B.E. in Artificial Intelligence and Data Science

Scheme of Teaching and Examinations 2025

V SEMESTER

Sl. No	Course and Course Code		Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	SDA	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	HSMC	BAD24501	Economics Management for IT Engineers	TD & PSB: AIDS	3	0	0	0	03	50	50	100	3
2	IPCC	BAD24502	Database Management & Systems	TD & PSB: AIDS	3	0	2	0	03	50	50	100	4
3	PCC	BAD24503	Machine Learning – 2	TD & PSB: AIDS	3	0	0	0	03	50	50	100	3
4	PCCL	BADL24504	Machine Learning Lab	TD & PSB: AIDS	0	0	2	0	03	50	50	100	1
5	PEC	BAD24505X	Professional Elective Course-1	TD & PSB: AIDS	3	0	0	0	03	50	50	100	3
6	AEC/SEC	BAD24556X	Skill Enhancement Course/Ability Enhancement Course-V	TD & PSB: AIDS	1	0	0	0	01	50	50	100	1
					0	0	2	0	02				
7	PROJ	BADP24507	Mini Project	TD & PSB:AIDS	0	0	4	0	03	100	-	100	2
8	AEC	BRMK24557	Research Methodology and IPR	Any Dept	2	2	0	0	03	50	50	100	3
9	MC	BESK24508	Environmental Studies	Civil	1	0	0	0	01	100	-	100	0
10	MC	BNSK24559	National Service Scheme (NSS)	NSS coordinator	0	0	2	0		100	-	100	0
		BPEK24559	Physical Education (PE) (Sports and Athletics)	Physical Education Director									
		BYOK24559	Yoga	Yoga Teacher									
		BLAK24559	Liberal Arts	Prominent NGO									
									Total	**650**	**350**	**1000**	**20**

PCC: Professional Core Course, **PCCL**: Professional Core Course laboratory, **UHV**: Universal Human Value Course, **MC**: Mandatory Course (Non-credit), **AEC**: Ability Enhancement Course, **SEC**: Skill Enhancement Course, **L:** Lecture, **T**: Tutorial, **P**: Practical **S= SDA**: Skill Development Activity, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation, **K**: This letter in the course code indicates common to all the stream of engineering. ESC: Engineering Science Course, ETC: Emerging Technology Course, PLC:Programming Language Course

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Professional Elective Course-1			
BAD24505A	Advanced Image Processing	BAD24505C	Social Network Analysis
BAD24505B	Full Stack Development	BAD24505D	Advance Java
Skill Enhancement Course/Ability Enhancement Course-V			
BAD24556A	AI tools for Data Engineers	BAD24556C	Applied Generative AI with Python and LangChain
BAD24556B	Data Analytics for IoT	BAD24556D	Ethics and Public Policy for AI

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B.E. in Artificial Intelligence and Data Science

Scheme of Teaching and Examinations 2025

VI SEMESTER

Sl. No	Course and Course Code		Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	SDA	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	IPCC	BAD24601	Big Data Analytics	TD & PSB: AIDS	3	0	2	0	03	50	50	100	4
2	PCC	BAD24602	Data Visualization using Tableau	TD & PSB: AIDS	3	0	0	0	03	50	50	100	3
3	PCC	BAD24603	Neural Networks & Deep Learning	TD & PSB: AIDS	3	0	0	0	03	50	50	100	3
4	PEC	BAD24604X	Professional Elective Course-2	TD & PSB: AIDS	3	0	0	0	03	50	50	100	3
5	OEC	BAD24605X	Open Elective Course-1	TD & PSB: AIDS	3	0	0	0	03	50	50	100	3
6	PROJ	BADP24606	Project Phase I	TD & PSB: AIDS	0	0	4	0	03	100	--	100	2
7	PCCL	BADL24607	Data Visualization Lab	TD & PSB: AIDS	0	0	2	0	03	50	50	100	1
8	SDC/AEC	BAD24657X	Skill Development Course (Online) / Ability Enhancement Course-VI	TD & PSB: AIDS	1	0	0	0	01	50	50	100	1
					0	0	2	0	02				
9	IKS	BIKS24608	Indian Knowledge System	Any Dept.	1	0	0	0	01	100	-	100	0
10	MC	BNSK24659	National Service Scheme (NSS)	NSS coordinator	0	0	2	0		100	---	100	0
		BPEK24659	Physical Education (PE) (Sports and Athletics)	Physical Education Director									
		BYOK24659	Yoga	Yoga Teacher									
		BLAK24659	Liberal Arts	Prominent NGO									
									Total	**650**	**350**	**1000**	**20**

PCC: Professional Core Course, **PCCL**: Professional Core Course laboratory, **UHV**: Universal Human Value Course, **MC**: Mandatory Course (Non-credit), **AEC**: Ability Enhancement Course, **SEC**: Skill Enhancement Course, **L:** Lecture, **T**: Tutorial, **P**: Practical **S= SDA**: Skill Development Activity, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation. **K**: This letter in the course code indicates common to all the stream of engineering. ESC: Engineering Science Course, ETC: Emerging Technology Course, PLC: Programming Language Course

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Professional Elective Course-2			
BAD24604A	Software Engineering with AGILE Methodologies	BAD24604C	Quantum Computing
BAD24604B	Cryptography and Network Security	BAD24604D	Cloud Computing
Open Elective Course-1			
BAD24605A	Foundations of Data Science	BAD24605C	Introduction to Machine Learning
BAD24605B	Introduction to Big Data	BAD24605D	Introduction to Algorithms
Skill Development Course (Online) / Ability Enhancement Course-VI			
BAD24657A	Agentic AI Systems and Applications	BAD24657B	MLOps: Deployment and Management of ML Systems

Department: **DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**		
Semester: **5**	Course Code: **BAD24501**	Contact Hrs /week: **3**
Course Description: **ECONOMICS MANAGEMENT for IT ENGINEERS**		No. of Credits: **3** L : T : P : S = **3:0:0:0**
Course Category: **HSMC**		Total no. of Hours = **39**
CIE: **50 Marks**	SEE: **50 Marks**	Exam Hours: **03**
Course Pre-requisites: Basic understanding of Economics		

1. PREAMBLE ABOUT THE COURSE

The course connects technology and business through the integration of economic and managerial concepts. It enables IT engineers to analyse costs, study markets, and make sound financial decisions. Students gain insights into micro and macroeconomic principles and develop entrepreneurial skills. Emphasis is placed on project preparation, evaluation, and effective resource Management. The course also focuses on key management functions such as planning, directing, and controlling. Ultimately, it equips engineers to combine innovation, leadership, and sustainability in business growth.

2. COURSE LEVEL OBJECTIVES

CLO1	Understand core concepts of economics and management relevant to engineering and IT environments.
CLO2	Analyse market trends, cost structures, and financial data for effective decision-making.
CLO3	Apply managerial functions such as planning, directing, controlling, and project preparation in IT projects
CLO4	Develop entrepreneurial and leadership abilities to align technological innovation with sustainable business growth.

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Understand the nature of management and core functions of planning, organizing, and staffing in engineering and IT organizations.	PO1, PO2, PO9, PO10, PO11, PSO1	L2	WK3 WK4	8
CO2	Apply the concepts of directing and controlling and evaluate different leadership styles and motivation theories.	PO1, PO2, PO9, PO10, PO11, PSO1	L3	WK3, WK4	8

CO3	Apply the characteristics and types of entrepreneurs and assess their role in economic development in India.	PO1, PO2, PO9, PO10, PO11, PSO1	L3	WK3, WK4	8
CO4	Develop project proposals by applying project identification, selection, and report preparation guidelines.	PO1, PO2, PO3, PO9, PO10, PO11, PSO1	L3	WK3, WK4	8
CO5	Apply engineering economics principles including demand, supply, and interest calculations in decision-making.	PO1, PO2, PO3, PO9, PO10, PO11, PSO1	L3	WK3, WK4	7

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	**Management:** Meaning, Nature and characteristics of management, scope and functional areas of management, Goals of management, Levels of management. **Planning**- Nature, importance, types of plans, steps in planning, **Organizing-** nature and purpose, Types of Organization. **Staffing**- Meaning, Process of recruitment and selection.	CO1	08
II	**Directing and controlling**- Meaning and Nature of Directing, Leadership Styles, Motivation theories. **Communication**- Meaning and importance, Coordination meaning and importance. **Controlling**- meaning, steps in controlling.	CO2	08
III	**Entrepreneur** – Meaning of entrepreneur, Characteristics of entrepreneurs, classification and types of entrepreneurs, role of entrepreneurs in economic development, entrepreneurship in India, **Feasibility study:** Market feasibility study, Technical feasibility study, Financial feasibility study and Social feasibility study.	CO3	08
IV	**Preparation of project and ERP** - Meaning of project, Project Identification, Project Selection, Project Report, Need and Significance of Project Report, Contents, Formulation, Guidelines by planning commission for Project Report, Types of reports and methods of report generation. **Enterprise Resource Planning:** Meaning and Importance, Human Resources	CO4	08
V	**Engineering and Economics**: Definition of micro and small enterprises, steps in establishing micro and small enterprises, problem solving and decision making, Laws of demand and supply, Law of Returns, Interest and interest factors, simple and compound interest, Cash flow.	CO5	07

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Principles of Management	P. C. Tripathi, P. N. Reddy	Tata McGraw Hill	7th Edition,2022	Module 1, 2
2	Management and Entrepreneurship	Kanishka Bedi	Oxford University Press	6th Edition, 2020	Module 3
3	Entrepreneurship Development	S. Anil Kumar, S. C. Poornima, M. K. Abraham, K. Jayashree	NEW AGE International Pvt Ltd	2nd Edition, 2023	Module 4
4	Engineering Economy	Leland T. Blank, Anthony Tarquin	McGraw Hill	9th edition, 2023	Module 5

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCS/WEB RESOURCE]

- https://onlinecourses.nptel.ac.in/noc21_mg90/preview
- https://elearn.nptel.ac.in/shop/nptel/foundation-course-in-managerial-economics/
- E-learning: www.vtu.ac.in
- https://elearn.nptel.ac.in/shop/nptel/project-management/

7. EVALUATION METHODOLOGY

a) Continuous Internal Evaluation (CIE) = 50 marks
b) Semester End Examination (SEE) = 50 marks
Total = 100 marks

CIE and SEE Framework:

Assessment	Actual Weightage in Marks	Final weightage in Marks
CIE 1	50	Avg of 2 CIEs out of 30
CIE 2	50	
AAT	20	20
SEE	100	50
Total		**100**
Grading Consideration		**50% CIE + 50% SEE**

8. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → / COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2					1		2	2	3
CO2	3	2					1		2	2	3
CO3	3	2					1		2	2	3
CO4	3	2	2				1		2	2	3
CO5	3	2	2				1		2	2	3

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

9. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → / COs ↓	PSO1	PSO2
CO1	3	
CO2	3	
CO3	3	
CO4	3	
CO5	3	

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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Department: **DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**		
Semester: **5**	Course Code: **BAD24502**	Contact Hrs /week: **3**
Course Description: **DATABASE MANAGEMENT SYSTEMS**		No. of Credits:**4** L : T : P : S = **3:0:2:0**
Course Category: **IPCC**		Total no. of Hours = **52**
CIE: **50 Marks**	SEE: **50 Marks**	Exam Hours: **03**
Course Pre-requisites: Basic knowledge of programming concepts, data structures, and fundamentals of computer systems is required for Database Management Systems.		

1. PREAMBLE ABOUT THE COURSE

Database Management Systems course is intended to deliver students the elementary concepts of a database management system and equips them to design and implement a database application built over those concepts. It also introduces advanced level areas like transaction processing, concurrency control and recovery management.

2. COURSE LEVEL OBJECTIVES

CLO1	Understand the basic concepts and the applications of database systems.
CLO2	Understand the relational database design principles.
CLO3	Master the basics of SQL and construct queries using SQL.
CLO4	Familiar with the basic issues of transaction processing and concurrency control.

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Understand fundamental database concepts, DBMS architecture, data models, schemas, and conceptual data modelling using ER diagrams.	PO1, PO2, PO11, PSO1	L2	WK3, WK4	08
CO2	Explore the relational database concepts, relational model constraints, relational algebra operations, and ER-to-Relational mapping techniques.	PO1, PO2,PO11, PSO1	L2	WK3, WK4	08

CO3	Develop SQL queries using DDL, DML, and advanced SQL concepts such as views, triggers, and assertions to manipulate databases.	PO2, PO3, PO5,PO11, PSO1	L3	WK3, WK4	08
CO4	Apply normalization techniques, functional dependencies, multivalued dependencies, and normal forms (1NF–5NF) to design efficient relational schemas.	PO1, PO2, PO3, PO11, PSO1	L3	WK3, WK4	08
CO5	Apply transaction management concepts including ACID properties, concurrency control techniques, locking protocols, and recovery mechanisms to ensure database consistency.	PO1, PO2, PO3, PO11, PSO1	L3	WK3, WK4	07

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	**Introduction to Databases:** Introduction, Characteristics of database approach, Advantages of using the DBMS approach, History of database applications. **Overview of Database Languages and Architectures:** Data Models, Schemas, and Instances. Three schema architecture and data independence, database languages, and interfaces, The Database System environment. **Conceptual Data Modelling using Entities and Relationships:** Entity types, Entity sets, attributes, roles, and structural constraints, Weak entity types, ER diagrams, Examples.	CO1	08
II	**Relational Model**: Relational Model Concepts, Relational Model Constraints and relational database schemas, Update operations, transactions, and dealing with constraint violations. **Relational Algebra:** Relational algebra: introduction, Selection and projection, set operations, renaming, Joins, Division, syntax, semantics. Operators, grouping and ungrouping, relational comparison. Examples of Queries in relational algebra. **Mapping Conceptual Design into a Logical Design:** Relational Database Design using ER-to-Relational mapping.	CO2	08
III	**SQL:**SQL data definition and data types, specifying constraints in SQL, retrieval queries in SQL, INSERT, DELETE, and UPDATE stents in SQL, Additional features of SQL. **Advances Queries:** More complex SQL retrieval queries, Specifying constraints as assertions and action triggers, Views in SQL, Schema change statements in SQL. Database	CO3	08

IV	**Normalization: Database Design Theory –** Introduction to Normalization using Functional and Multivalued Dependencies: Informal design guidelines for relation schema, Functional Dependencies, Normal Forms based on Primary Keys, Second and Third Normal Forms, Boyce-Codd Normal Form, Multivalued Dependency and Fourth Normal Form, Join Dependencies and Fifth Normal Form. Examples on normal forms.	CO4	08
V	**Transaction management and Concurrency –**Control Transaction management: ACID properties, serializability and concurrency control, Lock based concurrency control (2PL, Deadlocks), Time stamping methods, optimistic methods, database recovery management.	CO5	07

Lab Programs (Hours:13):

Exp. No.	Experiments
1.	Create a table called Employee & execute the following. Employee (EMPNO,ENAME,JOB, MANAGER_NO, SAL, COMMISSION) 1. Create a user and grant all permissions to the user. 2. Insert the any three records in the employee table contains attributes EMPNO, ENAME JOB, MANAGER_NO, SAL, COMMISSION and use rollback. Check the result. 3. Add primary key constraint and not null constraint to the employee table. 4. Insert null values to the employee table and verify the result.
2.	Create a table called Employee that contain attributes EMPNO, ENAME, JOB, MGR,SAL & execute the following. 1. Add a column commission with domain to the Employee table. 2. Insert any five records into the table. 3. Update the column details of job 4. Rename the column of Employ table using alter command. 5. Delete the employee whose Empno is 105.
3.	Queries using aggregate functions(COUNT,AVG,MIN,MAX,SUM),Group by,Orderby. Employee(E_id, E_name, Age, Salary) 1. Create Employee table containing all Records E_id, E_name, Age, Salary. 2. Count number of employee names from employee table 3. Find the Maximum age from employee table. 4. Find the Minimum age from employee table. 5. Find salaries of employee in Ascending Order. 6. Find grouped salaries of employees.
4.	Create a row level trigger for the customers table that would fire for INSERT or UPDATE or DELETE operations performed on the CUSTOMERS table. This trigger will display the salary difference between the old & new Salary. CUSTOMERS(ID,NAME,AGE,ADDRESS,SALARY)
5.	Create cursor for Employee table & extract the values from the table. Declare the variables ,Open the cursor & extract the values from the cursor. Close the cursor. Employee(E_id, E_name, Age, Salary)

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Fundamentals of Database Systems	Ramez Elmasri and Shamkant B. Navathe	Pearson	7th Edition, 2017	All Modules
2	Database management systems	Ramakrishnan, and Gehrke	McGraw Hill	3rd Edition, 2019	-

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCS/WEB RESOURCE

- https://nptel.ac.in/courses/106/105/106105175/
- https://www.coursera.org/learn/sql-data-science

7. EVALUATION METHODOLOGY

a) Continuous Internal Evaluation (CIE) = 50 marks
b) Semester End Examination (SEE) = 50 marks
Total = 100 marks

CIE and SEE Framework:

Assessment	Actual Weightage in Marks	Final weightage in Marks
CIE 1	50	Avg of 2 CIEs out of 25
CIE 2	50	
AAT	10	10
LAB	30	15
SEE	100	50
Total		**100**
Grading Consideration		**50% CIE + 50% SEE**

8. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → / COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	1								1
CO2	2	3	1		2						1
CO3	2	3	3								1
CO4	3	2	2		2						1
CO5	3	3	2								1

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

9. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → / COs ↓	PSO1	PSO2
CO1	3	
CO2	3	
CO3	3	
CO4	3	
CO5	3	

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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Department: **DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**		
Semester: **5**	Course Code: **BAD24503**	Contact Hrs /week: **3**
Course Description: **MACHINE LEARNING-2**		No. of Credits:**3** L : T : P : S = **3:0:0:0**
Course Category: **PCC**		Total no. of Hours = **39**
CIE: **50 Marks**	SEE: **50 Marks**	Exam Hours: **03**
Course Pre-requisites: Basic understanding of python, Machine Learning.		

1. PREAMBLE ABOUT THE COURSE

This subject encompasses advanced Machine Learning concepts like Supervised, Unsupervised, Semi-Supervised, and Reinforcement Learning. It covers classification techniques such as SVM, Random Forest, and Ensemble methods, along with multiclass strategies and performance evaluation. It introduces Explainable AI (XAI) tools like LIME and SHAP, clustering methods, and hyper-parameter optimization techniques including Grid Search, Random Search, and Bayesian methods. Additionally, it delves into the fundamentals of Reinforcement Learning, highlighting its key elements, processes, and real-world applications by building the skill of real world problem solving in students.

2. COURSE LEVEL OBJECTIVES

CLO1	To understand the fundamental concepts, algorithms, and challenges involved in supervised classification.
CLO2	To understand & gain knowledge of various multiclass classification techniques and their appropriate applications.
CLO3	To develop familiarity with unsupervised learning algorithms and their practical use.
CLO4	To enhance algorithm performance through hyper-parameter tuning and apply reinforcement learning concepts to real-world problems.

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Understand & apply supervised learning classification algorithms and ensemble techniques to perform classification	PO1, PO2,PO3, PO4,PO5, PO9,PSO1, PSO2	L2	WK3, WK4, WK5	8
CO2	Apply multiclass classification approaches and evaluate model	PO1, PO2,PO3,PO4,PO5,	L3	WK3, WK4, WK5	

	performance using suitable metrics and Explainable AI techniques.	PO9,PSO1, PSO2			8
CO3	Apply unsupervised learning methods to perform clustering.	PO1, PO2,PO3,PO4,PO5, PO9,PSO1, PSO2	L3	WK3, WK4, WK5	8
CO4	Implement machine learning models using different hyper-parameter tuning techniques.	PO1, PO2,PO3,PO4,PO5, PO9,PSO1, PSO2	L3	WK3, WK4, WK5	8
CO5	Understand reinforcement learning concepts for different learning environments with applications	PO1, PO2,PO3,PO4,PO5, PO9,PSO1, PSO2	L2	WK3, WK4, WK5	7

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	**Supervised Learning (Classification):** Support Vector Machine (SVC and SVR), Kernel Methods, Random Forest, Ensemble classification methods (Bagging and Boosting Techniques).	CO1	8
II	**Multiclass Classification:** Multiclass classification problem, Generalization bounds, Uncombined multi-class algorithms, aggregated multi-class algorithms, Performance Metrics Explainable AI: Introduction to XAI, LIME, SHAP.	CO2	8
III	**Unsupervised Learning:** Introduction to Unsupervised Learning, Clustering, k-means Clustering, Bisecting k- means, K-Means as special case of Expectation Maximization, Agglomerative Clustering and Divisive Clustering, DBSCAN, Comparing and Evaluating Clustering Algorithms, Semi-Supervised Learning models.	CO3	8
IV	**Hyperparameter Tuning**: Overview, Manual Search, Grid Search, Random Search, Random Search with Hyperopt, Bayesian Optimization, Multi-fidelity Optimization, Optuna.	CO4	8
V	**Reinforcement Learning(RL):**Key elements of RL, the RL Algorithm, how RL differs from other ML paradigms, The Markov Decision Process, Action space, Episodic and Continuous tasks, Return and discount factor, The Value function, Q-function, model based and model-free learning, types of environments, Applications.	CO5	7

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Introduction to Machine Learning with Python‖ Sarah Guido	Andreas C. Müller	O‘ Reilly	2017	3
2	Deep Reinforcement Learning with Python	Sudharsan Ravichandiran	Packt Publishing	2nd edition 2020	4,5
3	Principles of Data Science	Sinan Ozdemir, Sunil Kakade	Packt Publishing Limited	2nd Edition, 2018	3,4
4	Introduction to Machine Learning	Ethem Alpaydin	PHI Learning,	, 2nd Edition, 2019.	1,2

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCS/WEB RESOURCE

- https://towardsdatascience.com/hyperparameter-tuning-for-machine-learning-models-1b80d783b946
- https://smartlabai.medium.com/reinforcement-learning-algorithms-an-intuitive-overview-904e2dff5bbc

7. EVALUATION METHODOLOGY

a) Continuous Internal Evaluation (CIE) = 50 marks
b) Semester End Examination (SEE) = 50 marks
Total = 100 marks

CIE and SEE Framework:

Assessment	Actual Weightage in Marks	Final weightage in Marks
CIE 1	50	Avg of 2 CIEs out of 30
CIE 2	50	
AAT	20	20
SEE	100	50
Total		**100**
Grading Consideration		**50% CIE + 50% SEE**

8. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → / COs ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	2	3	2	3				2		
CO2	3	2	3	2	3				2		
CO3	3	2	3	2	3				2		
CO4	3	2	3	2	3				2		
CO5	3	2	3	2	3				2		

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

9. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → / COs ↓	PSO1	PSO2
CO1	2	3
CO2	2	3
CO3	2	3
CO4	2	3
CO5	2	3

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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Department: **DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**		
Semester: **5**	Course Code: **BADL24504**	Contact Hrs /week: **2**
Course Description: **MACHINE LEARNING LABORATORY**		No. of Credits:**1** L : T : P : S = **0:0:2:0**
Course Category: **PCCL**		Total no. of Hours = **13**
CIE: **50 Marks**	SEE: **50 Marks**	Exam Hours: **03**
Course Pre-requisites: Basic understanding of python, Machine Learning algorithms		

1. PREAMBLE ABOUT THE COURSE

This course aims to empower students with advanced programming capabilities using Python while building strong analytical skills in Unsupervised and Semi-Supervised machine learning techniques. It enhances the learners' ability to identify, select, and apply suitable algorithms to real-world problems and strengthens their practical knowledge by exposing them to real-time machine learning applications and implementations.

2. COURSE LEVEL OBJECTIVES

CLO1	To equip students with advanced Python programming skills
CLO2	To develop analytical capabilities in Unsupervised and Semi-Supervised learning algorithms
CLO3	To enable students to identify and apply appropriate machine learning techniques

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Apply the fundamental concepts, principles, and working mechanisms of Machine Learning algorithms.	PO1, PO2,PO3,PO4,PO5, PO9,PSO1,PSO2	L3	WK3, WK4, WK5	4
CO2	Develop Code, debug, and demonstrate the functionality of Ensemble learning techniques using appropriate machine learning tools and programming methods.	PO1, PO2,PO3,PO4,PO5, PO9,PSO1,PSO2	L3	WK3, WK4, WK5	4

CO3	Apply suitable Unsupervised and Semi-Supervised learning algorithms on real-world datasets and evaluate their performance.	PO1, PO2,PO3, PO4,PO5, PO9,PSO1,PSO2	L3	WK3, WK4, WK5	4

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

SI.NO	EXPERIMENTS/PROGRAMS
1	Write a program to demonstrate pipeline in Machine Learning.
2	Write a program to implement the Logistic Regression and K-fold cross validation on the diabetes dataset.
3	Write a program to demonstrate Support Vector Machine using different Kernel functions.
4	Write a program to implement Bagging and Boosting classifiers
5	Write a program to classify the data using Multiclass classification algorithm.
6	Write a program to cluster the data using K-Means clustering algorithm.
7	Write a program to demonstrate Random Forest algorithm and improve the performance using Manual & Randomized Search CV Hyper Parameter Tuning Techniques.
8	Write a program to demonstrate Random Forest algorithm and improve the performance using Grid Search CV Hyper Parameter Tuning Techniques.
9	Identify Real World Problem & Build a Machine Learning Model and perform analysis.

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition
1	Introduction to Machine Learning with Python‖ Sarah Guido	Andreas C. Müller	O' Reilly	2017
2	Deep Reinforcement Learning with Python	Sudharsan Ravichandiran	Packt Publishing	2nd edition 2020

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCS/WEB RESOURCE

- https://towardsdatascience.com/hyperparameter-tuning-for-machine-learning-models-1b80d783b946
- https://smartlabai.medium.com/reinforcement-learning-algorithms-an-intuitive-overview-904e2dff5bbc.

7. EVALUATION METHODOLOGY

a) Continuous Internal Evaluation (CIE) = 50 marks
b) Semester End Examination (SEE) = 50 marks
Total = 100 marks

8. Conduct of Practical Examination:

Assessment	Actual Weightage in Marks	Final weightage in Marks
Lab conduction and record	100	30
Lab test	50	20
SEE	100	50
Total		**100**
Grading Consideration		**50% CIE + 50% SEE**

9. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → / COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3	3	3				2		
CO2	3	3	3	3	3				2		
CO3	3	3	3	3	3				2		

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

10. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → / COs ↓	PSO1	PSO2
CO1	2	3
CO2	2	3
CO3	2	3

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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Department: **DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**		
Semester: **5**	Course Code: **BAD24505A**	Contact Hrs /week: **3**
Course Description: **ADVANCED IMAGE PROCESSING**		No. of Credits:**3** L : T : P : S = **3:0:0:0**
Course Category: **PEC**		Total no. of Hours = **39**
CIE: **50 Marks**	SEE: **50 Marks**	Exam Hours: **03**
Course Pre-requisites: Basics of Image Processing		

1. PREAMBLE ABOUT THE COURSE

This course introduces fundamental and advanced concepts in image data representation and processing for computer vision. Students will learn key techniques in digital morphology, image restoration, object recognition, and image understanding. Emphasis is placed on both theoretical foundations and practical implementation using tools such as OpenCV. By the end, learners will be able to analyse, interpret, and build intelligent vision-based systems.

2. COURSE LEVEL OBJECTIVES

CLO1	To develop insight into various techniques of Digital image representation and processing.
CLO2	To evaluate the techniques followed in Digital Image Morphology and Spectral Image enhancement
CLO3	To illustrate the techniques involved in image restoration algorithms
CLO4	To illustrate the techniques involved in object and symbol recognition algorithms.

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Understand and apply fundamental image data structures, representation levels, and practical tools	PO1,PO2,PO4, PO5,PSO1	L2-L3	WK3, WK4	08
CO2	Analyze and process images using morphological operations	PO1,PO2,PO3,PO4, PO5,PSO1	L3-L4	WK3, WK4	08
CO3	Analyze image degradation models and implement image restoration and enhancement techniques	PO1,PO2,PO3,PO4, PO5,PSO1	L3-L4	WK3, WK4	08

	using frequency-domain methods and low-light enhancement techniques				
CO4	Design and implement object, symbol, and texture recognition systems	PO1,PO2,PO3,PO4, PO5,PSO1	L3-L5	WK3, WK4	08
CO5	Apply machine learning and pattern recognition, for image understanding semantic segmentation, and motion analysis techniques	PO1,PO2,PO3,PO4, PO5,PSO1	L3-L5	WK3, WK4	07

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	**Data structures for image analysis:** Levels of image data representation, Traditional image data structures- Matrices, Chains, Topological data structures, Relational structures, Hierarchical data structures-Pyramids, Quadtrees, Other pyramidal structures **Practical Aspects of a Vision System**: Image Display: OpenCV	CO1	08
II	**Digital Morphology:** Elements of Digital Morphology-Binary Dilation, Binary Erosion, Opening and Closing. The Hit-and-Miss Transform, Identifying Region Boundaries, Conditional Dilation, Counting Regions	CO2	08
III	**Image Restoration**: Image Degradations in the Real World, The Frequency Domain, Fourier Transforms in OpenCV, The Inverse Filter, The Wiener Filter, Motion Blur—A Special Case **Low light image enhancement:** retinex methods, dark channel prior	CO3	08
IV	**Object recognition:** Knowledge representation, Statistical pattern recognition, Syntactic pattern recognition, Recognition as graph matching **Symbol Recognition:** Optical Character Recognition (OCR) on Simple Perfect Images, OCR on Scanned Images—Segmentation	CO4	08
V	**Image understanding:** Pattern recognition methods in image understanding, Image understanding using Random Forests, Semantic image segmentation and understanding **Texture:** Texture recognition method applications **Motion analysis and Video tracking:** Motion models to aid tracking	CO5	07

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Image Processing: Analysis and Machine Vision	Milan Sonka, Vaclav Hlavac, and Roger Boyle	Cengage Learning	4th Edition	All Modules
2	Algorithms for Image Processing and Computer Vision	J.R. Parker	Wiley Publishing	Second Edition	All Modules
3	Pattern Recognition- Statistical, Structural and neural approach	A Robert Schalkoff	John Willey & Sons	4th Edition	All Modules
4	Digital Image Processing	R. Gonzalez and R. E. Wood	Prentice Hall of India	4th Edition	All Modules

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCS/WEB RESOURCE

- Digital Image Processing, Wilhelm Burger http://omercetin.com.tr/DERS/IP/Kitap/2.Principles%20of%20digital%20image%20processin g.pdf
- Introductory Digital Image Processing, John R Jensen https://media.oiipdf.com/pdf/f11c7ea9-28a4-42c8-8854 21a2f96a6338.pdf
- https://www.coursera.org/specializations/image-processing
- https://www.coursera.org/learn/digital
- https://www.udemy.com/course/digital-image-processing-from-ground-up-in-python/

7. EVALUATION METHODOLOGY

a) Continuous Internal Evaluation (CIE) = 50 marks
b) Semester End Examination (SEE) = 50 marks
Total = 100 marks

CIE and SEE Framework:

Assessment	Actual Weightage in Marks	Final weightage in Marks
CIE 1	50	Avg of 2 CIEs out of 30
CIE 2	50	
AAT	20	20
SEE	100	50
Total		**100**
Grading Consideration		**50% CIE + 50% SEE**

8. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → / COs ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	2		1	1						
CO2	2	2	1	1	3						
CO3	2	3	3	2	1						
CO4	2	2	3	3	2						
CO5	2	2	3	3	2						

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

9. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → / COs ↓	PSO1	PSO2
CO1	3	1
CO2	3	1
CO3	3	1
CO4	3	1
CO5	3	1

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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Department: **DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**		
Semester: **5**	Course Code: **BAD24505B**	Contact Hrs /week: **3**
Course Description: **FULL STACK DEVELOPMENT**		No. of Credits:**3** L : T : P : S = **3:0:0:0**
Course Category: **PEC**		Total no. of Hours = **39**
CIE: **50 Marks**	SEE: **50 Marks**	Exam Hours: **03**
Course Pre-requisites: Basic knowledge of programming (HTML, CSS, JavaScript), databases, and fundamental web technologies is required for Full Stack Development.		

1. PREAMBLE ABOUT THE COURSE

This subject provides comprehensive exposure to all dimensions of web application development using the MERN stack—comprising MongoDB, Express.js, React.js, and Node.js. The course covers the complete development lifecycle of a web application, including the design and implementation of the front end, back end, and RESTful APIs.The concepts are systematically organized into modules that introduce students to the fundamentals of JavaScript, the Document Object Model (DOM), React components and forms, React state management, and server-side development using Express.js and MongoDB. The course also emphasizes modularization, package management, and best practices for developing scalable and maintainable web applications. To reinforce theoretical learning, the laboratory component offers hands-on experience in building and integrating the front-end and back-end layers. Students will apply the learned concepts to design, develop, and deploy simple full-stack web applications, thereby gaining a holistic understanding of modern web development using the MERN stack.

2. COURSE LEVEL OBJECTIVES

CLO1	To understand the essential javascript concepts for web development.
CLO2	To style Web applications using bootstrap.
CLO3	To utilize React JS to build front end User Interface.
CLO4	To understand the usage of API's to create web applications using Express JS.
CLO5	To store and model data in a no sql database.

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Apply Javascript to build dynamic and interactive Web projects .	PO1,PO2,PO3,PO5, PO11 & PSO1	L2-L4	WK2, WK3, WK4	08

CO2	Implement user interface components for JavaScript-based Web using React.JS	PO1,PO2,PO3,PO5, PO11 & PSO1	L2-L4	WK2, WK3, WK4	08
CO3	Apply Express/Node to build web applications on the server side.	PO1,PO2,PO3,PO5, PO11 & PSO1	L2-L4	WK2, WK3, WK4	08
CO4	Develop data model in an open source nosql database.	PO1,PO2,PO3,PO5, PO11 & PSO1	L2-L4	WK2, WK3, WK4	08
CO5	Demonstrate modularization and packing of the front-end modules .	PO1,PO2,PO3,PO5, PO11 & PSO1	L2-L4	WK2, WK3, WK4	07

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	**Basic JavaScript** Instructions, Statements, Comments, Variables, Data Types, Arrays, Strings, Functions, Methods & Objects, Decisions & Loops.	CO1	08
II	**Document Object Model:** DOM Manipulation, Selecting Elements, Working with DOM Nodes, Updating Element Content & Attributes, Events, Different Types of Events, How to Bind an Event to an Element, Event Delegation, Event Listeners.	CO2	08
III	**Form enhancement and validation**. Introduction to MERN: MERN components, Server less Hello world. **React Components:** Issue Tracker, React Classes, Composing Components, Passing Data Using Properties, Passing Data Using Children, Dynamic Composition.	CO3	08
IV	**React State:** Initial State, Async State Initialization, Updating State, Lifting State Up, Event Handling, Stateless Components, Designing Components, State vs. Props, Component Hierarchy, Communication, Stateless Components. **Express,** REST API, GraphQL, Field Specification, Graph Based, Single Endpoint, Strongly Typed, Introspection, Libraries, The About API GraphQL Schema File, The List API, List API Integration, Custom Scalar types, The Create API, Create API Integration, Query Variables, Input Validations, Displaying Errors.	CO4	08
V	MongoDB: Basics, Documents, Collections, Databases, Query Language, Installation, The Mongo Shell, MongoDB CRUD Operations, Create, Read, Projection, Update, Delete, Aggregate, MongoDB Node.js Driver, Schema Initialization, Reading from MongoDB, Writing to MongoDB. Modularization and Webpack ,Back-End Modules Front-End Modules and Webpack Transform and Bundle, Libraries Bundle ,Hot Module Replacement, Debugging DefinePlugin: Build Configuration, Production Optimization.	CO5	07

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	JavaScript & jQuery: Interactive Front-End Web Development	Jon Duckett	Wiley	2014	Moule 1 & 2
2	Pro MERN Stack: Full Stack Web App Development with Mongo, Express, React, and Node.	Vasan Subramanian	Apress	2019	Module 3,4 & 5

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCS/WEB RESOURCE

- https://github.com/vasansr/pro-mern-stack
- https://nptel.ac.in/courses/106106156
- https://archive.nptel.ac.in/courses/106/105/106105084/

7. EVALUATION METHODOLOGY

a) Continuous Internal Evaluation (CIE) = 50 marks
b) Semester End Examination (SEE) = 50 marks
Total = 100 marks

CIE and SEE Framework:

Assessment	Actual Weightage in Marks	Final weightage in Marks
CIE 1	50	Avg of 2 CIEs out of 30
CIE 2	50	
AAT	20	20
SEE	100	50
Total		**100**
Grading Consideration		**50% CIE + 50% SEE**

8. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → / COs ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	1	2		2						1
CO2	3	1	2		2						1
CO3	3	1	2		2						1
CO4	3	1	2		2						1
CO5	3	1	2		2						1

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

9. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → / COs ↓	PSO1	PSO2
CO1	1	2
CO2	1	2
CO3	1	2
CO4	1	2
CO5	1	2

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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Department: **DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**		
Semester: **5**	Course Code: **BAD24505C**	Contact Hrs /week: **3**
Course Description: **SOCIAL NETWORK ANALYSIS**		No. of Credits:**3** L: T: P: S = **3:0:0:0**
Course Category: **PCC**		Total no. of Hours = **39**
CIE: **50 Marks**	SEE: **50 Marks**	Exam Hours: **03**
Course Pre-requisites: Basic knowledge of graph theory, probability and statistics, and programming fundamentals.		

1. PREAMBLE ABOUT THE COURSE

This course introduces the fundamental concepts of social network analysis (SNA) and its role in understanding relationships and interactions within complex networks. It covers key topics such as network measures, network growth models, and link analysis algorithms used to study real-world networks. The course also explores community detection and link prediction techniques to identify hidden patterns and structures in networks. Students will learn to analyze and interpret social network data for applications in social media, communication, and information systems.

2. COURSE LEVEL OBJECTIVES

CLO1	To introduce the fundamentals of Social Network Analysis and its significance in interpreting societal connections and behaviors.
CLO2	To analyze models of network growth and evaluate the structural properties of real-world networks.
CLO3	To explore link analysis and community detection algorithms for understanding and identifying meaningful relationships within networks.
CLO4	To apply link prediction techniques to forecast potential future connections and network evolution.

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Illustrate the core concepts of Social Network Analysis and its levels of study.	PO1, PO2, PO3, PO4, PO5, PO9, PO11, PSO1.	L2-L4	WK3, WK4	8
CO2	Demonstrate the different network growth models for real-world networks.	PO1, PO2, PO3, PO4, PO5, PO9, PO11, PSO1.	L2-L4	WK3, WK4	8

CO3	Apply algorithms of PageRank and SimRank to analyze and interpret link relationships.	PO1, PO2, PO3, PO4, PO5, PO9, PO11, PSO1.	L2-L4	WK3, WK4	8
CO4	Apply community detection methods and evaluating their effectiveness in real-world scenarios.	PO1, PO2, PO3, PO4, PO5, PO9, PO11, PSO1.	L2-L4	WK3, WK4	8
CO5	Analyze heuristic, probabilistic, and supervised models to predict network link formations and changes.	PO1, PO2, PO3, PO4, PO5, PO9, PO11, PSO1.	L2-L4	WK3, WK4	7

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	**Networks and Society -** What is Social Network Analysis, why do We Study Social Networks, Applications of Social Network Analysis, Preliminaries, Three Levels of Social Network Analysis. **Network Measures -** Network Basics, Node Centrality, Assortativity, Transitivity and Reciprocity, Similarity, Degeneracy.	CO1	8
II	**Network Growth Models -** Properties of Real-World Networks, Random Network Model, Ring Lattice Network Model, Watts–Strogatz Model, Preferential Attachment Model, Price's Model, Local-world Network.	CO2	8
III	**Link Analysis -** Applications of Link Analysis, Signed Networks, Strong and Weak Ties, Link Analysis Algorithms, PageRank, Personalised PageRank, DivRank, SimRank, PathSIM.	CO3	8
IV	**Community Structure in Networks -** Applications of Community Detection, Types of Communities, Community Detection Methods, Disjoint Community Detection, Overlapping Community Detection, Local Community Detection, Community Detection vs Community Search, Evaluation of Community Detection Methods.	CO4	8
V	**Link Prediction -** Applications of Link Prediction, Temporal Changes in a Network, Problem Definition Evaluating Link Prediction Methods, Heuristic Models, Probabilistic Models, Supervised Random Walk, Information-theoretic Model, Latest Trends in Link Prediction.	CO5	7

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Social Network Analysis	Tanmoy Chakraborty	Wiley India Pvt. Ltd	2021	Module 1 , 2
2	Network Science	Albert-Laszlo Barabasi	Cambridge University Press	2016	Module 3,4,5
3	Social Network Analysis: Methods and Applications	Stanley Wasserman, Katherine Faus	Cambridge University Press	1994	-

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCS/WEB RESOURCE

- https://onlinecourses.nptel.ac.in/noc22_cs117/preview
- https://social-network-analysis.in
- https://www.coursera.org/learn/social-network-analysis

7. EVALUATION METHODOLOGY

a) Continuous Internal Evaluation (CIE) = 50 marks
b) Semester End Examination (SEE) = 50 marks
Total = 100 marks

CIE and SEE Framework:

Assessment	Actual Weightage in Marks	Final weightage in Marks
CIE 1	50	Avg of 2 CIEs out of 30
CIE 2	50	
AAT	20	20
SEE	100	50
Total		**100**
Grading Consideration		**50% CIE + 50% SEE**

8. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → / COs ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	3	3	2	2				2		1
CO2	3	3	3	2	2				2		1
CO3	3	3	3	2	2				2		1
CO4	3	3	3	2	2				2		1
CO5	3	3	3	2	2				2		1

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

9. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → / COs ↓	PSO1	PSO2
CO1	3	
CO2	3	
CO3	3	
CO4	3	
CO5	3	

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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Department: **DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**		
Semester: **5**	Course Code: **BAD24505D**	Contact Hrs /week: **3**
Course Description: **ADVANCED JAVA**		No. of Credits:**3** L: T: P: S = **3:0:0:0**
Course Category: **PCC**		Total no. of Hours = **39**
CIE: **50 Marks**	SEE: **50 Marks**	Exam Hours: **03**
Course Pre-requisites: Basic knowledge of Java programming concepts including classes, objects, inheritance, and exception handling.		

1. PREAMBLE ABOUT THE COURSE

This course provides an in-depth understanding of advanced Java programming concepts, focusing on Collections Framework, String handling, GUI development using Swing, web application development through Servlets and JSP, and database connectivity using JDBC. It aims to equip students with the skills to build robust, scalable, and interactive enterprise-level Java applications.

2. COURSE LEVEL OBJECTIVES

CLO1	Understanding the fundamentals of the collection framework.
CLO2	Demonstrate the fundamental concepts of String operations and Swing applications.
CLO3	Design and develop web applications using Java servlets and JSP.
CLO4	Apply database interaction through Java database Connectivity.

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Apply appropriate collection class/interface to solve the given problem.	PO1, PO2, PO3, PO4, PO5, PO9, PO11, PSO1	L3	WK3, WK4,	08
CO2	Demonstrate the concepts of String operations in Java.	PO1, PO2, PO3, PO4, PO5, PO9, PO11, PSO1	L3	WK3, WK4	08
CO3	Apply the concepts of Swings to build Java applications.	PO1, PO2, PO3, PO4, PO5, PO9, PO11, PSO1	L3	WK3, WK4	08
CO4	Develop web-based applications using Java servlets and JSP.	PO1, PO2, PO3, PO4, PO5, PO9, PO11, PSO1	L3	WK3, WK4	08

CO5	Use JDBC to build database applications.	PO1, PO2, PO3, PO4, PO5, PO9, PO11, PSO1	L3	WK3, WK4	07

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	**The collections and Framework:** Collections Overview, The Collection Interfaces, The Collection Classes, accessing a collection Via an Iterator, Storing User Defined Classes in Collections, The Random Access Interface, Working with Maps, Comparators, The Collection Algorithms, Arrays, The legacy Classes and Interfaces, Parting Thoughts on Collections.	CO1	08
II	**String Handling:** The String Constructors, String Length, Special String Operations, Character Extraction, String Comparison, Searching Strings, Modifying a String, Data Conversion Using valueOf( ), Changing the Case of Characters Within a String, joining strings, Additional String Methods, StringBuffer , StringBuilder.	CO2	08
III	**Introducing Swing:** The Origin of Swing, Swing Is Built on AWT, Two Key Swing Features, The MVC Connection, Components and Containers, The Swing Packages, A Simple Swing Application, Event Handling, Painting in Swing. **Exploring Swing:** JLabel and ImageIcon,JTextField,The Swing Buttons-JButton, JToggleButton, Check Boxes, Radio Buttons	CO3	08
IV	**Introducing servlets:** Background; The Life Cycle of a Servlet; Using Tomcat for Servlet Development; A simple Servlet; The Servlet API; The Jakarta. Servlet Package; Reading Servlet Parameter; The Jakarta.servlet.http package; Handling HTTP Requests and Responses; Using Cookies; Session Tracking. Java Server Pages (JSP); JSP tags, Variables and Objects, Methods, Control statements, Loops, Request String, Parsing other information, User sessions, Cookies, Session Objects.	CO4	08
V	**JDBC Objects:** The Concept of JDBC; JDBC Driver Types; JDBC Packages; A Brief Overview of the JDBC process; Database Connection; Associating the JDBC/ODBC Bridge with the Database; Statement **Objects; ResultSet;** Transaction Processing; Metadata, Data types; Exceptions.	CO5	07

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	JAVA the Complete Reference	Herbert Schild	Tata McGraw Hill	Twelfth Edition	All modules
2	The Complete Reference J2EE	Jim Keogh	Tata McGraw-Hill	2007	All modules

3	Introduction to JAVA Programming	Y. Daniel Liang	Pearson Education	7th Edition	All modules
4	The J2EE Tutorial	Stephanie Bodoff et al	Pearson Education	2nd Edition	All modules
5	Advanced JAVA programming	Uttam K Roy	Oxford University press	2015	All modules

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCS/WEB RESOURCE

- https://nptel.ac.in/courses/106/105/106105191/
- https://nptel.ac.in/courses/106/105/106105225/
- https://youtu.be/qGMxs-PbFPk

7. EVALUATION METHODOLOGY

a) Continuous Internal Evaluation (CIE) = 50 marks
b) Semester End Examination (SEE) = 50 marks
Total = 100 marks

CIE and SEE Framework:

Assessment	Actual Weightage in Marks	Final weightage in Marks
CIE 1	50	Avg of 2 CIEs out of 30
CIE 2	50	
AAT	20	20
SEE	100	50
Total		**100**
Grading Consideration		**50% CIE + 50% SEE**

8. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → / COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	2	2	3				2		1
CO2	3	3	2	2	3				2		1
CO3	3	3	2	2	3				2		1
CO4	3	3	2	2	3				2		1
CO5	3	3	2	2	3				2		1

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

9. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → / COs ↓	PSO1	PSO2
CO1	3	
CO2	3	
CO3	3	
CO4	3	
CO5	3	

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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Department: **DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**		
Semester: **5**	Course Code: **BAD24556A**	Contact Hrs /week: **1**
Course Description: **AI TOOLS FOR DATA ENGINEERS**		No. of Credits:**1** L : T : P : S = **0:0:2:0**
Course Category: **SEC**		Total no. of Hours = **13**
CIE: **50 Marks**	SEE: **50 Marks**	Exam Hours: **01**
Course Pre-requisites: Python programming		

1. PREAMBLE ABOUT THE COURSE

This course introduces Artificial Intelligence (AI) tools are revolutionizing the way engineers learn, innovate, and solve complex problems by enabling intelligent content generation, automated coding, knowledge discovery, and rapid application development. This hands-on course provides students with practical exposure to Google's free AI ecosystem, including Gemini, NotebookLM, Google AI Studio, Gemini Code Assist, Gemini CLI, and Opal, enabling them to apply AI effectively for writing, research, programming, and engineering applications. The course emphasizes responsible and ethical AI usage, data privacy, prompt engineering, multimodal AI, and AI-assisted software development through practical exercises and a mini-project, preparing students to leverage Generative AI tools in academic, research, and professional environments.

2. COURSE LEVEL OBJECTIVES

CLO1	Understand the capabilities, limitations, and responsible-use considerations of modern generative AI.
CLO2	Gain practical fluency with Google's freely available AI tools for writing, research, prototyping, and coding.
CLO3	Apply AI assistance to realistic engineering tasks while respecting data privacy and academic integrity.
CLO4	Build and demonstrate a small AI-powered solution by integrating multiple free tools.

3. COURSE OUTCOMES (COs) & COMPETENCIES

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

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	**Explain** the fundamentals, capabilities, limitations, ethical considerations, and responsible use of Generative AI and Large Language Models (LLMs).	PO1,PO2,PO3, PO4,PO5,PO11, PSO1PSO2	L2	WK1,WK8	4
CO2	**Apply** Google AI tools, including Gemini, NotebookLM, and Google AI Studio, for	PO1,PO2,PO3, PO4,PO5,PO11, PSO1PSO2	L3	WK2,WK3, WK5	4

	effective prompting, content generation, research, summarization, reasoning, and multimodal applications.				
CO3	**Develop** AI-assisted software solutions using Gemini Code Assist, Gemini CLI, and no-code AI tools for coding, debugging, prototyping, and AI tools while adhering to ethical, privacy, and academic integrity principles automation.	PO1,PO2,PO3, PO4,PO5,PO11, PSO1PSO2	L3	WK2,WK4, WK5	4

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	**Foundations and NotebookLM** What is generative AI and how LLMs work (intuition). The free Google AI ecosystem and account setup. Limits/quotas, regional availability, SynthID watermarks, data privacy and academic integrity. Hands-on: create/verify free accounts; first prompts in Gemini. Source-grounded research; uploading PDFs/links/notes; summaries, study guides, FAQs; citations and traceability; Audio Overviews. Hands-on: create a notebook from 3–5 sources and generate a summary, study guide, and audio overview; verify citations.	CO1	4
II	**Google AI Studio and AI-Assisted Coding** Multimodal prompting (text + image); system instructions; structured (JSON) output; the Build app-prototyping mode. Hands-on: analyze an image with a prompt; produce structured output; prototype a mini web app in Build mode. Gemini Code Assist in the IDE: completion, generation, explanation, refactoring, AI-written unit tests. Gemini CLI: terminal-based coding agent to scaffold and debug. Hands-on: use Gemini CLI to scaffold and fix a small project.	CO2	4
III	**No-Code & Creative and Mini-Project & Assessment** Building no-code AI mini-apps with Opal (chaining prompts, model calls, tools); overview of Google Labs creative tools (Whisk, Flow, Veo) and their free credit limits. Hands-on: build and share a small Opal app; try one Labs creative tool. Integrate two or more tools to solve a small engineering problem; demonstration, viva, and reflection on ethics, limits, and verification of AI output.	CO3	4

5. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCS/WEB RESOURCE

- https://gemini.google.com
- https://notebooklm.google.com
- https://aistudio.google.com
- https://developers.google.com/gemini-code-assist
- https://ai.google.dev

6. EVALUATION METHODOLOGY

a) Continuous Internal Evaluation (CIE) = 50 marks
b) Semester End Examination (SEE) = 50 marks
Total = 100 marks

Assessment	Actual Weightage in Marks	Final weightage in Marks
CIE 1	50	Avg of 2 CIEs out of 30
CIE 2	50	
AAT	20	20
SEE	100	50
Total		**100**
Grading Consideration		**50% CIE + 50% SEE**

Evaluation Method: Both the CIE and SEE examinations shall be conducted using OMR-based objective question papers, and students shall record their responses on OMR answer sheets.

7. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → / COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3	2	3						2
CO2	3	3	3	2	3						2
CO3	3	3	3	2	3						2
CO4	3	3	3	2	3						2

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

8. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → / COs ↓	PSO1	PSO2
CO1	1	3
CO2	1	3
CO3	1	3
CO4	1	3

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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Department: **DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**		
Semester: **5**	Course Code: **BAD24556B**	Contact Hrs /week: **2**
Course Description: **DATA ANALYTICS FOR IOT**		No. of Credits:**1** L : T : P : S = **0:0:2:0**
Course Category: **AEC**		Total no. of Hours = **13**
CIE: **50 Marks**	SEE: **50 Marks**	Exam Hours: **03**
Course Pre-requisites: Basic understanding of Python, statistics, and IoT fundamentals		

1. PREAMBLE ABOUT THE COURSE

This laboratory course focuses on analyzing data generated from Internet of Things (IoT) devices using modern data analytics techniques. Students will learn how to collect, preprocess, analyze, and visualize IoT data for meaningful insights. The course emphasizes handling real-time sensor data, applying statistical and machine learning techniques, and developing solutions for real-world IoT applications. It introduces students to time-series analysis, anomaly detection, and predictive modeling in IoT environments.

2. COURSE LEVEL OBJECTIVES

CLO1	To develop skills in collecting, preprocessing, and analyzing IoT data.
CLO2	To enable students to apply statistical and machine learning techniques to IoT datasets.
CLO3	To prepare students to design and implement data-driven IoT applications.

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Apply data preprocessing and cleaning techniques on IoT datasets.	PO1, PO2, PO5, PSO1, PSO2	L3	WK3, WK4	3
CO2	Analyze IoT data using statistical methods and visualization tools.	PO1, PO2, PO3, PO5, PSO1, PSO2	L3	WK3,	3
CO3	Analyze IoT data using statistical methods and visualization tools.	PO1, PO2, PO3, PO5, PSO1, PSO2	L3	WK4	3
CO4	Develop IoT data analytics applications using modern tools and frameworks.	PO1, PO2, PO3, PO5, PSO1, PSO2	L3	WK3,	3

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

SI.NO	EXPERIMENTS/PROGRAMS
1	Collect and visualize IoT sensor data using Python.
2	Perform data cleaning and preprocessing on IoT datasets.
3	Analyze time-series IoT data using statistical techniques.
4	Implement data visualization using Matplotlib/Seaborn.
5	Apply clustering techniques (K-means) on IoT datasets.
6	Implement classification models for IoT data prediction.

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition
1	Data Analytics for IoT	John Soldatos	River Publishers	-
2	Python Data Science Handbook	Jake VanderPlas	O'Reilly	-

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCS/WEB RESOURCE

- https://nptel.ac.in/courses/106/105/106105166/
- https://www.geeksforgeeks.org/internet-of-things/
- https://docs.python.org/3/

7. EVALUATION METHODOLOGY

a) Continuous Internal Evaluation (CIE) = 50 marks
b) Semester End Examination (SEE) = 50 marks
Total = 100 marks

8. CONDUCT OF PRACTICAL EXAMINATION:

Assessment	Actual Weightage in Marks	Final weightage in Marks
Lab conduction and record	100	30
Lab test	50	20
SEE	100	50
Total		**100**
Grading Consideration		**50% CIE + 50% SEE**

9. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → / COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2			3				2		
CO2	3	3	2		3				2		
CO3	2	3	3		3				2		
CO4	2	3	3		3				2		

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

10. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → / COs ↓	PSO1	PSO2
CO1	2	2
CO2	2	2
CO3	2	2
CO4	2	2

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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Department: **DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**		
Semester: **5**	Course Code: **BAD24556C**	Contact Hrs /week: **1**
Course Description: **APPLIED GENERATIVE AI WITH PYTHON AND LANGCHAIN**		No. of Credits:**1** L : T : P : S = **0:0:2:0**
Course Category: **SEC**		Total no. of Hours = **13**
CIE: **50 Marks**	SEE: **50 Marks**	Exam Hours: **01**
Course Pre-requisites: Python programming, basics of data structures		

1. PREAMBLE ABOUT THE COURSE

Large Language Models (LLMs) have become the foundation of modern Generative Artificial Intelligence, enabling intelligent conversational systems, automated content generation, software development, and enterprise AI applications. This course provides a practical understanding of LLM architectures, prompt engineering, API integration, Retrieval-Augmented Generation (RAG), vector databases, and AI application development using industry-standard frameworks such as LangChain, Streamlit, and CrewAI. Students will gain hands-on experience in developing AI-powered applications, building intelligent agents, evaluating LLM performance, and understanding the ethical, legal, and responsible deployment of AI systems through practical exercises and a capstone project, preparing them for real-world AI engineering and development.

2. COURSE LEVEL OBJECTIVES

CLO1	**Understand** the fundamentals of Large Language Models (LLMs) and prompt engineering.
CLO2	**Apply** LLM APIs, Python, and RAG techniques to develop AI-powered applications.
CLO3	**Develop** intelligent AI solutions using LangChain, Streamlit, and AI agent frameworks.
CLO4	**Evaluate** LLM applications with ethical, legal, and performance considerations.

3. COURSE OUTCOMES (COs) & COMPETENCIES

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

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	**Explain** the fundamentals of Large Language Models (LLMs), transformer architecture, and prompt engineering techniques.	PO1,PO2,PO3, PO4,PO5,PO11, PSO1PSO2	L2	WK1, WK8	4
CO2	**Apply** LLM APIs, Python integration, embeddings, and Retrieval-Augmented Generation (RAG) to develop AI-powered solutions.	PO1,PO2,PO3, PO4,PO5,PO11, PSO1PSO2	L3	WK2,WK 3, WK5	4
CO3	**Develop** intelligent AI applications using LangChain, Streamlit, AI agents, and multi-agent	PO1,PO2,PO3, PO4,PO5,PO11, PSO1PSO2	L3	WK2,WK 4, WK5	4

	frameworks and performance, ethics.				

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	**LLM Foundations & Prompt Engineering** Transformer basics, attention, tokens, parameters, zero-shot / few-shot, role prompting, CoT, ReAct	CO1	4
II	**API Engineering , Python Integration , RAG Pipelines & Vector Databases** OpenAI API, rate limits, Python client, ChatCompletion, function calling, cost estimation,Embeddings, vector stores (Pinecone/ChromaDB), document chunking, retrieval, augmentation, generation	CO2	4
III	**LangChain , AI Application Development AI Agents, Evaluation & Ethics** LCEL chains, memory, conversational retrieval, Streamlit chat UI, session state management, AI agents, multi-agent (CrewAI), LLM evaluation (RAGAS), AI ethics, EU AI Act, capstone project	CO3	4

5. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCS/WEB RESOURCE

- https://arxiv.org/abs/1706.03762
- DAIR.AI. (2024). Prompt Engineering Guide. https://www.promptingguide.ai
- Perez, F. & Ribeiro, I. (2022). Ignore Previous Prompt: Attack Techniques for LLMs. https://arxiv.org/abs/2211.09527
- Anthropic. (2024). Constitutional AI: Harmlessness from AI Feedback. https://arxiv.org/abs/2212.08073
- Greshake, K. et al. (2023). Not What You've Signed Up For: Indirect Prompt Injection Attacks. https://arxiv.org/abs/2302.12173
- OpenAI. (2024). API Reference. https://platform.openai.com/docs/api-reference

6. EVALUATION METHODOLOGY

a) Continuous Internal Evaluation (CIE) = 50 marks
b) Semester End Examination (SEE) = 50 marks
Total = 100 marks

Assessment	Actual Weightage in Marks	Final weightage in Marks
CIE 1	50	Avg of 2 CIEs out of 30
CIE 2	50	
AAT	20	20
SEE	100	50
Total		**100**
Grading Consideration		**50% CIE + 50% SEE**

Evaluation Method: Both the CIE and SEE examinations shall be conducted using OMR-based objective question papers, and students shall record their responses on OMR answer sheets.

7. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → / COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3	2	3						2
CO2	3	3	3	2	3						2
CO3	3	3	3	2	3						2

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

8. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → / COs ↓	PSO1	PSO2
CO1	1	3
CO2	1	3
CO3	1	3

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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Department: **DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**		
Semester: **5**	Course Code: **BAD24556D**	Contact Hrs /week: **2**
Course Description: **ETHICS AND PUBLIC POLICY FOR AI**		No. of Credits:**1** L : T : P : S = **0:0:2:0**
Course Category: **AEC**		Total no. of Hours = **13**
CIE: **50 Marks**	SEE: **50 Marks**	Exam Hours: **03**
Course Pre-requisites: Basic understanding of Artificial Intelligence concepts, social issues, and ethical principles		

1. PREAMBLE ABOUT THE COURSE

This course introduces students to ethical issues and public policy considerations in Artificial Intelligence. With the rapid adoption of AI technologies, concerns related to bias, fairness, transparency, accountability, and privacy have become critical. This course focuses on analyzing ethical dilemmas, understanding regulatory frameworks, and evaluating the societal impact of AI systems. It also emphasizes responsible AI development and the role of governance in ensuring ethical deployment of AI technologies.

2. COURSE LEVEL OBJECTIVES

CLO1	To develop awareness of ethical issues and societal implications of AI.
CLO2	To develop awareness of ethical issues and societal implications of AI.
CLO3	To enable students to design and apply responsible AI practices.

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Apply ethical principles to evaluate AI systems and decision-making processes.	PO1, PO2, PO5, PO9, PSO1	L3	WK3, WK4	3
CO2	Analyze legal and policy frameworks governing AI technologies.	PO1, PO2, PO3,PO5, PO9, PSO1	L3	WK3, WK4	3
CO3	Analyze legal and policy frameworks governing AI technologies.	PO1, PO2, PO3,PO5, PO9, PSO1	L3	WK3, WK4	3

CO4	Develop ethical AI solutions considering privacy, transparency, and social impact.	PO1, PO2, PO3,PO5, PO9, PSO1	L3	WK3, WK4	3

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

SI.NO	EXPERIMENTS/PROGRAMS
1	Study of ethical principles in Artificial Intelligence.
2	Case study analysis of AI bias and fairness issues.
3	Analyze privacy concerns and data protection in AI systems.
4	Study AI governance frameworks and regulations (e.g., GDPR concepts).
5	Study accountability and responsibility in AI decision-making.

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition
1	Ethics of Artificial Intelligence	Nick Bostrom & Eliezer Yudkowsky	Cambridge University Press	-
2	Artificial Intelligence: A Guide for Thinking Humans	Nick Bostrom & Eliezer Yudkowsky	Farrar, Straus and Giroux	-

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCS/WEB RESOURCE

- NPTEL – AI Ethics Courses: https://nptel.ac.in/
- SWAYAM – AI and Society: https://swayam.gov.in/

7. EVALUATION METHODOLOGY

a) Continuous Internal Evaluation (CIE) = 50 marks
b) Semester End Examination (SEE) = 50 marks
Total = 100 marks

8. CONDUCT OF PRACTICAL EXAMINATION:

Assessment	Actual Weightage in Marks	Final weightage in Marks
Lab conduction and record	100	30
Lab test	50	20
SEE	100	50
Total		**100**
Grading Consideration		**50% CIE + 50% SEE**

9. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → / COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2			3				2		
CO2	3	3	2		3	3			2		
CO3	2	3	3		3				2		
CO4	2	3	3		3				2		

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

10. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → / COs ↓	PSO1	PSO2
CO1	2	
CO2	2	
CO3	2	
CO4	2	

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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Department: **DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**		
Semester: **5**	Course Code: **BAD24P507**	Contact Hrs /week: **2**
Course Description: **MINI PROJECT**		No. of Credits:**2** L : T : P : S = **0:0:4:0**
Course Category: **PROJ**		Total no. of Hours = **26**
CIE: **50 Marks**	SEE: -	Exam Hours: -
Course Pre-requisites: Programming languages, Problem solving		

1. COURSE LEVEL OBJECTIVES

CLO1	Acquire the ability to make links across different areas of knowledge and to generate, develop and evaluate ideas and information so as to apply these skills to the project task.
CLO2	Acquire the skills to communicate effectively and to present ideas clearly and coherently to a specific audience in both the written and oral forms.
CLO3	Acquire collaborative skills through working in a team to achieve common goals.
CLO4	Learn on their own, reflect on their learning and take appropriate action to improve it.

2. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Interpreting and implementing the project in the chosen domain by applying the concepts learnt.	PO1-PO11, PSO1,PSO2	L4	WK3, WK4, WK5, WK6, WK8	3
CO2	The course will facilitate effective participation by the student in team work and development of communication and presentation skills essential for being part of any of the domains in his / her future career.	PO1-PO11, PSO1,PSO2	L4	WK3, WK4, WK5, WK6, WK8	3
CO3	Applying project life cycle effectively to develop an efficient product.	PO1-PO11, PSO1,PSO2	L3	WK3, WK4, WK5, WK6, WK8	3
CO4	Produce students who would be equipped to pursue higher studies in a	PO1-PO11, PSO1,PSO2	L4	WK3, WK4, WK5,	4

	specialized area or carry out research work in an industrial environment.			WK6, WK8	

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

- **Guidelines for Mini Project**

1. The mini project is to be carried out individually or by a team of two-four students.
2. Each student in a team must contribute equally in the tasks mentioned below.
3. Each group has to select a current topic that will use the technical knowledge of their program of study after intensive literature survey.
4. The project should result in system/module which can be demonstrated, using the available resources in the college.
5. The CIE evaluation will be done by the committee constituted by the department. The committee shall consist of respective guide & two senior faculty members as examiners. The evaluation will be done for each student separately.
6. The final copy of the report should be submitted after incorporation of any modifications suggested by the evaluation committee.

- **The mini-project tasks would involve:**

1. Carry out the Literature Survey of the topic chosen.
2. Understand the requirements specification of the mini-project.
3. Detail the design concepts as applicable through appropriate functional block diagrams.
4. Commence implementation of the methodology after approval by the faculty.
5. Conduct thorough testing of all the modules developed and carry out integrated testing.
6. Demonstrate the functioning of the mini project along with presentations of the same.
7. Prepare a project report covering all the above phases with proper inference to the results obtained.
8. Conclusion and Future Enhancements must also be included in the report.

The students are required to submit the report in the prescribed format provided by the department.

3. CONTINUOUS INTERNAL EVALUATION (CIE):

Phase	Activity	Weightage
I	Synopsis submission, approval of the selected topic, Problem definition, Literature review, formulation of objectives, methodology	10M
II	Mid-term evaluation to review the progress of implementation, design, testing and result analysis along with documentation	30M
III	Submission of report, Final presentation and demonstration	10M

4. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → / COs ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	3	3	2	3	3	2	1	1	1	2
CO2	3	3	3	2	3	3	2	1	1	1	2
CO3	3	3	3	2	3	3	2	1	1	1	2
CO4	3	3	3	2	3	3	2	1	1	1	2

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

5. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → / COs ↓	PSO1	PSO2
CO1	2	2
CO2	2	2
CO3	2	2
CO3	2	2

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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Department: **DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**		
Semester: **5**	Course Code: **BRMK24557**	Contact Hrs /week: **3**
Course Description: **RESEARCH METHODOLOGY AND IPR**		No. of Credits:**3** L : T : P : S = **2:2:0:0**
Course Category: **AEC**		Total no. of Hours = **39**
CIE: **50 Marks**	SEE: **50 Marks**	Exam Hours: **03**
Course Pre-requisites: Basics of Engineering Mathematics and Logical Reasoning		

1. PREAMBLE ABOUT THE COURSE

This course introduces research methodology and intellectual property rights for engineering students. Students explore the foundations of research including types, approaches, significance, and research processes. Literature review techniques, research design, experimental designs, and sampling methods are studied. Data collection approaches covering primary and secondary data sources, measurement and scaling are examined. Statistical hypothesis testing including tests for mean, proportion, and variance, and interpretation and report writing skills are developed. The course concludes with intellectual property rights including patents, copyrights, trademarks, and emerging IPR challenges, equipping students with research skills and legal framework awareness.

2. COURSE LEVEL OBJECTIVES

CLO1	To make the student understand the foundations of Research and problem solution
CLO2	Knowledge in Research design, Qualitative and Quantitative Research.
CLO3	Knowledge to analyze data using statistical methods and develop critical thinking skills
CLO4	To understand the different types of Intellectual Property Rights (IPR).

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Apply fundamental research methodology concepts, including types, processes, and problem formulation, to initiate a research study.	PO1	L2	WK1,WK3, WK7, WK8, WK9	3
CO2	Use appropriate techniques to conduct literature reviews and develop theoretical/conceptual frameworks in line with academic standards.	PO2	L3	WK1,WK3, WK7, WK8, WK9	3

CO3	Investigate research problems using proper sampling, data collection, and hypothesis testing procedures	PO4	L3	WK1,WK3, WK7, WK8, WK9	3
CO4	Present a structured review manuscript while adhering to IPR, ethical standards, and teamwork principles.	PO8, PO9, PO11	L2	WK1,WK3, WK7, WK8, WK9	3

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	**Research Methodology:** Introduction, Meaning of Research, Objectives of Research, Types of Research, Research Approaches, Significance of Research, Research and Scientific Method, Research Process, Criteria of Good Research, Problems Encountered by Researchers in India. **Defining the Research Problem**: Research Problem, Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem, An Illustration. Textbook 3: Chapter 1, Chapter 2	CO1	8
II	**Reviewing the Literature:** Place of the literature review in research, bringing clarity and focus to research problem, improving research methodology, broadening knowledge base in research area, enabling contextual findings, Review of the literature, searching the existing literature, reviewing the selected literature, developing a theoretical framework, developing a conceptual framework, writing about the literature reviewed. **Research Design:** Meaning of Research Design, Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs, Important Experimental Designs. Textbook 3: Chapter 3, Chapter 4	CO2	8
III	**Design of Sample Surveys:** Introduction, Sample Design, Sampling and Non-Sampling Errors, Sample Survey versus Census Survey, Types of Sampling Designs. **Measurement and Scaling**: Qualitative and Quantitative Data. **Data Collection**: Introduction, Experimental and Surveys, Collection of Primary Data, Collection of Secondary Data, Selection of Appropriate Method for Data Collection, Case Study Method. Textbook 3: Chapter 5, Chapter 6, Chapter 7	CO3	8
	Testing of Hypotheses: Hypothesis, Basic Concepts Concerning Testing of Hypotheses, Testing of Hypothesis, Test Statistics and Critical Region, Critical Value and Decision Rule, Procedure for Hypothesis Testing, Hypothesis Testing for Mean, Proportion, Variance, for Difference of Two Mean, for Difference of Two Proportions,	CO4	8

	for Difference of Two Variances, P-Value approach, Power of Test, Limitations of the Tests of Hypothesis. **Interpretation and Report Writing:** Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports. Textbook 3: Chapter 9, Chapter 13		
	Intellectual Property: Principles of IPR, Kinds of IPR, Patent – Concepts, Novelty, Utility, Inventiveness/Non-obviousness, Procedure for granting and obtaining patents; Copyright – conditions for grant of copyright, Copyright in Literary, Dramatic and Musical Works, Sound Recording, Cinematograph Films, Copyright in Computer Programme, Author Special Rights, Right of Broadcasting and performers; Trademark Law and Practices – Procedure of registration of trademark; Emerging Issues and Challenges; Future Aspects of Intellectual Property Rights. Textbook 4: Chapter 1, Chapter 2, Chapter 3	CO4	7

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition
1	Business Research Methods	Donald Cooper and Pamela Schindler	Tata McGraw Hill.	9th Edition
2	Business Research Methods	Alan Bryman and Emma Bell	Oxford University Press	-
3	Research Methodology: Methods and Techniques	Kothari, C.R	New Age International	
4	Intellectual Property Law	Lionel Bently and Brad Sherman		3rd Edition

6. EVALUATION METHODOLOGY

c) Continuous Internal Evaluation (CIE) = 50 marks
d) Semester End Examination (SEE) = 50 marks
Total = 100 marks

7. CONDUCT OF PRACTICAL EXAMINATION:

Assessment	Actual Weightage in Marks	Final weightage in Marks
CIE 1	50	Avg of 2 CIEs out of 30
CIE 2	50	
AAT	20	20
SEE	100	50
Total		**100**
Grading Consideration		**50% CIE + 50% SEE**

8. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	-	-	-	-	-	-	-	-	-	-
CO2	-	3	-	-	-	-	-	-	-	-	-
CO3	-	-	-	3	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	2	2	-	1
Average	**3**	3	**-**	**3**	**-**	**-**	**-**	**2**	**2**	**-**	**1**

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

9. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → / **COs ↓**	**PSO1**	**PSO2**
CO1		
CO2		
CO3		
CO4		

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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Department: **DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**		
Semester: **6**	Course Code: **BAD24601**	Contact Hrs /week: **3**
Course Description: **BIG DATA ANALYTICS**		No. of Credits: **4** L: T: P: S = **3:0:2:0**
Course Category: **IPCC**		Total no. of Hours = **52**
CIE: **50 Marks**	SEE: **50 Marks**	Exam Hours: **03**
Course Pre-requisites: Programming Foundations, Database Management, Probability and Statistics, Data Warehousing.		

1. PREAMBLE ABOUT THE COURSE

This subject provides a comprehensive understanding of the Hadoop ecosystem and its associated tools and techniques used in Big Data Analytics. It introduces students to the fundamentals of Hadoop, covering its architecture, distributed storage, and processing concepts. The course emphasizes key ecosystem components such as HDFS**,** Hive**,** Pig, and related frameworks that enable efficient data management and analysis. A major focus is placed on understanding the advantages of Hadoop over traditional data processing systems, particularly its ability to handle large volumes of structured, semi-structured, and unstructured data effectively. To reinforce theoretical knowledge, the course includes extensive hands-on laboratory sessions where students gain practical experience in the installation, configuration, and execution of various Hadoop tools, along with demonstrations of their core functionalities in real-world data scenarios. By the end of the course, students will have both the conceptual foundation and the practical skills necessary to work with Big Data platforms and apply analytical tools to solve large-scale data challenges.

2. COURSE LEVEL OBJECTIVES

CLO1	To understand the fundamentals of big data and its eco-system.
CLO2	To implement MapReduce programs for processing big data.
CLO3	To realize storage and processing of big data using MongoDB, Pig, Hive and Spark.
CLO4	To analyze big data using machine learning techniques.

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Understand the fundamental concepts, architecture, and ecosystem of Big Data technologies.	PO1,PO5,PO11 & PSO1,PSO2	L2	WK3, WK4	08
CO2	Implement MapReduce programs to process and analyze large-scale datasets.	PO1,2,3,4,5,11 & PSO1,PSO2	L3	WK3, WK4	08

CO3	Apply Big Data storage and querying techniques using tools such as MongoDB, Pig, Hive, and Spark.	PO1,2,3,4,5,11 & PSO1,PSO2	L3	WK3, WK4	08
CO4	Analyze large datasets using appropriate Big Data frameworks and processing models.	PO1,2,4,11 & PSO1,PSO2	L4	WK3, WK4	08
CO5	Analyze Big Data using machine learning techniques to extract meaningful insights and patterns.	PO1,3,4,5,11 & PSO1,PSO2	L4	WK3, WK4	07

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	**Introduction:** Classification of data, Characteristics, Evolution and definition of Big data, What is Big data, Why Big data, Traditional Business Intelligence Vs Big Data,Typical data warehouse and Hadoop environment. **Big Data Analytics:** What is Big data Analytics, Classification of Analytics, Importance of Big Data Analytics, Technologies used in Big data Environments, Few Top Analytical Tools , NoSQL, Hadoop.	CO1	08
II	**Introduction to Hadoop:** Introducing hadoop, Why hadoop, Why not RDBMS, RDBMS Vs Hadoop, History of Hadoop, Hadoop overview, Use case of Hadoop, HDFS (Hadoop Distributed File System),Processing data with Hadoop, Managing resources and applications with Hadoop YARN(Yet Another Resource Negotiator). **Introduction to Map Reduce Programming:** Introduction, Mapper, Reducer, Combiner, Partitioner, Searching, Sorting, Compression.	CO2	08
III	**Introduction to MongoDB:** What is MongoDB, Why MongoDB, Terms used in RDBMS and MongoDB, Data Types in MongoDB, MongoDB Query Language.	CO3	08
IV	**Introduction to Hive:** What is Hive, Hive Architecture, Hive data types, Hive file formats, Hive Query Language (HQL), RC File implementation, User Defined Function (UDF). **Introduction to Pig:** What is Pig, Anatomy of Pig, Pig on Hadoop, Pig Philosophy, Use case for Pig, Pig Latin Overview, Data types in Pig, Running Pig, Execution Modes of Pig, HDFS Commands, Relational Operators, Eval Function, Complex Data Types, Piggy Bank, User Defined Function, Pig Vs Hive.	CO4	08
V	**Spark and Big Data Analytics:** Spark, Introduction to Data Analysis with Spark. **Text, Web Content and Link Analytics**: Introduction, Text Mining, Web Mining, Web Content and Web Usage Analytics, Page Rank, Structure of Web and Analyzing a Web Graph.	CO5	07

Lab Programs (Hours:13):

Sl. No.	Experiments
1.	Installation of Hadoop.
2.	Basic Hadoop commands execution.
3.	Demonstration of map-reduce activity through matrix multiplication.
4.	Demonstration of map-reduce activity through weather data process.
5.	Installation of MongoDB.
6.	Demonstration of data storage, processing and retrieval using MongoDB
7.	Installation of Hive.
8.	Demonstration of basic hive functionalities.
9.	Installation of Pig.
10.	Demonstration of basic pig functionalities.

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	"Big data and Analytics" (Recommended)	Seema Acharya and Subhashini Chellappan	Wiley India Publishers	2nd Edition	Module 1,2,3 & 4
2	"Big Data Analytics, Introduction to Hadoop, Spark and Machine Learning" (Recommended)	Rajkamal and Preeti Saxena.	McGraw Hill Publication	-	Module 5
3	"MapReduce Design Patterns: Building Effective Algorithms and Analytics for Hadoop and Other Systems" (Reference)	Adam Shook and Donald Mine	O'Reilly	-	-
4	"Hadoop: The Definitive Guide"	Tom White	O'reilly Media	-	-

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCS/WEB RESOURCE

- https://www.kaggle.com/datasets/grouplens/movielens-20m-dataset
- https://www.youtube.com/watch?v=bAyrObl7TYE&list=PLEiEAq2VkUUJqp1k-g5W1mo37urJQOdCZ
- https://www.youtube.com/watch?v=GG-VRm6XnNk https://www.youtube.com/watch?v=JglO2Nv_92A
- https://www.youtube.com/watch?v=VmO0QgPCbZY&list=PLEiEAq2VkUUJqp1kg5W1mo37urJQOdCZ&in dex=4

7. EVALUATION METHODOLOGY

a) Continuous Internal Evaluation (CIE) = 50 marks
b) Semester End Examination (SEE) = 50 marks
Total = 100 marks

CIE and SEE Framework:

Assessment	Actual Weightage in Marks	Final weightage in Marks
CIE 1	50	Avg of 2 CIEs out of 25
CIE 2	50	
LAB	15	15
AAT	10	10
SEE	100	50
Total		**100**
Grading Consideration		**50% CIE + 50% SEE**

8. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → / COs ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3				1						1
CO2	3	1	1	1	2						1
CO3	3	2	2	2	2						1
CO4	3	1		2							1
CO5	3		1	1	1						1

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

9. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → / COs ↓	PSO1	PSO2
CO1	1	2
CO2	1	2
CO3	1	2
CO4	1	2
CO5	1	2

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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Department: **DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**		
Semester: **6**	Course Code: **BAD24602**	Contact Hrs /week: **3**
Course Description: **DATA VISUALIZATION USING TABLEAU**		No. of Credits:**3** L : T : P : S = **3:0:0:0**
Course Category: **PCC**		Total no. of Hours = **39**
CIE: **50 Marks**	SEE: **50 Marks**	Exam Hours: **03**
Course Pre-requisites: Basic understanding of Microsoft Excel		

1. PREAMBLE ABOUT THE COURSE

The course Data Visualization using Tableau introduces learners to the art and science of presenting data effectively. It focuses on transforming raw data into meaningful visual insights using Tableau's powerful features. Students learn to design interactive dashboards and analytical reports for real-world applications. Emphasis is placed on data interpretation, storytelling, and visual best practices. By the end, Students can create compelling visualizations that drive data-informed decision-making.

2. COURSE LEVEL OBJECTIVES

CLO1	To introduce the principles and best practices of effective data visualization and design.
CLO2	To enable students to create, analyze, and interpret visualizations using Tableau's interactive features.
CLO3	To develop the ability to connect, prepare, and model data for insightful visualization and storytelling.
CLO4	To provide exposure to advanced visualization tools such as Tableau through practical, project-based learning, including dashboard creation and presentation.

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Understand the fundamentals, principles, and techniques of effective data visualization and their importance in data interpretation.	PO1,PO2,PO5, PO9,PO11,PSO1,PSO2	L2	WK3, WK4, WK5	8
CO2	Explore the architecture, features, and core functionalities	PO1,PO2,PO5, PO9,PO11,PSO1,PSO2	L2	WK3, WK4, WK5	8

	of Tableau, including data connections and interface components.				
CO3	Apply data connection, blending, and calculation techniques to prepare and transform data for analysis and storytelling.	PO1,PO2,PO3,PO4,PO5, PO9,PO11,PSO1,PSO2	L3	WK3, WK4, WK5	7
CO4	Create and implement different types of charts, plots, and maps in Tableau, incorporating sorting and filtering techniques for effective visualization.	PO1,PO2,PO3,PO4,PO5, PO9,PO11,PSO1,PSO2	L4	WK3, WK4, WK5	8
CO5	Analyze advanced Tableau solutions by creating interactive dashboards, performing trend analysis, and applying forecasting techniques to derive actionable data insights.	PO1,PO2,PO3,PO4,PO5, PO9,PO11,PSO1,PSO2	L4	WK3, WK4, WK5	8

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	**Introduction to Data Visualization:** Introduction to the Art and Science of Data Visualization, what is Data Visualization? Importance of Data Visualization, Brief History of Data Visualization, Data Visualization Tools, **Design Fundamentals:** Design Principles, Colors, and "Chart Junk", The Shaffer 4 Cs of Data Visualization, Best practices (examples).	CO1	08
II	**Storytelling with Data:** Creating a good data set for analysis, Selecting data for your KPIs, Approaches to storytelling with data, Dashboards vs. Storyboards vs. Infographics. **Tableau:** What is Tableau? History of Tableau, Tableau architecture, Tableau Desktop, Workspace, Connecting to data source, Files and folders, Tableau navigation, Terminologies, Data types, Data aggregation, File types.	CO2	08
III	**Data connection:** Extracting data, Joining, Blending, Sorting, Fields operations. **Tableau calculations**: Operators, Functions, Numeric, string, date, table calculations.	CO3	07

IV	**Sort and filter:** Basic filters, Filter operations, Extract filters, Quick filters, Context filters, Condition filters, Data source filters, Top filters, Build groups, hierarchy, sets. **Charts:** Bar, Line, Pie, Crosstab, Bubble, Bullet, Area, Pareto, Bump chart, Gantt chart, Histogram, Motion charts, Waterfall charts. Plots: Scatter, Boxplot. Maps: Heat map, Tree map.	CO4	08
V	**Level of Details Expression (LOD) fundamentals:** Fixed, Include and Exclude LOD's Syntax, Examples. **Advanced Tableau:** Bringing Data on a dual Axis, Creating moving averages chart, Reference bands and distribution bands with parameterization, Dashboard, Formatting, Forecasting, Trend Lines.	CO5	08

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Practical Tableau: 100 Tips, Tutorials, and Strategies from a Tableau Zen Master.	Ryan Sleeper,	O'Reilly Media	2nd Edition, 2023	Module III, IV, V
2	Storytelling with Data: A Data Visualization Guide for Business Professionals,	Cole Nussbaumer Knaflic,	Wiley	2nd Edition, 2020.	Module I and II
3	Learning Tableau 2025	JoshuaN. Milligan,	Packt Publishing,	6th Edition, 2025.	
Reference Books					
4	Data Visualisation: A Handbook for Data Driven Design	Andy Kirk	Sage Publications	2nd Edition,2020	Module I, II
5	Communicating Data with Tableau	Ben Jones	O'Reilly Media	1st Edition, 2021	Module III
6	The Big Book of Dashboards	Steve Wexler, Jeffrey Shaffer, Andy Cotgreave,	Wiley	2nd Edition,2020	Module IV, V

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCS/WEB RESOURCE]

- https://www.coursera.org/learn/datavisualization.
- https://freevideolectures.com/course/4041/nptel-introduction-to-learning-analytics/11
- https://www.coursera.org/learn/dataviz-dashboards
- https://www.udemy.com/course/the-complete-data-visualization-course/
- https://www.classcentral.com/course/swayam-introduction-to-data-visualization-452115

7. EVALUATION METHODOLOGY

a) Continuous Internal Evaluation (CIE) = 50 marks
b) Semester End Examination (SEE) = 50 marks
Total = 100 marks

CIE and SEE Framework:

Assessment	Actual Weightage in Marks	Final weightage in Marks
CIE 1	50	Avg of 2 CIEs out of 30
CIE 2	50	
AAT	20	20
SEE	100	50
Total		**100**
Grading Consideration		**50% CIE + 50% SEE**

8. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → / COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2			3				2		2
CO2	3	2			3				2		2
CO3	3	2	2	2	3				2		2
CO4	3	2	2	2	3				2		2
CO5	3	2	2	2	3				2		2

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

9. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → / COs ↓	PSO1	PSO2
CO1	1	3
CO2	1	3
CO3	1	3
CO4	1	3
CO5	1	3

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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Department: **DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**		
Semester: **6**	Course Code: **BAD24603**	Contact Hrs /week: **3**
Course Description: **NEURAL NETWORKS & DEEP LEARNING**		No. of Credits:**3** L : T : P : S = **3:0:0:0**
Course Category: **PCC**		Total no. of Hours = **39**
CIE: **50 Marks**	SEE: **50 Marks**	Exam Hours: **03**
Course Pre-requisites: Core concepts of Machine Learning & its algorithms.		

1. PREAMBLE ABOUT THE COURSE

This course aims to impart hands-on knowledge on advanced machine learning topics, providing in-depth coverage of Data Augmentation and Convolution-based techniques. It further focuses on the application of Deep Learning models such as Convolutional Neural Networks (CNN) and Recurrent Neural Networks (RNN), while also offering exposure to unsupervised feature engineering methods. Through advanced conceptual understanding, students will be equipped to explore, experiment, and apply modern ML and DL techniques to real-world problem scenarios.

2. COURSE LEVEL OBJECTIVES

CLO1	To provide hands-on experience in advanced Machine Learning concepts
CLO2	To deliver detailed knowledge on Data Augmentation and Convolution operations
CLO3	To develop competency in implementing Deep Learning architectures such as CNNs and RNNs
CLO4	To expose students to unsupervised feature engineering techniques

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Understand the fundamental concepts, principles, and architectures of Neural Networks.	PO1, PO2,PO3,PO4,PO5, PO9,PSO1,PSO2	L2	WK3, WK4, WK5	08
CO2	Interpret the conceptual and theoretical insight behind advanced Deep Learning architectures such as CNN and related models.	PO1, PO2,PO3,PO4,PO5, PO9,PSO1,PSO2	L3	WK3, WK4, WK5	08

CO3	Implement deep learning models using gradient-based visualization and explainability techniques	PO1, PO2,PO3,PO4,PO5, PO9,PSO1,PSO2	L3	WK3, WK4, WK5	08
CO4	Apply Recurrent Neural Network architectures including LSTM and GRU for sequence learning applications.	PO1, PO2,PO3,PO4,PO5, PO9,PSO1,PSO2	L3	WK3, WK4, WK5	08
CO5	Design and implement Deep Learning approaches for sequential data and develop Generative Adversarial Networks (GANs) to generate synthetic data for improving performance on limited datasets.	PO1, PO2,PO3,PO4,PO5, PO9,PSO1,PSO2	L3	WK3, WK4, WK5	07

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	**Introduction:** Understanding the Biological Neurons, Exploring the Artificial Neurons (Perceptron), Perceptron learning rule, Examples on single layer perceptron, Process of designing a Neural Networks (Architecture), Types of Activation Functions, derivative of activation functions. Multilayer perceptron (Mathematics Behind Back propagation, Deep L layer Neural Network, Understanding the notion of forward and backward propagation), Optimization algorithms in NN, Loss functions, Dropout, Implementation of ANN.	CO1	08
II	**Convolutional Neural Networks:** Mathematics behind CNN, Layers, Architectures of CNN, ILSVRC winner architectures, Implementation of CNN, Building the model from the scratch	CO2	08
III	**Introduction:** Gradient based approaches, Visualizing gradients, Saliency map, Class Model, SmoothGRAD, DeConvolution, Guided Back Propagation Grad-CAM, Occlusion sensitivity	CO3	08
IV	**Recurrent Neural Networks:** Types of RNN, Challenges in training RNN: Exploding and Vanishing Gradients, Networks with Memory Long Short-Term Memory (LSTM): Gated Recurrent Unit (GRU), Sequence Learning Architectures, Sequence Learning with one RNN Layer, Sequence Learning with multiple RNN Layers Implementation example using Keras in Python: sentiment analysis	CO4	08
V	**Other Deep Learning Architectures:** Encoder-Decoder Architecture, Attention Mechanism, Transformer Architecture, Generative Adversarial Networks, Unet.	CO5	07

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Deep learning	Amit Kumar Das, Saptarsi Goswami, Pabitra Mitra, Amlan	Pearson	1st Edition	3
2	Deep learning	Bengio, Yoshua, Ian J. Goodfellow, and Aaron Courville	MIT Press	2020	4,5
3	Neural Networks: A Systematic Introduction	Raúl Rojas	Springer		1
4	Pattern Recognition and Machine Learning	Bishop C	Springer	2019	2

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCS/WEB RESOURCE

- https://cs231n.github.io/convolutional-networks/
- https://github.com/terryum/awesome-deep-learning-papers
- https://project.inria.fr/deeplearning/files/2016/05/deepLearning.pdf
- Deep Learning specialization in Coursera.
- https://nptel.ac.in/courses/106106184
- https://www.udemy.com/topic/deep-learning/

7. EVALUATION METHODOLOGY

a) Continuous Internal Evaluation (CIE) = 50 marks
b) Semester End Examination (SEE) = 50 marks
Total = 100 marks

CIE and SEE Framework:

Assessment	Actual Weightage in Marks	Final weightage in Marks
CIE 1	50	Avg of 2 CIEs out of 30
CIE 2	50	
AAT	20	20
SEE	100	50
Total		**100**
Grading Consideration		**50% CIE + 50% SEE**

8. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → / COs ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	2	3	2	3				2		
CO2	3	2	3	2	3				2		
CO3	3	2	3	2	3				2		
CO4	3	2	3	2	3				2		
CO5	3	2	3	2	3				2		

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

9. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → / COs ↓	PSO1	PSO2
CO1	1	3
CO2	1	3
CO3	1	3
CO4	1	3
CO5	1	3

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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Department: **DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**		
Semester: **6**	Course Code: **BAD24604A**	Contact Hrs /week: **3**
Course Description: **SOFTWARE ENGINEERING WITH AGILE METHODLOGIES**		No. of Credits:**3** L: T: P: S = **3:0:0:0**
Course Category: **PEC**		Total no. of Hours = **39**
CIE: **50 Marks**	SEE: **50 Marks**	Exam Hours: **03**
Course Pre-requisites: **Basics of Software Engineering**		

1. PREAMBLE ABOUT THE COURSE

Software Engineering with Agile introduces the principles of software development combined with modern Agile methodologies. The course focuses on iterative development, collaboration, and adaptability using frameworks like Scrum and XP. It equips students with essential skills in planning, development, testing, and delivering high-quality software in dynamic environments.

2. COURSE LEVEL OBJECTIVES

CLO1	To understand the foundational principles, processes, and evolving nature of software engineering.
CLO2	To learn and apply various software process models, including Agile methodologies, in real-world contexts.
CLO3	To acquire skills in eliciting, modeling, and validating software requirements effectively.
CLO4	To build a strong foundation in software design, testing, and quality assurance practices.

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Understand the software nature, engineering practices, myths, and software process models	PO1, PO2, PO3, PO4, PO5, PO9, PO11, PSO1	L2	WK3, WK4, WK5	08
CO2	Interpret requirements engineering activities including elicitation, modeling, and validation in software development.	PO1, PO2, PO3, PO4, PO5, PO9, PO11, PSO1	L2	WK3, WK4, WK5	08
CO3	Implement agile principles, practices, and tools for software development agility.	PO1, PO2, PO3, PO4, PO5, PO9, PO11, PSO1	L3	WK3, WK4, WK5	08

CO4	Apply design concepts, process, and architecture for quality software development	PO1, PO2, PO3, PO4, PO5, PO9, PO11, PSO1	L3	WK3, WK4, WK5	08
CO5	Analyse software testing strategies and quality assurance for reliable software.	PO1, PO2, PO3, PO4, PO5, PO9, PO11, PSO1	L4	WK3, WK4, WK5	07

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	**Software and Software Engineering:** The nature of Software, The unique nature of WebApps, Software Engineering, The software Process, Software Engineering Practice, Software Myths. **Process Models:** A generic process model, Process assessment and improvement, Prescriptive process models: Waterfall model, Incremental process models, Evolutionary process models, Concurrent models, Specialized process models. Unified Process, Personal and Team process models	CO1	08
II	**Understanding Requirements:** Requirements Engineering, Establishing the groundwork, Eliciting Requirements, Developing use cases, Building the requirements model, Negotiating Requirements, Validating Requirements. **Requirements Modeling Scenarios, Information and Analysis classes:** Requirement Analysis, Scenario based modeling, UML models that supplement the Use Case, Data modeling Concepts, Class Based Modeling. **Requirement Modeling Strategies:** Flow oriented Modeling , Behavioral Modeling.	CO2	08
III	**Agile Development:** What is Agility?, Agility and the cost of change. What is an agile Process?, Extreme Programming (XP), Other Agile Process Models, A tool set for Agile process. Principles that guide practice: Software Engineering Knowledge, Core principles, Principles that guide each framework activity.	CO3	08
IV	**Software Design:** Design within the context of software engineering, Design process and quality, Design concepts: abstraction, modularity, architecture, patterns. **Architectural Design:** Architectural styles and patterns, reference architectures, component-level design, designing class-based components, conducting component-level design, design for reuse.	CO4	08
V	**Software Testing:** Introduction to software testing, Strategic approach, Test strategies for conventional and object-oriented software, Validation testing, System testing, White-box and Black-box testing, Basis Path Testing, Control structure testing. **Software Quality:** Concepts of quality, Software quality assurance, Reviews, Software reliability and metrics.	CO5	07

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Software Engineering – A Practitioner's Approach	Roger S. Pressman	Tata McGraw Hill	7th Edition	All Modules
2	An Integrated Approach to Software Engineering	Pankaj Jalote	Wiley India		

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCS/WEB RESOURCE

- https://www.geeksforgeeks.org/software-engineering/software-engineering/
- https://onlinecourses.nptel.ac.in/noc20_cs68/preview
- https://www.youtube.com/watch?v=WxkP5KR_Emk&list=PLrjkTql3jnm9b5nrggx7Pt1G4U AHeFlJ
- http://elearning.vtu.ac.in/econtent/CSE.php
- http://elearning.vtu.ac.in/econtent/courses/video/CSE/15CS42.html
- https://nptel.ac.in/courses/128/106/128106012/ (DevOps)

7. EVALUATION METHODOLOGY

a) Continuous Internal Evaluation (CIE) = 50 marks
b) Semester End Examination (SEE) = 50 marks
Total = 100 marks

CIE and SEE Framework:

Assessment	Actual Weightage in Marks	Final weightage in Marks
CIE 1	50	Avg of 2 CIEs out of 30
CIE 2	50	
AAT	20	20
SEE	100	50
Total		**100**
Grading Consideration		**50% CIE + 50% SEE**

8. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → / COs ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	3	2	2	3				2		1
CO2	3	3	2	2	3				2		1
CO3	3	3	2	2	3				2		1
CO4	3	3	2	2	3				2		1
CO5	3	3	2	2	3				2		1

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

9. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → / COs ↓	PSO1	PSO2
CO1	3	
CO2	3	
CO3	3	
CO4	3	
CO5	3	

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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Department: **DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**		
Semester: **6**	Course Code: **BAD24604B**	Contact Hrs /week: **3**
Course Description: **CRYPTOGRAPHY & NETWORK SECURITY**		No. of Credits:**3** L: T: P: S = **3:0:0:0**
Course Category: **PEC**		Total no. of Hours = **39**
CIE: **50 Marks**	SEE: **50 Marks**	Exam Hours: **03**
Course Pre-requisites: Basic knowledge of computer networks, data communication, and discrete mathematics.		

1. PREAMBLE ABOUT THE COURSE

This course provides a comprehensive study of cryptographic techniques and network security mechanisms, focusing on both symmetric and asymmetric encryption methods such as DES, RSA, and Diffie-Hellman. It explores key management, user authentication, and secure communication protocols essential for protecting data in modern networks. Additionally, the course covers real-world applications like email and IP security, emphasizing practical implementation and cryptanalysis principles.

2. COURSE LEVEL OBJECTIVES

CLO1	To understand the fundamental concepts of cryptography, information security, and the core security principles.
CLO2	To analyze and compare various cryptographic algorithms based on their design, functionality, and security strength.
CLO3	To illustrate the working of public key and private key cryptography techniques with suitable examples.
CLO4	To apply key distribution and certification mechanisms and evaluate protection techniques to secure computer networks.

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Understand Cryptography, Network Security theories, algorithms and systems.	PO1, PO2, PO3, PO4, PO5 PO9, PO11, PSO1,PSO2	L2	, WK3, WK4, WK5	8
CO2	Apply different Cryptography and Network Security operations on different applications.	PO1, PO2, PO3, PO4, PO5 PO9, PO11, PSO1,PSO2	L3	WK3, WK4, WK5	8

CO3	Analyze different methods for authentication and access control.	PO1, PO2, PO3, PO4, PO5 PO9, PO11, PSO1,PSO2	L4	WK3, WK4, WK5	8
CO4	Evaluate Public and Private key, Key management, distribution and certification.	PO1, PO2, PO3, PO4, PO5 PO9, PO11, PSO1,PSO2	L4	WK3, WK4, WK5	8
CO5	Design necessary techniques to build protection mechanisms to secure computer networks.	PO1, PO2, PO3, PO4, PO5 PO9, PO11, PSO1,PSO2	L4	WK3, WK4, WK5	7

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	**Classical Encryption Techniques:** Symmetric Cipher Model, Cryptography, Cryptanalysis and BruteForce Attack, Substitution Techniques, Caesar Cipher, Monoalphabetic Cipher, Playfair Cipher, Hill Cipher, Polyalphabetic Cipher, One Time Pad. **Block Ciphers and the Data Encryption Standard:** Traditional block Cipher structure, Stream Ciphers and Block Ciphers, Motivation for the Feistel Cipher structure, the Feistel Cipher, The data encryption standard, DES encryption, DES decryption, A DES example, results, the avalanche effect, the strength of DES, the use of 56-Bit Keys, the nature of the DES algorithm, timing attacks, Block cipher design principles, number of rounds, design of function F, key schedule algorithm.	CO1	8
II	**Public-Key Cryptography and RSA:** Principles of public-key cryptosystems. Public-key cryptosystems. Applications for public-key cryptosystems, requirements for public-key cryptosystems. public-key cryptanalysis. The RSA algorithm, description of the algorithm, computational aspects, the security of RSA. **Other Public-Key Cryptosystems:** Diffie-Hellman key exchange, The algorithm, key exchange protocols, man in the middle attack, Elgamal Cryptographic systems.	CO2	8
III	**Key Management and Distribution:** Symmetric key distribution using Symmetric encryption, A key distribution scenario, Hierarchical key control, session key lifetime, a transparent key control scheme, Decentralized key control, controlling key usage, Symmetric key distribution using asymmetric encryption, simple secret key distribution, secret key distribution with confidentiality and authentication, A hybrid scheme, distribution of public keys, public announcement of public keys, publicly available directory, public key authority, public keys certificates.	CO3	8
IV	**User Authentication:** Remote user Authentication principles, Mutual Authentication, one-way authentication, remote user Authentication using Symmetric encryption, Mutual Authentication, oneway Authentication,	CO4	8

	Kerberos, Motivation, Kerberos version 4, Kerberos version 5, Remote user Authentication using Asymmetric encryption, Mutual Authentication, one-way Authentication.		
V	**Electronic Mail Security:** Pretty good privacy, S/MIME, **IP Security:** IP Security overview, IP Security policy, Encapsulating Security payload, Combining security associations, Internet key exchange.	CO5	7

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Cryptography and Network Security	William stallings	Pearson Publication	Seventh Edition 2022	1,2,3,4 and 5
2	Cryptography and Network Security	V.K Pachghare	PHI	Second Edition 2021	-
3	Cryptography and Network Security	Behrouz A.Foruzan	Tata McGraw Hill	Second Edition 2020	-

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCS/WEB RESOURCE

- https://nptel.ac.in/courses/106105031
- https://onlinecourses.nptel.ac.in/noc21_cs16
- https://www.digimat.in/nptel/courses/video/106105031
- https://www.youtube.com/watch?v=DEqjC0G5KwU
- https://www.youtube.com/watch?v=FqQ7TWvOaus

7. EVALUATION METHODOLOGY

a) Continuous Internal Evaluation (CIE) = 50 marks
b) Semester End Examination (SEE) = 50 marks
Total = 100 marks

CIE and SEE Framework:

Assessment	Actual Weightage in Marks	Final weightage in Marks
CIE 1	50	Avg of 2 CIEs out of 30
CIE 2	50	
AAT	20	20
SEE	100	50
Total		**100**
Grading Consideration		**50% CIE + 50% SEE**

8. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → / COs ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	3	3	2	1				2		1
CO2	3	3	3	2	1				2		1
CO3	3	3	3	2	1				2		1
CO4	3	3	3	2	1				2		1
CO5	3	3	3	2	1				2		1

Correlation Weightage: 1 – Low, 2 – Moderate, 3 – High

9. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → / COs ↓	PSO1	PSO2
CO1	3	1
CO2	3	1
CO3	3	1
CO4	3	1
CO5	3	1

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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Department: **DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**		
Semester: **6**	Course Code: **BAD24604C**	Contact Hrs /week: **3**
Course Description: **QUANTUM COMPUTING**		No. of Credits:**3** L: T: P: S = **3:0:0:0**
Course Category: **PEC**		Total no. of Hours = **39**
CIE: **50 Marks**	SEE: **50 Marks**	Exam Hours: **03**
Course Pre-requisites: Basic knowledge of linear algebra (vectors, matrices, eigenvalues), probability and statistics		

1. PREAMBLE ABOUT THE COURSE

This course offers a foundational and practical introduction to quantum computing, covering quantum mechanics principles, qubit operations, quantum gates, essential algorithms, and hands-on implementation using Qiskit.

2. COURSE LEVEL OBJECTIVES

CLO1	To understand core concepts of quantum mechanics and quantum computing.
CLO2	To design quantum circuits using single and multi-qubit gates.
CLO3	To implement quantum operations and basic algorithms using Qiskit.
CLO4	To apply major quantum algorithms to solve computational problems.

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Understand Quantum Machine Learning – What Quantum Computing Means To Data Mining.	PO1, PO2, PO3, PO4, PO5, PSO1, PSO2	L2	WK3, WK4, WK5	08
CO2	Understand the basics of quantum machine learning.	PO1, PO2, PO3, PO4, PO5, PSO1, PSO2	L2	WK3, WK4, WK5	08
CO3	Apply by implementing quantum classification algorithms on the real dataset.	PO1, PO2, PO3, PO4, PO5, PO10, PSO1, PSO2	L3	WK3, WK4, WK5	08
CO4	Implement quantum regression techniques on real datasets.	PO1, PO2, PO3, PO4, PO5, PO9, PO11, PSO1, PSO2	L3	WK3, WK4, WK5	08

CO5	Analyze pattern recognition tasks using Quantum Machine Learning on real datasets.	PO1, PO2, PO3, PO4, PO5, PO9, PO11, PSO1, PSO2	L4	WK3, WK4, WK5	07

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	**Introduction to Quantum Computing:** Introduction to QC and brief about the quantum mechanics, Why QC, Classic architecture vs quantum architecture, History of QC, What is QC, Qubit notations, Features of QC (Superposition, entanglement, decoherence), Use cases of QC, Linear vector spaces, Postulates of quantum mechanics.	CO1	08
II	**Quantum bits (qubits) & Quantum logic gates:** Quantum State Transformation, Introduction to Logic Gates, Quantum gates & Circuits – Single Qubit Gates and Operations, Multiple Qubit Gates and Operations, Introduction to Quantum Simulator.	CO2	08
III	**Practical Implementation:** Introduction to Qiskit and Qsim simulator toolkit, Python libraries needed for the implementation of Quantum computing, Implementation of Pauli gates in Qiskit and Qsim, Implementation of Hadamard gate, Implementation of 2 qubit quantum gates, Implementation of three qubit quantum gates.	CO3	08
IV	**Quantum Algorithms I:** No cloning theorem, Quantum Teleportation, Deutsch's-Jozsa Algorithm, Bernstien Vazirani, practical implementation of the algorithms using Qiskit.	CO4	08
V	**Quantum Algorithms II:** Quantum Fourier transformation, Simon, Shor's, Grover's algorithm & generalization, practical implementation of the algorithms using Qiskit, Introduction to Quantum Machine Learning.	CO5	07

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Learn Quantum Computing with Python and IBM Quantum Experience.	Robert Loredo.		2020	1,2,3,4 and 5
2	Fundamentals of Quantum Computing Theory and Practice.	Venkateswaran Kasirajan	Springer	1st 2021	-
3	Quantum Machine Learning - What Quantum Computing Means to Data Mining.	Peter Wittek	Elsevier	2014	-
4	Quantum Machine Learning with Python: Using Cirq from Google Research and IBM Qiskit.	Santanu Pattanayak.		2018	-

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCS/WEB RESOURCE

- https://www.educative.io/courses/hands-on-quantum-machine-learning-python
- https://www.udemy.com/course/quantum-computing-and-quantum-machine-learning-part-1/
- https://www.udemy.com/course/quantum-computing-and-quantum-machine-learning-part-2/

7. EVALUATION METHODOLOGY

a) Continuous Internal Evaluation (CIE) = 50 marks
b) Semester End Examination (SEE) = 50 marks
Total = 100 marks

CIE and SEE Framework:

Assessment	Actual Weightage in Marks	Final weightage in Marks
CIE 1	50	Avg of 2 CIEs out of 30
CIE 2	50	
AAT	20	20
SEE	100	50
Total		**100**
Grading Consideration		**50% CIE + 50% SEE**

8. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → / COs ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	3	2	2	2						
CO2	3	3	2	2	2						
CO3	3	3	2	2	2				2		
CO4	3	3	2	2	2				2		2
CO5	3	3	2	2	2				2		2

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

9. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → / COs ↓	PSO1	PSO2
CO1	2	2
CO2	2	2
CO3	2	2
CO4	2	2
CO5	2	2

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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Department: **DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**		
Semester: **6**	Course Code: **BAD24604D**	Contact Hrs /week: **3**
Course Description: **CLOUD COMPUTING**		No. of Credits:**3** L: T: P: S = **3:0:0:0**
Course Category: **PEC**		Total no. of Hours = **39**
CIE: **50 Marks**	SEE: **50 Marks**	Exam Hours: **03**
Course Pre-requisites: Basic understanding of computer architecture and organization, understanding of memory management and process concepts		

1. PREAMBLE ABOUT THE COURSE

This course offers a comprehensive overview of cloud computing concepts, architectures, and applications. It covers the evolution of cloud technologies, major platforms like AWS, Google AppEngine, Azure, and Hadoop, and the role of virtualization in scalable environments. Students will explore cloud architectures, security challenges, and real-world scientific, business, and consumer applications, developing both conceptual understanding and analytical skills to evaluate various cloud services and models.

2. COURSE LEVEL OBJECTIVES

CLO1	Introduce the rationale behind the cloud computing revolution and the business drivers.
CLO2	Introducing various models of cloud computing.
CLO3	Introduction on how to design cloud native applications, the necessary tools and the design tradeoffs.
CLO4	Realize the importance of Cloud Virtualization, Abstraction and Enabling Technologies and cloud security.

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Understand and analyze various cloud computing platforms and service provider.	PO1, PO2, PO3, PO4, PO5, PO9, PO11, PSO1,PSO2	L2	WK3, WK4, WK5	08
CO2	Apply various virtualization concepts.	PO1, PO2, PO3, PO4, PO5, PO9, PO11, PSO1,PSO2	L3	WK3, WK4, WK5	08
CO3	Identify the architecture, infrastructure and delivery models of cloud computing.	PO1, PO2, PO3, PO4, PO5,	L3	WK3, WK4, WK5	08

		PO9, PO11, PSO1,PSO2			
CO4	Apply the Security aspects of CLOUD.	PO1, PO2, PO3, PO4, PO5, PO9, PO11, PSO1,PSO2	L3	WK3, WK4, WK5	08
CO5	Analyse platforms for development of cloud applications.	PO1, PO2, PO3, PO4, PO5, PO9, PO11, PSO1,PSO2	L3	WK3, WK4, WK5	07

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	**Introduction:** Introduction, Cloud Computing at a Glance, Historical Developments, Building Cloud Computing Environments, Amazon Web Services (AWS), Google AppEngine, Microsoft Azure, Hadoop, Force.com and Salesforce.com, Manjrasoft Aneka.	CO1	08
II	**Virtualization:** Introduction, Characteristics of Virtualized, Environments Taxonomy of Virtualization Techniques, Execution Virtualization, Other Types of Virtualizations, Virtualization and Cloud Computing, Pros and Cons of Virtualization, Technology Examples.	CO2	08
III	**Cloud Computing Architecture:** Introduction, Cloud Reference Model, Types of Clouds, Economics of the Cloud, Open Challenges.	CO3	08
IV	**Cloud Security:** Risks, Top concern for cloud users, privacy impact assessment, trust, OS security, VM Security, Security Risks posed by shared images and management OS.	CO4	08
V	**Cloud Platforms in Industry Amazon web services:** - Compute services, Storage services, Communication services, Additional services. Google AppEngine: - Architecture and core concepts, Application life cycle, Cost model, Observations. **Cloud Applications: Scientific applications:** - HealthCare: ECG analysis in the cloud, Biology: gene expression data analysis for cancer diagnosis, Geoscience: satellite image processing. Business and consumer applications: CRM and ERP, Social networking, media applications.	CO5	07

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Mastering Cloud Computing	Rajkumar Buyya, Christian Vecchiola, and Thamrai Selvi	McGraw Hill Education	2013	All Modules
2	Cloud Compting Theory and Practice	Dan C. Marinescu, Morgan Kaufmann	Morgan Kaufmann, Elsevier	2013	
3	Cloud Computing: A Practical Approach	Toby Velte, Anthony Velte	McGraw-Hill Osborne Media	2017	
4	Cloud Application Architectures: Building Applications and Infrastructure in the Cloud	George Reese	O'Reilly Publication	2009	
5	Cloud Computing Explained: Implementation Handbook for Enterprises	John Rhoton	Recursive Press	2nd Edition	

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCS/WEB RESOURCE

- https://www.tutorialspoint.com/cloud_computing/index.htm
- Lecture notes on Cloud Computing: https://siiet.ac.in/wp-content/uploads/2019/05/CSE-IV-I-cc-notes.pdf
- https://nptel.ac.in/courses/106105167
- https://www.coursera.org/courses?query=cloud%20computing%20concepts
- https://www.coursera.org/learn/gcp-fundamentals
- https://www.youtube.com/watch?v=1N3oqYhzHv4
- https://www.youtube.com/watch?v=RWgW-CgdIk0

7. EVALUATION METHODOLOGY

a) Continuous Internal Evaluation (CIE) = 50 marks
b) Semester End Examination (SEE) = 50 marks
Total = 100 marks

CIE and SEE Framework:

Assessment	Actual Weightage in Marks	Final weightage in Marks
CIE 1	50	Avg of 2 CIEs out of 30
CIE 2	50	
AAT	20	20
SEE	100	50
Total		**100**
Grading Consideration		**50% CIE + 50% SEE**

8. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → / COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	2	2	3				2		1
CO2	3	3	2	2	3				2		1
CO3	3	3	2	2	3				2		1
CO4	3	3	2	2	3				2		1
CO5	3	3	2	2	3				2		1

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

9. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → / COs ↓	PSO1	PSO2
CO1	3	2
CO2	3	2
CO3	3	2
CO4	3	2
CO5	3	2

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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Department: **DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**		
Semester: **6**	Course Code: **BAD24605A**	Contact Hrs /week: **3**
Course Description: **FOUNDATIONS OF DATA SCIENCE**		No. of Credits:**3** L : T : P : S = **3:0:0:0**
Course Category: **OEC**		Total no. of Hours = **39**
CIE: **50 Marks**	SEE: **50 Marks**	Exam Hours: **03**
Course Pre-requisites: Basic knowledge of Mathematics (Algebra and Functions), Fundamentals of Probability, Elementary knowledge of Statistics		

1. PREAMBLE ABOUT THE COURSE

This course introduces the fundamental concepts of Data Science, including data types, data preprocessing, data mining techniques, descriptive and inferential statistics, and hypothesis testing. It provides students with a strong mathematical and statistical foundation required to analyze data and draw meaningful conclusions. The course emphasizes analytical thinking and problem-solving skills necessary for data-driven decision-making in Artificial Intelligence and Data Science domains.

2. COURSE LEVEL OBJECTIVES

CLO1	To understand the problems solvable with data science
CLO2	Ability to solve problems from a statistical perspective.
CLO3	To build the skills to create data analytical pipelines
CLO4	To bring the familiarity with the data science ecosystem and the various tools needed to continue developing as a data scientist.

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Identify and classify data types, data science lifecycle stages, and core components of Data Science.	PO1,PO2,PO3,PO4,PO5, PSO1,PSO2	L2	WK2, WK3, WK4	8
CO2	Apply data mining concepts and basic mining tasks to analyze real-world datasets.	PO1,PO2,PO3,PO4,PO5, PSO1,PSO2	L3	WK2, WK3, WK4	8

CO3	Compute descriptive statistical measures and perform appropriate data visualization techniques.	PO1,PO2,PO3,PO4,PO5, PSO1,PSO2	L3	WK2, WK3, WK4	8
CO4	Analyze probability distributions and construct confidence intervals using inferential statistical methods.	PO1,PO2,PO3,PO4,PO5, PSO1,PSO2	L4	WK2, WK3, WK4	8
CO5	Perform hypothesis testing and interpret statistical results for data-driven decision making.	PO1,PO2,PO3,PO4,PO5, PSO1,PSO2	L3	WK2, WK3, WK4	7

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	**Introduction to Data Science:** Evolution of Data Science, Data Science Roles, Lifecycle of Data Science, Representation of Data Science as a Venn Diagram, Technologies revolving around Data Science. **Types of Data:** Structured and Unstructured Data, Quantitative and Qualitative Data, Four Levels of data (Nominal, Ordinal, Interval, Ratio Level). **Data Pre-processing:** Asking interesting question, Obtaining of data, Exploration of data, Modeling of data, Communication and visualization.	CO1	08
II	**Data Mining:** What is Data Mining? Types of Data Mining, Challenges of implementation in Data Mining, Advantages and Disadvantages, Applications of Data Mining. **Overview of Basic Data Mining Tasks:** Classification, Regression, Time Series Analysis, Prediction, Clustering, Sequence Discovery.	CO2	08
III	**Basics of Statistics:** Introduction to Statistics, Terminologies in Statistics, Measures of center, variance and relative standing, Normalization of data using the z-score, Empirical rule, Categories in Statistics (Descriptive and Inferential Statistics). **Descriptive Statistics:** Data Objects and Attribute, Basic Statistical Description of Data (Measuring the Central Tendency of Data, Measuring the Dispersion of Data, Graphical Displays), Data Visualization Techniques, Measuring Data Similarity and Dissimilarity.	CO3	08
IV	**Inferential Statistics:** Overview of Probability Distributions (Bernoulli, Binomial, Poisson, Chi-square, t-tail), Joint distribution of the Sample Mean and Sample Variance, Confidence Intervals, Bayesian Analysis of samples from Normal Distribution, Fisher Estimator, Central Limit Theorem.	CO4	08

V	**Hypothesis Testing:** Testing simple hypotheses, Uniform tests, Two-sided alternatives, t-Test, F-Distribution, Bayes Test Procedures, Case studies based on Hypothesis Testing.	CO5	07

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Principles of Data Science, Limited	Sinan Ozdemir, Sunil Kakade	Packt Publishing	2nd Edition, 2018	Module 1 and 2
2	Probability and Statistics	by Morris H Degroot, Mark J Schervish	Pearson	4th Edition, 2012.	Module 3,4 and 5
3	Data Mining Concepts and Techniques	Jiawei Han and Micheine Kamber, Morgan Kaufmann	Oxford Higher Education	3rd Edition, 2011.	
4	Machine Learning: A probabilistic perspective	Murphy, KevinP	MIT Press	2nd Edition, 2018	

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCS/WEB RESOURCE

- **Learn Data Science : Open content for self-directed learning in Data Science :**http://learnds.com/
- **Foundations of Data Science:** https://www.cs.cornell.edu/jeh/book.pdf
- **Introduction to Mathematical Thinking:** https://www.coursera.org/learn/mathematical-thinking
- **IBM Data Science Professional Certificate:** https://www.coursera.org/professional-certificates/ibm-data-science.

7. EVALUATION METHODOLOGY

a) Continuous Internal Evaluation (CIE) = 50 marks
b) Semester End Examination (SEE) = 50 marks
Total = 100 marks

CIE and SEE Framework:

Assessment	Actual Weightage in Marks	Final weightage in Marks
CIE 1	50	Avg of 2 CIEs out of 30
CIE 2	50	
AAT	20	20
SEE	100	50
Total		**100**
Grading Consideration		**50% CIE + 50% SEE**

8. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → / COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3	1	1						
CO2	3	3	3	1	1						
CO3	3	3	3	1	1						
CO4	3	3	3	1	1						
CO5	3	3	3	1	1						

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

9. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → / COs ↓	PSO1	PSO2
CO1	2	2
CO2	2	2
CO3	2	2
CO4	2	2
CO5	2	2

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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Department: **DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**		
Semester: **6**	Course Code: **BAD24605B**	Contact Hrs /week: **3**
Course Description: **INTRODUCTION TO BIG DATA**		No. of Credits:**3** L : T : P : S = **3:0:0:0**
Course Category: **OEC**		Total no. of Hours = **39**
CIE: **50 Marks**	SEE: **50 Marks**	Exam Hours: **03**
Course Pre-requisites: Programming Foundations, Database Management, Probability and Statistics, Data Warehousing.		

1. PREAMBLE ABOUT THE COURSE

This subject provides a comprehensive understanding of the Hadoop ecosystem and its associated tools and techniques used in Big Data Analytics. It introduces students to the fundamentals of Hadoop, covering its architecture, distributed storage, and processing concepts. The course emphasizes key ecosystem components such as HDFS**,** Hive**,** Pig, and related frameworks that enable efficient data management and analysis.A major focus is placed on understanding the advantages of Hadoop over traditional data processing systems, particularly its ability to handle large volumes of structured, semi-structured, and unstructured data effectively. To reinforce theoretical knowledge, the course includes extensive hands-on laboratory sessions where students gain practical experience in the installation, configuration, and execution of various Hadoop tools, along with demonstrations of their core functionalities in real-world data scenarios. By the end of the course, students will have both the conceptual foundation and the practical skills necessary to work with Big Data platforms and apply analytical tools to solve large-scale data challenges.

2. COURSE LEVEL OBJECTIVES

CLO1	Understand the fundamental concepts of Big Data, its characteristics, and the components of the Hadoop ecosystem.
CLO2	Explain the basic ideas behind distributed data processing using MapReduce and the role of tools such as Hive, Pig, MongoDB, and Spark in managing Big Data.
CLO3	Describe how Big Data analytics supports decision-making by enabling the identification of patterns, trends, and insights from large datasets.

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Understand the fundamental concepts, characteristics, and challenges associated with Big Data.	PO1,2,11,PSO1,PO S2	L2	WK3, WK4	08

CO2	Understand the architecture and key components of the Hadoop ecosystem used for Big Data management.	PO1,2,11, PSO1, POS2	L2	WK3, WK4	07
CO3	Interpret the basic functioning of distributed processing using the MapReduce model.	PO1,2,11, PSO1, POS2	L3	WK3, WK4	08
CO4	Understand the roles and features of Big Data tools such as Hive, Pig, MongoDB, and Spark in storing and processing large datasets.	PO1,2,11, PSO1, POS2	L2	WK3, WK4	08
CO5	Analyze how Big Data analytics techniques can be used to identify patterns, trends, and insights that support data-driven decision making.	PO1,2,11, PSO1, POS2	L4	WK3, WK4	08

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	**Fundamentals of Big Data:** Classification and types of data, Characteristics of Big Data (volume, velocity, variety, etc.), Need for Big Data and its applications, Comparison: Traditional systems vs. Big Data approach, Overview of Big Data ecosystem, Introduction to Big Data Analytics and its importance, Overview of NoSQL databases and Hadoop	CO1	08
II	**Basics of Hadoop Ecosystem:** What is Hadoop and why it is used, Limitations of traditional RDBMS for Big Data, Conceptual overview of HDFS, Basic idea of distributed processing, Simple conceptual flow of MapReduce	CO2	07
III	**Introduction to NoSQL and MongoDB:** What is NoSQL and why it emerged, Types of NoSQL databases, Conceptual understanding of MongoDB and document-based storage, Simple examples of data representation	CO3	08
IV	**Overview of Hive and Pig:** Purpose of Hive and Pig in Big Data processing, Very high-level architecture of Hive and Pig, Differences between Hive, and Pig, Use cases and when they are preferred	CO4	08
V	**Introduction to Spark and Big Data Applications:** What is Apache Spark, Why Spark is faster, Common applications in text analytics, web analytics, and simple insights generation, High-level understanding of PageRank and its use	CO5	08

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	"Big data and Analytics" (Recommended)	Seema Acharya and Subhashini Chellappan	Wiley India Publishers	2nd Edition	Module 1,2,3 & 4
2	"Big Data Analytics, Introduction to Hadoop, Spark and Machine Learning" (Recommended)	Rajkamal and Preeti Saxena.	McGraw Hill Publication	-	Module 5
3	"MapReduce Design Patterns: Building Effective Algorithms and Analytics for Hadoop and Other Systems" (Reference)	Adam Shook and Donald Mine	O'Reilly	-	-
4	"Hadoop: The Definitive Guide"	Tom White	O'reilly Media	-	-

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCS/WEB RESOURCE

- https://www.kaggle.com/datasets/grouplens/movielens-20m-dataset
- https://www.youtube.com/watch?v=bAyrObl7TYE&list=PLEiEAq2VkUUJqp1k-g5W1mo37urJQOdCZ
- https://www.youtube.com/watch?v=GG-VRm6XnNk
  https://www.youtube.com/watch?v=JglO2Nv_92A
- https://www.youtube.com/watch?v=VmO0QgPCbZY&list=PLEiEAq2VkUUJqp1kg5W1mo37urJQOdCZ&in dex=4

7. EVALUATION METHODOLOGY

a) Continuous Internal Evaluation (CIE) = 50 marks
b) Semester End Examination (SEE) = 50 marks
Total = 100 marks

CIE and SEE Framework:

Assessment	Actual Weightage in Marks	Final weightage in Marks
CIE 1	50	Avg of 2 CIEs out of 30
CIE 2	50	
AAT	20	20
SEE	100	50
Total		**100**
Grading Consideration		**50% CIE + 50% SEE**

8. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → / COs ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	2	1			1						1
CO2	2	1			1						1
CO3	2	1			1						1
CO4	2	1			1						1
CO5	2	1		1	1						1

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

9. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → / COs ↓	PSO1	PSO2
CO1	1	3
CO2	1	3
CO3	1	3
CO4	1	3
CO5	1	3

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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Department: **DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**		
Semester: **6**	Course Code: **BAD24605C**	Contact Hrs /week: **3**
Course Description: **INTRODUCTION TO MACHINE LEARNING**		No. of Credits:**3** L : T : P : S = **3:0:0:0**
Course Category: **OEC**		Total no. of Hours = **39**
CIE: **50 Marks**	SEE: **50 Marks**	Exam Hours: **03**
Course Pre-requisites: Basic concept of Artificial Intelligence, Introduction to Python programming		

1. PREAMBLE ABOUT THE COURSE

This course bridges foundations with machine learning methodologies, covering key techniques such as regression, classification, and clustering. Through laboratory sessions focused on Python-based model development, students explore performance metrics, validation strategies, and real-world data handling. Emphasis is placed on building interpretable models supported by statistical reasoning, providing practical experience in applying ML techniques to real datasets. This subject serves as a foundational platform for advanced Artificial Intelligence applications.

2. COURSE LEVEL OBJECTIVES

CLO1	To examine and analyse datasets in terms of their features, properties, and characteristics to understand the nature of the problem they represent.
CLO2	To learn and apply appropriate data pre-processing techniques to transform raw data into algorithm-ready formats.
CLO3	To gain a comprehensive understanding of different types of Machine Learning algorithms, their applicability, and the concept of inductive bias.
CLO4	To familiarize students with dimensionality reduction methods and approaches that enhance computational efficiency in machine learning workflows through feature engineering.

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Analyse datasets based on their features, properties, and characteristics to interpret the underlying problem requirements using python	PO1,PO2, PO3,PO4, PO5, PO9,PSO1, POS2	L3	WK3, WK4, WK5	8

CO2	Apply suitable data pre-processing techniques to convert raw data into formats that are appropriate for machine learning algorithms.	PO1,PO2, PO3,PO4, PO5, PO9,PSO1, POS2	L2	WK3, WK4, WK5	8
CO3	Understand the concepts of Missing values, Noise in data & dimensionality techniques to perform data preprocessing	PO1,PO2, PO3,PO4, PO5, PO9,PSO1, POS2	L2	WK3, WK4, WK5	8
CO4	Explore the various types of machine learning algorithms along with their applicability	PO1,PO2, PO3,PO4, PO5, PO9,PSO1, POS2	L2	WK3, WK4, WK5	8
CO5	Apply various feature engineering techniques to real world ML dataset.	PO1,PO2, PO3,PO4, PO5, PO9,PSO1, POS2	L3	WK3, WK4, WK5	7

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	**Basics of Numpy Arrays:** NumPy Array Attributes, Creating nd arrays, Data Types for nd arrays, Basic Indexing and Slicing, Boolean Indexing, Reshaping of Arrays, Statistical Methods, Sorting, Unique and Other Set Logic, **Introduction to pandas Data Structures:** Series, DataFrame, Index Objects Essential Functionality, Reindexing, Dropping Entries from an Axis, Indexing, Selection, and Filtering, Sorting and Ranking, Combining Datasets: Concat, Append, Merge and Join.	CO1	8
II	**Introduction to Machine Learning**: Basic steps of ML, Perspectives and Issues, Designing learning systems, Concepts of hypotheses. Datasets and Partitions, Data Pre-processing and Scaling: Different Pre-processing techniques, Data Integration, Outlier removal, artifact removal, Applying Data Transformations, Scaling Training and Test Data the Same Way, Data Normalization, Data Transformation techniques.	CO2	8
III	**Dealing with Missing Values**: Assumptions and Missing Data Mechanisms, Simple approaches to missing Data, Dealing with Noisy Data: Identifying Noise, Types of Noise Data, Noise filtering at data level. Data Reduction: Curse of Dimensionality, PCA, LDA, Data sampling, Binning	CO3	8
IV	**Introduction to Supervised learning** - Regression Algorithms: Linear Regression, Polynomial Regression, Loss functions, k-Nearest Neighbors (Regression and Classification), Naive Bayes	CO4	8
V	**Feature Engineering**: Feature Extraction, Feature Ranking, Best Features, Feature Selection	CO5	7

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Data preprocessing in Data Mining	Salvador García, JuliánLuengo Francisco Herrera	Springer		1
2	Introduction to Machine Learning with Python	Sarah Guido, Andreas C. Müller	O‘ Reilly	1st Edition 2017	3
3	Data Analytics using Python	Bharti Motwani	Wiley		2
4	Fundamentals of Machine Learning for Predictive Data Analytics: Algorithms	John D. Kelleher, Brian Mac Namee, and Aoife D'Arcy	The MIT Press, 2015		4
5	Introduction to Machine Learning	Ethem Alpaydin	PHI Learning		5

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCS/WEB RESOURCE

- Building Machine Learning Systems with Python http://totoharyanto.staff.ipb.ac.id/files/2012/10/Building Machine-Learning-Systems-with-Python-RichertCoelho.pdf
- Foundations of Machine Learning https://cs.nyu.edu/~mohri/mlbook/
- Understanding Machine Learning: From Theory to Algorithms https://www.cs.huji.ac.il/w~shais/UnderstandingMachineLearning/understanding-machine-learning- theoryalgorithms.pdf
- https://www.coursera.org/learn/machine-learning

7. EVALUATION METHODOLOGY

a) Continuous Internal Evaluation (CIE) = 50 marks
b) Semester End Examination (SEE) = 50 marks
Total = 100 marks

CIE and SEE Framework:

Assessment	Actual Weightage in Marks	Final weightage in Marks
CIE 1	50	Avg of 2 CIEs out of 30
CIE 2	50	
AAT	20	20
SEE	100	50
Total		**100**
Grading Consideration		**50% CIE + 50% SEE**

8. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → / COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	3	2	3				2		
CO2	3	2	3	2	3				2		
CO3	3	2	3	2	3				2		
CO4	3	2	3	2	3				2		
CO5	3	2	3	2	3				2		

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

9. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → / COs ↓	PSO1	PSO2
CO1	2	3
CO2	2	3
CO3	2	3
CO4	2	3
CO5	2	3

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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Department: **DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**		
Semester: **6**	Course Code: **BAD24605D**	Contact Hrs /week: **3**
Course Description: **INTRODUCTION TO ALGORITHMS**		No. of Credits: **3** L : T : P : S = **3: 0:0:0**
Course Category: **OEC**		Total no. of Hours = **39**
CIE: **50 Marks**	SEE: **50 Marks**	Exam Hours: **03**
Course Pre-requisites: Understanding of programming fundamentals		

1. PREAMBLE ABOUT THE COURSE

This course provides a systematic approach to designing efficient algorithms and analyzing their performance using mathematical tools such as asymptotic notation. It introduces major algorithmic paradigms including divide and conquer, decrease and conquer, transform and conquer, greedy strategies, and dynamic programming. Students will learn to apply these techniques to solve real-world computational problems effectively. The course strengthens analytical and problem-solving skills essential for advanced computing domains. By the end, learners will be able to compare, evaluate, and implement optimized algorithms suited for various applications.

2. COURSE LEVEL OBJECTIVES

CLO1	To learn the methods for analyzing algorithms and evaluating their performance.
CLO2	To demonstrate the efficiency of algorithms using asymptotic notations.
CLO3	To solve problems using various algorithm design methods, including brute force, greedy, divide and conquer, decrease and conquer, transform and conquer, dynamic programming, backtracking, and branch and bound.
CLO4	To learn the concepts of P and NP complexity classes.

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Understand the fundamental concepts of algorithms, algorithmic problem-solving techniques, fundamental data structures, and asymptotic notations used for analyzing algorithm efficiency.	PO1, PO2, PO3 PSO1	L2	WK3, WK4	08

CO2	Analyze the efficiency of recursive and non-recursive algorithms and apply brute force approaches such as sorting, searching, and string-matching techniques.	PO1, PO2, PO3 PSO1	L4	WK3, WK4	08
CO3	Analyze the efficiency of recursive and non-recursive algorithms and apply brute force approaches such as sorting, searching, and string-matching techniques.	PO1,PO2, PO3, PO4, PSO1	L4	WK3, WK4	08
CO4	Apply transform-and-conquer techniques, balanced search trees, heaps, hashing, and space-time trade-off strategies for efficient problem solving.	PO1,PO2, PO3, PO4,PO5, PSO1	L3	WK3, WK4	08
CO5	Apply dynamic programming and greedy methods to solve optimization problems such as knapsack, shortest path, and minimum spanning tree.	PO1,PO2, PO3, PO4,PO5, PSO1	L3	WK3, WK4	07

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	**Introduction:** What is an Algorithm? Fundamentals of Algorithmic Problem Solving, Important problem Types, Fundamental Data Structures, Analysis Framework, Asymptotic Notations and Basic Efficiency Classes, Analysis Framework, Asymptotic Notations and Basic Efficiency Classes	CO1	08
II	**Fundamentals Of The Analysis Of Algorithm Efficiency:** Mathematical Analysis of Non-recursive Algorithms, Mathematical Analysis of Recursive Algorithms. **Brute Force Approaches:** Selection Sort and Bubble Sort, Sequential Search and Brute Force String Matching.	CO2	08
III	**Exhaustive Search** (Travelling Salesman problem and Knapsack Problem). Depth First search and Breadth First search. **Decrease-And-Conquer**: Insertion Sort, Topological Sorting. **Divide And Conquer**: Merge Sort, Binary Tree Traversals.	CO3	08
IV	**Transform-And-Conquer**: Balanced Search Trees (AVL Trees), Heaps and Heapsort. **Space-Time Tradeoffs:** Sorting by Counting: Comparison counting sort, Input Enhancement in String Matching: Horspool's Algorithm, Hashing.	CO4	08
V	**Dynamic Programming**: Three basic examples, The Knapsack Problem and Memory Functions. **The Greedy Method:** Kruskal's Algorithm, Dijkstra's Algorithm, Huffman Trees and Codes.	CO5	07

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Introduction to the Design and Analysis of Algorithms	Anany Levitin	Pearson	3rd Edition, 2017	All Modules
2	Introduction to Algorithms	Thomas H. Cormen	PHI	3rd Edition	-
3	Computer Algorithms/C++	Ellis Horowitz, SatrajSahni and Rajasekaran	Universities Press	2nd Edition, 2014	-

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCS/WEB RESOURCE

- Design and Analysis of Algorithms: https://nptel.ac.in/courses/106/101/106101060/

7. EVALUATION METHODOLOGY

a) Continuous Internal Evaluation (CIE) = 50 marks
b) Semester End Examination (SEE) = 50 marks
Total = 100 marks

CIE and SEE Framework:

Assessment	Actual Weightage in Marks	Final weightage in Marks
CIE 1	50	Avg of 2 CIEs out of 30
CIE 2	50	
AAT	20	20
SEE	100	50
Total		**100**
Grading Consideration		**50% CIE + 50% SEE**

8. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → / COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	2								
CO2	3	3	2	2							
CO3	3	3	2	2							
CO4	2	3	2	2	2						
CO5	3	3	2	2	2						

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

9. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → / COs ↓	PSO1	PSO2
CO1	3	1
CO2	3	1
CO3	3	1
CO4	3	1
CO5	3	1

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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Department: **DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**		
Semester: **6**	Course Code: **BADP24606**	Contact Hrs /week: **2**
Course Description: **PROJECT PHASE-1**		No. of Credits:**2** L: T: P: S = **0:0:4:0**
Course Category: **PROJ**		Total no. of Hours = **26**
CIE: **100 Marks**	SEE: -	Exam Hours: -
Course Pre-requisites: Knowledge of programming, Mathematical Foundations, Data Structures and Algorithms (DSA), Machine Learning (ML)		

1. MAJOR PROJECT GUIDELINES

1. The project topic, title and synopsis have to be finalized and submitted to their respective internal guide(s) before the beginning of the 6th semester.

2. The detailed Synopsis (approved by the department Project Review Committee) has to be submitted during the last of 6th semester.

2. COURSE LEVEL OBJECTIVES

CLO1	Acquire the ability to make links across different areas of knowledge and to generate, develop and evaluate ideas and information so as to apply these skills to the project task.
CLO2	Acquire the skills to communicate effectively and to present ideas clearly and coherently to a specific
CLO3	Acquire collaborative skills through working in a team to achieve common goals.
CLO4	Self-learn, reflect on their learning and take appropriate action to improve it.

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Apply knowledge of mathematics, science and engineering to solve respective engineering domain problems.	PO1, PO2, PO3, PO4, PO5,PO6,PO7,PO8, PO9, PO10,PO11, PSO1,PSO2	L3-L4	WK1, WK2, WK3, WK4, WK5, WK6	08
CO2	Design, develop, present and document innovative/multidisciplinary	PO1, PO2, PO3, PO4, PO5,PO6,PO7,PO8,	L2-L4	WK1, WK2, WK3, WK4,	08

	modules for a complete engineering system.	PO9, PO10,PO11, PSO1,PSO2		WK5, WK6	
CO3	Use modern engineering tools, software and equipment to solve problem and engage in life long learning to follow technological developments.	PO1, PO2, PO3, PO4, PO5,PO6,PO7,PO8, PO9, PO10,PO11, PSO1,PSO2	L3-L4	WK1, WK2, WK3, WK4, WK5, WK6	05
CO4	Function effectively as an individual, or leader in diverse teams, with the understanding of professional	PO1, PO2, PO3, PO4, PO5,PO6,PO7,PO8, PO9, PO10,PO11, PSO1,PSO2	L3-L4	WK1, WK2, WK3, WK4, WK5, WK6	05

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. EVALUATION METHODOLOGY

a) Continuous Internal Evaluation (CIE) = 100 marks
Total = 100 marks

5. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → / COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	2	2	3	3	3	3	2	3	1
CO2	3	3	2	2	3	3	3	3	2	3	1
CO3	3	3	2	2	3	3	3	3	2	3	1
CO4	3	3	2	2	3	3	3	3	2	3	1

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

6. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → / COs ↓	PSO1	PSO2
CO1	3	3
CO2	3	3
CO3	3	3
CO4	3	3

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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Department: **DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**		
Semester: **6**	Course Code: **BADL24607**	Contact Hrs /week: **2**
Course Description: **DATA VISUALIZATION LABORATORY**		No. of Credits:**1** L : T : P : S = **0:0:2:0**
Course Category: **LABORATORY**		Total no. of Hours = **13**
CIE: **50 Marks**	SEE: **50 Marks**	Exam Hours: **03**
Course Pre-requisites: Basic Excel		

1. PREAMBLE ABOUT THE COURSE

The Data Visualization Laboratory introduces students to the process of converting raw data into meaningful graphical representations. It provides hands-on practice with visualization tools and dashboard development using platforms like Tableau. Students learn to analyze datasets, choose appropriate visual formats, and present insights clearly for decision-making. The course enhances analytical thinking, creativity, and real-world data interpretation skills.

2. COURSE LEVEL OBJECTIVES

CLO1	To understand the fundamental principles of data visualization and effective information design.
CLO2	To develop hands-on skills in creating charts, reports, and dashboards using modern visualization tools.
CLO3	To apply analytical techniques for interpreting datasets and deriving meaningful insights.
CLO4	To illustrate data-driven results clearly through interactive and visually compelling presentations.

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Apply core Tableau concepts such as measures, calculated fields, parameters, joins, and data extracts to prepare and structure datasets for visualization.	PO1,PO2,PO3,PO4, PO5 ,PO9,PO11,PSO1, PSO2	L3	WK3, WK4, WK5	3
CO2	Implement data manipulation techniques including filtering,	PO1,PO2,PO3,PO4, PO5	L3	WK3, WK4, WK5	3

	grouping, aliasing, and set creation to derive meaningful insights from datasets.	,PO9,PO11,PSO1, PSO2			
CO3	Evaluate and optimize visualizations using formatting, analytics features, storytelling techniques, and best design practices to enhance clarity and effectiveness.	PO1,PO2,PO3,PO4, PO5 ,PO9,PO11,PSO1, PSO2	L3	WK3, WK4, WK5	2
CO4	Analyze datasets using advanced visualization techniques such as maps, reference lines, trend analysis, forecasting, and clustering to identify patterns and relationships	PO1,PO2,PO3,PO4, PO5 ,PO9,PO11,PSO1, PSO2	L4	WK3, WK4, WK5	2
CO5	Design and develop interactive dashboards by integrating multiple visualizations and implementing dashboard actions to communicate data-driven insights effectively.	PO1,PO2,PO3,PO4, PO5 ,PO9,PO11,PSO1, PSO2	L4	WK3, WK4, WK5	2

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Sl. No.	Experiments/Programs
1	Demonstrate the use of Measure Names and Measure Values in Tableau using the given dataset.
2	Demonstrate the creation and usage of Calculated Fields in Tableau using the given dataset.
3	Illustrate the application of Parameters in Tableau using the given dataset.
4	Explain and demonstrate Joins and Data Extract techniques in Tableau using the given dataset.
5	Demonstrate Data Filtering methods in Tableau using the given dataset.
6	Illustrate Grouping, Aliasing, and Set creation in Tableau using the given dataset.
7	Illustrate the process of plotting Pie Charts on a Map in Tableau.
8	Demonstrate the use of Reference Lines, Trend Lines, and Forecasting features in Tableau using the given dataset.
9	Illustrate clustering functionality in Tableau using the given dataset.
10	Demonstrate the creation of Dashboards and implementation of Dashboard Actions in Tableau.

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Experiments Covered
1	Practical Tableau: 100 Tips, Tutorials, and Strategies from a Tableau Zen Master	Ryan Sleeper	O'Reilly Media	2nd Edition, 2023.	1,2,3
2	Storytelling with Data: A Data Visualization Guide for Business Professionals	Cole Nussbaumer Knaflic	Wiley	2nd Edition, 2020	7,8
3	Learning Tableau 2025	Joshua N. Milligan	Packt Publishing	6th Edition, 2025.	4,5,6
4	Communicating Data with Tableau	Ben Jones	O'Reilly Media	1st Edition, 2021.	9,10

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCS/WEB RESOURCE]

- https://www.coursera.org/learn/datavisualization.
- https://freevideolectures.com/course/4041/nptel-introduction-to-learning-analytics/11
- https://www.edx.org/course/data-visualization-for-all
- https://www.udemy.com/course/the-complete-data-visualization-course/

7. EVALUATION METHODOLOGY

a) Continuous Internal Evaluation (CIE) = 50 marks
b) Semester End Examination (SEE) = 50 marks
Total = 100 marks

CIE Framework:

ASSESSMENT AND EVALUATION PATTERN		
	CIE	**SEE**
WEIGHTAGE	**50%**	**50%**
Record	10	**50**
Test	20	
Experiential Learning (Dashboard Creation)	20	NIL
Total Marks for the Course	**50**	**50**

8. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → / COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3	2	2				2		2
CO2	3	3	3	2	2				2		2
CO3	3	3	3	2	2				2		2
CO4	3	3	3	2	2				2		2
CO5	3	3	3	2	2				2		2

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

9. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → / COs ↓	PSO1	PSO2
CO1	2	2
CO2	2	2
CO3	2	2
CO4	2	2
CO5	2	2

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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Global Academy of Technology

(An Autonomous Institution, affiliated to VTU, Belagavi, recognized by Karnataka and Approved by AICTE, New Delhi.)

B.E. in Artificial Intelligence and Data Science

Scheme of Teaching and Examinations (AY 2024-25)

VII SEMESTER

Sl. No	Course	Course Code	Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
					Theory Lecture	Tutorial	Practical\ Drawing	SDA	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	IPCC	BAD24701	Natural Language Processing	TD & PSB: AIDS	3	0	2	0	03	50	50	100	4
2	IPCC	BAD24702	Prompt Engineering	TD & PSB: AIDS	3	0	2	0	03	50	50	100	4
3	PCC	BAD24703	Deep Learning for Computer Vision	TD & PSB: AIDS	3	0	0	0	03	50	50	100	3
4	PEC	BAD24704X	Professional Elective Course III	TD & PSB: AIDS	3	0	0	0	03	50	50	100	3
5	OEC	BAD24705X	Open Elective Course II	TD & PSB: AIDS	3	0	0	0	03	50	50	100	3
6	PROJ	BADP24706	**Major Project Phase-II**	TD & PSB: AIDS	0	0	14	0	03	100	100	200	7
										350	**350**	**700**	**24**

Professional Elective Course III

BAD24704A	Generative AI	BAD24704C	Parallel Programming
BAD24704B	AI in Cybersecurity	BAD24704D	UI/UX Design

Open Elective Course II

BAD24705A	Data Visualization	BAD24705C	Business Intelligence
BAD24705B	Introduction to NLP	BAD24705D	Data Security and Privacy

PCC: Professional Core Course, **PCCL**: Professional Core Course laboratory, **PEC**: Professional Elective Course, **OEC**: Open Elective Course PR: Project Work, **L:** Lecture, **T**: Tutorial, **P**: Practical **S= SDA**: Skill Development Activity, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation. **TD-** Teaching Department, **PSB**: Paper Setting department, **OEC**: Open Elective Course, **PEC**: Professional Elective Course. **PROJ**: Project work

Note: VII and VIII semesters of IV years of the program

(1) Institutions can swap the VII and VIII Semester Schemes of Teaching and Examinations to accommodate research internships/ industry internships after the VI semester.

(2) Credits earned for the courses of VII and VIII Semester Scheme of Teaching and Examinations shall be counted against the corresponding semesters whether the VII or VIII semesters is completed during the beginning of the IV year or the later part of IV years of the program.

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Global Academy of Technology

(An Autonomous Institution, affiliated to VTU, Belagavi, recognized by Karnataka and Approved by AICTE, New Delhi.)

B.E. in Artificial Intelligence and Data Science

Scheme of Teaching and Examinations (AY 2024-25)

VIII SEMESTER

Sl. No	Course	Course Code	Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	SDA	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	PEC	BAD24801X	Professional Elective (Online Courses) IV	TD & PSB: AIDS	3	0	0	0	03	50	50	100	3
2	PEC	BAD24802X	Professional Elective (Online Courses) V	TD & PSB: AIDS	3	0	0	0	03	50	50	100	3
3	INT	BAD24803	Internship (Industry/Research) (14 - 20 weeks)	TD & PSB: AIDS	0	0	12	0	03	100	100	200	10
										200	**200**	**400**	**16**

Professional Elective Course IV

BAD24801A	Generative AI for Computer Vision	BAD24801C	Cyber Security and Privacy
BAD24801B	Scalable Data Science	BAD24801D	Reinforcement Learning

Professional Elective Course V

BAD24802A	Responsible & Safe AI Systems	BAD24802C	Social Networks
BAD24802B	Introduction to Large Language Models (LLMs)	BAD24802D	Ethical Hacking

L: Lecture, **T**: Tutorial, **P**: Practical **S= SDA**: Skill Development Activity, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation. **TD-** Teaching Department, **PSB**: Paper Setting department, **OEC**: Open Elective Course, **PEC**: Professional Elective Course. **PROJ**: Project work, **INT**: Industry Internship / Research Internship / Rural Internship

Note: VII and VIII semesters of IV years of the program

Swapping Facility

- Institutions can swap VII and VIII Semester Scheme of Teaching and Examinations to accommodate **research internships/ industry internships/Rural Internship** after the VI semester.
- Credits earned for the courses of VII and VIII Semester Scheme of Teaching and Examinations shall be counted against the corresponding semesters whether VII or VIII semester is completed during the beginning of IV year or later part of IV year of the program.

Elucidation:

Head of the Department
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Bengaluru - 560 098

12/6/25

Dean Academic
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At the beginning of IV years of the program i.e., after VI semester, VII semester classwork and VIII semester **Research Internship /Industrial Internship / Rural Internship** shall be permitted to be operated simultaneously by the University so that students have ample opportunity for an internship. In other words, a good percentage of the class shall attend VII semester classwork and a similar percentage of others shall attend to Research Internship or Industrial Internship or Rural Internship.

Research/Industrial /Rural Internship shall be carried out at an Industry, NGO, MSME, Innovation center, Incubation centre, Start-up, centre of Excellence (CoE), Study Centre established in the parent institute and /or at reputed research organizations/institutes.

The mandatory Research internship /Industry internship / Rural Internshipis for 14 to 20 weeks. The internship shall be considered as a head of passing and shall be considered for the award of a degree. Those, who do not take up/complete the internship shall be declared to fail and shall have to complete it during the subsequent University examination after satisfying the internship requirements.

Research internship: A research internship is intended to offer the flavor of current research going on in the research field. It helps students get familiarized with the field and imparts the skill required for carrying out research.

Industry internship: Is an extended period of work experience undertaken by students to supplement their degree for professional development. It also helps them learn to overcome unexpected obstacles and successfully navigate organizations, perspectives, and cultures. Dealing with contingencies helps students recognize, appreciate, and adapt to organizational realities by tempering their knowledge with practical constraints.

Rural Internship: Rural development internship is an initiative of Unnat Bharat Abhiyan Cell, RGIT in association with AICTE to involve students of all departments studying in different academic years for exploring various opportunities in techno-social fields, to connect and work with Rural India for their upliftment.

The faculty coordinator or mentor has to monitor the student's internship progress and interact with them to guide for the successful completion of the internship.

The students are permitted to carry out the internship anywhere in India or abroad. University shall not bear any expenses incurred in respect of the internship.

With the consent of the internal guide and Principal of the Institution, students shall be allowed to carry out the internship at their hometown (**within or outside the state or abroad**), provided favorable facilities are available for the internship and the student remains regularly in contact with the internal guide. **University shall not bear any cost involved in carrying out the internship by students.** However, students can receive any financial assistance extended by the organization.

Professional Elective /Open Elective Course: These are ONLINE courses suggested by the respective Board of Studies. Details of these courses shall be made available for students on the VTU web portal.

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Department: **DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**		
Semester: **7**	Course Code: **BAD24701**	Contact Hrs /week: **3**
Course Description: **Natural Language Processing**		No. of Credits: **4** L : T : P : S = **3:0:2:0**
Course Category: **IPCC**		Total no. of Hours = **52**
CIE: **50 Marks**	SEE: **50 Marks**	Exam Hours: **03**
Course Pre-requisites: Foundational knowledge in Data Science with Python, Machine Learning I, and Machine Learning II		

1. PREAMBLE ABOUT THE COURSE

Natural Language Processing (NLP) is a rapidly evolving field that enables computers to understand, interpret, and generate human language. This course introduces students to the fundamental concepts, techniques, and applications of NLP, including text preprocessing, language modeling, word embeddings, syntactic analysis, and information extraction. It also explores real-world applications such as sentiment analysis, text classification, machine translation, dialog systems, and ethical considerations in building responsible NLP systems, preparing students to apply NLP methods in modern AI and data-driven applications.

2. COURSE LEVEL OBJECTIVES

CLO1	To learn the fundamentals of natural language processing.
CLO2	To understand the working of Language based models and apply word embedding algorithms.
CLO3	To understand the role of semantics of sentences and pragmatics and apply them in NER.
CLO4	To perform sentiment analysis and text classification.
CLO5	Facilitate project-based opportunities under machine translation, dialog systems and ethical considerations in NLP.

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Understand NLP foundations, text processing techniques, and practical applications.	PO1,2,3,4,5,6,7,11 PSO1,PSO2	L2	WK3 ,WK 4	8
CO2	Apply diverse language models, embeddings; adapt in practical applications.	PO1,2,3,4,5,6,7,11 PSO1,PSO2	L3	WK3 ,WK 4	8

CO3	Implement tagging, parsing, Named Entity Recognition techniques.	PO1,2,3,4,5,6,7,11 PSO1,PSO2	L3	WK3 ,WK 4	8
CO4	Perform classical NLP, sentiment analysis, text classification, and summarization.	PO1,2,3,4,5,6,7,11 PSO1,PSO2	L3	WK3 ,WK 4	8
CO5	Obtain competence in machine translation, dialog systems, and ethical NLP practices.	PO1,2,3,4,5,6,7,11 PSO1,PSO2	L2	WK3 ,WK 4	7

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	**Introduction to NLP and Text Processing:** Definition and scope of NLP, Historical overview and milestones in NLP, Components of NLP, NLP applications, Phases of NLP, Tokenization, Stemming, Lemmatization, Stop word removal, Zipf's law, Punctuation handling, Text normalization, Case conversion.	CO1	8
II	**Language Modeling:** Bag of Words, Bag of N-grams, TF-IDF, Hashing with HashingVectorizer, Split words, Encoding with one_hot, Hash encoding, N-gram models and language probability. **Word embeddings:** Word2Vec, Training word embeddings, Applications of word embeddings, Word embedding algorithms, CBOW, Skip-Gram, GloVe, reuse an embedding, Gensim Python Library, Plot word vectors using PCA.	CO2	8
III	**Syntax, Parsing:** Part-of-speech tagging, Dependency parsing and constituency parsing, Parsing algorithms and techniques. **Named Entity Recognition:** Introduction to NER, NER techniques and tools, Applications of NER in information extraction.	CO3	8
IV	**Applied NLP:** Classical NLP pipeline, Sentiment analysis applications in social media and reviews, Text classification methods, Interpreting Text Classification models, Text summarization.	CO4	8
V	**Machine Translation and Dialog Systems:** Introduction to machine translation, Statistical and neural machine translation, Types of dialog systems, Introduction to chatbots and virtual assistants **NLP Ethics and Bias:** Ethical considerations, Fairness, Accountability, Multilingual NLP	CO5	8

Lab Programs (Hours:13):

Prog. No.	Lab Programs
1	Write a Python program to demonstrate Lemmatization and Stemming
2	Write a program to implement TF-IDF technique and demonstrate Word2vec embedding.
3	Write a program for implementing POS tagging and Named Entity Recognition using NLTK.
4	Write a program for spam detection using NLTK.
5	Write a program to demonstrate Neural machine translation with attention.
6	Write a program to build an NLP classifier which can use input text parameters to determine the label/s of the blog.
7	Write a program to design and test a sequential model that analyses the customer's sentiments based on their reviews in the IMDB database.
8	Write a program to implement transfer learning, paraphrasing from iNLTK.

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Deep Learning for Natural Language Processing	Jason Brownlee	Machine Learning Mastery	-	01,02,03
2	Practical Natural Language Processing	Sowmya Vajjala, Bodhisattwa Majumder, Anuj Gupta, Harshit Surana	O'Reilly Media	-	04, 05
3	Natural Language Processing with Python (Reference Book)	Steven Bird, Ewan Klein, Edward Loper	O'Reilly Media	-	01, 02, 04
4	Speech and Language Processing (Reference Book)	Daniel Jurafsky, James H. Martin	Pearson Prentice Hall	-	03, 04, 05

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCS/WEB RESOURCE)

- https://onlinecourses.nptel.ac.in/noc19_cs56/preview
- https://www.udemy.com/course/data-science-natural-language-processing-in-python/
- https://www.coursera.org/specializations/natural-language-processing

7. EVALUATION METHODOLOGY

a) Continuous Internal Evaluation (CIE) = 50 marks
b) Semester End Examination (SEE) = 50 marks
Total = 100 marks

CIE and SEE Framework:

Assessment	Actual Weightage in Marks	Final weightage in Marks
CIE 1	50	Avg of 2 CIEs out of 25
CIE 2	50	
AAT	10	10
LAB	30	15
SEE	100	50
Total		**100**
Grading Consideration		**50% CIE + 50% SEE**

8. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → / COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	3	1	2	3	3				3
CO2	3	2	2	2	2	3	3				3
CO3	3	2	3	1	2	3	2				3
CO4	3	2	2	2	2	3	3				3
CO5	3	2	2	2	2	3	2				3

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

9. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → / COs ↓	PSO1	PSO2
CO1	2	3
CO2	2	3
CO3	2	3
CO4	2	3
CO5	2	3

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

*****

Department: **DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**		
Semester: **7**	Course Code: **BAD24702**	Contact Hrs /week: 3
Course Description: **PROMPT ENGINEERING**		No. of Credits:**4** L : T : P : S = **3:0:0:0**
Course Category: **IPCC**		Total no. of Hours = **39**
CIE: **50 Marks**	SEE: **50 Marks**	Exam Hours: **03**
Course Pre-requisites: Basic understanding of Artificial Intelligence concepts and familiarity with programming and Natural Language Processing fundamentals.		

1. PREAMBLE ABOUT THE COURSE

Prompt Engineering is an emerging discipline that focuses on designing effective prompts to guide Large Language Models (LLMs) in generating accurate and relevant responses. This course provides foundational knowledge and practical strategies for crafting prompts for various tasks such as text generation, summarization, question answering, and reasoning. It also explores advanced prompting techniques, real-world applications, ethical issues, and future directions of AI-driven systems.

2. COURSE LEVEL OBJECTIVES

CLO1	Describe the principles and concepts underlying prompt engineering.
CLO2	Design and formulate effective prompts for various AI models to achieve desired outputs
CLO3	Analyse and assess the performance of different prompts to improve the quality and reliability of AI-generated outputs.
CLO4	Apply prompt engineering techniques to solve real-world problems in various domains.

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Understand basics of prompt engineering principles including how prompt structure and phrasing impacts the performance of AI models.	PO1, PO2	Understand (L2)	WK3, WK4	8
CO2	Design and implement effective prompts for NLP tasks such as text generation, summarization, and translation using AI models.	PO2, PO3	L3	WK3, WK4	8
CO3	Critically evaluate the effectiveness of prompts assess the quality and performance of prompts in terms of accuracy,	PO4	L4	WK3, WK4	8

	coherence, and relevance, identifying areas for improvement.				
CO4	Applying prompt engineering to solve real-world problems in education, healthcare, and business using AI	PO3, PO5	L3	WK3, WK4	8
CO5	Collaborate in teams to design, implement, and evaluate prompt-based AI solutions for real-world projects.	PO9, PSO1	L3	WK3, WK4	7

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	**Introduction to Prompt Engineering** Raise of Context Learning, Prompts, Prompt Engineering, LLM Settings, Basics of prompting, Elements of a Prompt, Settings for Prompting Language Model , General Tips for Designing Prompts, Designing Prompts for Different Tasks: few examples of common tasks using different prompts- Text Summarization, Information Extraction, Question Answering, Text Classification, Conversation/Role Playing, Code Generation, Reasoning	CO1	8
II	**Techniques for Effective Prompts** Techniques designed to improve performance on complex tasks - Zero-Shot Prompting, Few-shot prompting,Chain-of-thought (CoT) prompting, Zero-Shot CoT, Self-Consistency, Knowledge Generation Prompting, Program-aided Language Model (PAL), ReAct, Directional Stimulus Prompting	CO2	8
III	**Best Practices in Prompt Engineering Tools & IDEs** Capabilities include: Developing and experimenting with prompts, Evaluating prompts. Versioning and deploying prompts; Advanced prompting techniques: advanced applications with LLMs. LLMs and external tools/APIs -- LLMs with External Tools; Data-augmented Generation – Steps, External Data, QA with sources, Summarization using sources	CO3	8
IV	**Applications of Prompt Engineering: LLM Applications:** Function Calling with LLMs - Getting Started with Function Calling, Function Calling with GPT-4, Function Calling with Open-Source LLMs. Function Calling Use Cases: Conversational Agents, Natural Language Understanding, Math Problem Solving, API Integration, Information Extraction.	CO4	8
V	**Opportunities and Future Directions** Model safety, Prompt Injection, Prompt Leaking, Jail Breaking; Reinforcement Learning from Human Feedback (RLHF) -- Popular examples: aClaude (Anthropic), ChatGPT (OpenAI), **Future directions:** Augmented LMs, Emergent ability of LMs, Acting / Planning - Reinforcement Learning, Multimodal Prompting, Graph Prompting.	CO5	7

Lab Programs (Hours:13):

Sl.No	Experiment
1	**Basic Prompt Construction** Design and test basic prompts to generate text responses and observe how prompt wording affects the output of a Large Language Model.
2	**Text Summarization using LLMs** Create prompts to summarize a given article or paragraph into concise summaries or bullet points.
3	**Information Extraction using Prompts** Design prompts to extract specific information (such as names, dates, or key facts) from a given text document.
4	**Few-Shot Prompting for Text Classification** Provide example inputs and outputs within the prompt to guide the model in classifying text into predefined categories.
5	**Chain-of-Thought Prompting for Reasoning Tasks** Use step-by-step prompts to solve logical or mathematical problems and analyze the reasoning generated by the model.
6	**Prompt Evaluation and Optimization** Compare multiple prompts for the same task and refine them to improve accuracy, relevance, and clarity of the AI-generated responses.
7	**Role-Based Prompting** Design prompts by assigning roles to the AI model (e.g., teacher, software engineer, data analyst) and observe how the responses change based on the role specified.
8	**Prompting for Code Generation** Create prompts to generate simple programs (e.g., Python code for sorting numbers or calculating factorial) and evaluate the correctness and clarity of the generated code.

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Unlocking the Secrets of Prompt Engineering: Master the art of creative language generation to accelerate your journey from novice to pro	Gilbert Mizrahi, Jan 2024	Packt Publishing	1st Edition, ISBN-13:978-1835083833	1,2
2	Prompt Engineering for Generative AI	James Phoenix, Mike Taylor	O'Reilly Media,	May 2024, Inc.,ISBN: 9781098153434	3,4,5
3	The Art of Asking ChatGPT for High-Quality Answers_ A Complete Guide to Prompt Engineering	Ibrahim John , Nzunda	Technologies Limited,	2023, ISBN-13: 9781234567890	1,2,3

4	Programming Large Language Models with Azure Open AI: Conversational programming and prompt engineering with LLMs	Francesco Esposito	Microsoft Pr	1st Edition, April 2024, ISBN-13: 978-0138280376	4,5

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCS/WEB RESOURCE

- Prompt Engineering Guide – https://www.promptingguide.ai
- DeepLearning.AI – ChatGPT Prompt Engineering for Developers (Coursera)
- OpenAI Documentation – https://platform.openai.com/docs
- Google Prompt Engineering Whitepapers and Research Articles
- Hugging Face Transformers Documentation – https://huggingface.co/docs

7. EVALUATION METHODOLOGY

a) Continuous Internal Evaluation (CIE) = 50 marks
b) Semester End Examination (SEE) = 50 marks
Total = 100 marks

CIE and SEE Framework:

Assessment	Actual Weightage in Marks	Final weightage in Marks
CIE 1	50	Avg of 2 CIEs out of 25
CIE 2	50	
AAT	10	10
LAB	30	15
SEE	100	50
Total		**100**
Grading Consideration		**50% CIE + 50% SEE**

8. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → / COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2									
CO2	2	3	3		2						
CO3		3		3							
CO4		2	3		3						
CO5			2						3	2	

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

9. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → / COs ↓	PSO1	PSO2
CO1	2	3
CO2	2	3
CO3	2	3
CO4	2	3
CO5	2	3

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

*****

Department: **DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**		
Semester: **7**	Course Code: **BAD24703**	Contact Hrs /week: **3**
Course Description: **DEEP LEARNING FOR COMPUTER VISION**		No. of Credits:**3** L:T:P:S = **3:0:0:0**
Course Category: **PCC**		Total no. of Hours = **39**
CIE:**50 Marks**	SEE:**50 Marks**	Exam Hours: **03**
Course Pre-requisites: Basic knowledge of Image Processing & Deep Learning		

1. PREAMBLE ABOUT THE COURSE

This course introduces students to the fundamental concepts and techniques in computer vision and generative AI. It covers core theories, models, and methodologies used for visual data analysis and intelligent image processing. Students will learn how modern AI techniques such as diffusion models, generative AI, and deep learning architectures are applied to solve real-world problems like object detection and face recognition. The course also provides hands-on understanding of advanced models such as R-CNN and YOLO, enabling students to build systems capable of identifying objects, detecting faces, and performing visual recognition tasks. Through this course, students gain both theoretical knowledge and practical skills required to develop modern AI-based vision applications.

2. COURSE LEVEL OBJECTIVES

CLO1	To impart the fundamentals of image formation, the major ideas, methods, and techniques of computer vision and pattern recognition
CLO2	To understand the workings of Generative AI and the diffusion models.
CLO3	To develop an appreciation for various techniques of Computer Vision for Object detection and Face Recognition systems
CLO4	To provide the student with programming experience from implementing computer vision and object recognition applications.

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Understand the basic concepts, terminology, theories, models, and methods in the field of computer vision.	PO1, PO2, PO3,PO4, PO5, PO6, PO9,PO11 PSO1,PSO2	L2	WK3, WK4	8
CO2	Apply Generative AI for text and image applications.	PO1, PO2, PO3,PO4, PO5, PO6, PO9,PO11 PSO1,PSO2	L3	WK3, WK4	8

CO3	Apply diffusion models to understand the working of removal of noise.	PO1, PO2, PO3,PO4, PO5, PO6, PO9,PO11 PSO1,PSO2	L3	WK3, WK4	8
CO4	Apply state-of-the-art architectures such as R-CNN and YOLO for object detection.	PO1, PO2, PO3,PO4, PO5, PO6, PO9,PO11 PSO1,PSO2	L3	WK3, WK4	8
CO5	Demonstrate the face recognition concepts in detecting photography, face identification, and face classification.	PO1, PO2, PO3,PO4, PO5, PO6, PO9,PO11 PSO1,PSO2	L3	WK3, WK4	7

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	**Introduction to Computer Vision Basic concepts**: pixel representation of an image, Image in frequency domain, different color models, and their transformation, Filtering and Convolution, Image preprocessing using PIL/Pillow, OpenCV, and Keras: reading multiple images from a directory, plotting, enhancement, filtering, re-scaling, morphological operations and image data augmentation.	CO1	8
II	**Object Detection Basic concepts**: bounding box representation, sliding window methods, anchor boxes, grid cells, and non-maximum suppression (NMS). State-of-the-art architectures: R CNN and YOLO. Evaluation metrics: Intersection over Union (IoU) and Mean Average Precision (mAP), Practical use case.	CO4	8
III	**Generative AI Models**: Introduction to Gen AI, Types, Variational Autoencoders and GANs (Variations of GANs – cGAN, wGAN, cyclic GAN, style tranfers using GAN), difference between VAEs & GANs, Image Captioning – LSTMs based, Transformers based.	CO2	8
IV	**Normalizing Flows and Diffusion Models**: Diffusion process, Forward Diffusion, Reverse Diffusion, Training a diffusion model, Architecture, Guided Diffusion, Stable diffusion, Sampling Procedure, Practical Implementation.	CO3	8
V	**Face Recognition**: Deep learning for face recognition: face detection in photographs, face identification & verification using VGGFace2, and face classification using FaceNet. Practical use case. Challenges: privacy and ethical considerations, variability in pose, expression, lightning, and occlusion.	CO5	7

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Deep learning for Computer Vision by Jason Brownlee.	Jason Brownlee	Machine Learning Mastery	1st	Module 1,2,3,4,5

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCS/WEB RESOURCE

- **NPTEL:** Deep Learning for Computer Vision – https://nptel.ac.in
- **SWAYAM:** Artificial Intelligence and Deep Learning courses – https://swayam.gov.in
- **MOOC:** Convolutional Neural Networks by Andrew Ng – https://www.coursera.org
- **Web Resource:** OpenCV Computer Vision Tutorials – https://opencv.org
- **Web Resource:** YOLO Object Detection Documentation – https://docs.ultralytics.com

7. EVALUATION METHODOLOGY

a) Continuous Internal Evaluation (CIE) = 50 marks
b) Semester End Examination (SEE) = 50 marks
Total = 100 marks

CIE and SEE Framework:

Assessment	Actual Weightage in Marks	Final weightage in Marks
CIE 1	50	Avg of 2 CIEs out of 30
CIE 2	50	
AAT	20	20
SEE	100	50
Total		**100**
Grading Consideration		**50% CIE + 50% SEE**

8. COURSE OUTCOMES& PROGRAM OUTCOMES MAPPING

POs → / COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	2	2	3	3	2			3		3
CO2	2	2	2	3	3	2			3		3
CO3	3	2	3	3	3	2			3		3
CO4	3	2	3	3	3	2			3		3
CO5	3	3	3	3	3	3			3		3

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

9. COURSE OUTCOMES& PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → / COs ↓	PSO1	PSO2
CO1	2	3
CO2	2	3
CO3	2	3
CO4	2	3
CO5	2	3

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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Department: **DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**		
Semester: **7**	Course Code: **BAD24704A**	Contact Hrs /week:**3**
Course Description: **GENERATIVE AI**		No. of Credits:**3** L : T : P : S = **3:0:0:0**
Course Category: **PEC**		Total no. of Hours = **39**
CIE: **50 Marks**	SEE: **50 Marks**	Exam Hours: **03**
Course Pre-requisites: Basic knowledge of Python programming, linear algebra, probability, and fundamental machine learning concepts		

1. PREAMBLE ABOUT THE COURSE

Generative Artificial Intelligence focuses on creating new data such as text, images, audio, and video using machine learning models. The course introduces the principles and techniques of generative models including VAEs, GANs, Diffusion Models, and Large Language Models. Students learn how these models are designed and trained for various applications. The course also discusses real-world uses of generative AI in different domains. Ethical aspects such as bias, fairness, and responsible AI are also highlighted. By the end of the course, students gain knowledge of implementing generative AI techniques.

2. COURSE LEVEL OBJECTIVES

CLO1	Understand the fundamental concepts, architectures, and principles of generative artificial intelligence.
CLO2	Develop the ability to design and implement generative AI models using modern deep learning techniques.
CLO3	Analyze the applications of generative AI models in solving real-world problems across different domains.
CLO4	Examine ethical issues, bias, and fairness considerations in the development and deployment of generative AI systems.

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Understand the concepts, principles, and applications of Generative Artificial Intelligence and Large Language Models.	PO1,PO2,PO3,PO4,PO5,PO7,PO11,PSO1,PSO2	L2	WK3, WK4	8

CO2	Apply Autoencoders and Variational Autoencoders for generative data modeling.	PO1,PO2,PO3,PO4,PO5,PO7,PO11,PSO1,PSO2	L3	WK3, WK4	8
CO3	Apply Generative Adversarial Networks, CycleGAN, and Neural Style Transfer techniques.	PO1,PO2,PO3,PO4,PO5,PO7,PO11,PSO1,PSO2	L3	WK3, WK4	8
CO4	Develop Diffusion Models and Energy-Based Models for data generation tasks.	PO1,PO2,PO3,PO4,PO5,PO7,PO11,PSO1,PSO2	L3	WK3, WK4	8
CO5	Apply the concept of bias, fairness, and ethical considerations in the design and deployment of Generative AI systems.	PO1,PO2,PO3,PO4,PO5,PO7,PO11,PSO1,PSO2	L3	WK3, WK4	7

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	**Generative Modeling:** What Is Generative Modeling? Historical perspective on Generative AI, Generative Versus Discriminative Modeling, The Rise of Generative Modeling, Generative Modeling and Al, Our First Generative Model, The Generative Modeling Framework, Representation Learning	CO1	8
II	**Variational Autoencoders:** Introduction, Autoencoders, The Autoencoder Architecture, the Encoder, The Decoder, Joining the Encoder to the Decoder, Variational Autoencoder, The Encoder, The Loss Function, Analysis of the Variational Autoencoder, Training the VAE, Analysis of the VAE, Generating New Faces, Latent Space Arithmetic, Morphing Between Faces	CO2	8
III	**Generative Adversarial Networks:** Introduction to GAN (GAN), Deep Convolutional GAN (DCGAN), The Bricks Dataset, The Discriminator, The Generator, Training the DCGAN, Analysis of the DCGAN, GAN Training: Tips and Tricks, Wasserstein GAN with Gradient Penalty (WGAN-GP), Wasserstein Loss, The Lipschitz Constraint Enforcing the Lipschitz Constraint. The Gradient Penalty Loss, Training the WGAN-GP, Analysis of the WGAN-GP	CO3	8
IV	**Diffusion Models:** Introduction, Denoising Diffusion Models (DDM), The Flowers Dataset, The Forward Diffusion Process, The Reparameterization Trick, Diffusion Schedules, the Reverse Diffusion Process. The U-Net Denoising Model, Training the Diffusion Model Sampling from the Denoising Diffusion Model, Analysis of the Diffusion Model	CO4	8
V	**Bias and Fairness in Generative AI:** Understanding Bias in AI Types of biases (algorithmic, data, societal) Fairness Metrics Statistical parity, equal opportunity, disparate impact Mitigation Strategies Pre-processing, in-processing, and post-processing techniques Ethical Design and Deployment of Generative AI	CO5	7

	Ethical AI Design Principles Human-centered design, ethical by design Deployment Challenges Real-world implementation, monitoring, and feedback loops Responsible AI Frameworks Guidelines and best practices for ethical deployment		

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play	David Foste	O'Reilly Media.	2nd Edition, 2023	1,2,3,4
2	Deep Learning	Ian Good fellow, Yoshua Bengio, and Aaron Courville	MIT Press	2nd Edition 2016	-
3	Fairness and Machine Learning: Limitations and Opportunities	Solon Barocas, Moritz Hardt, Arvind Narayanan	MIT Press	2nd Edition, 2023	5
4	Responsible Artificial Intelligence: How to Develop and Use AI in a Responsible Way	Virginia Dignum	MIT Press	1st Edition, 2021	-

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCS/WEB RESOURCE

- NPTEL – Deep Learning https://nptel.ac.in/courses/106106184
- Coursera – Generative AI Specialization https://www.coursera.org
- Google Generative AI Learning Path https://developers.google.com/learn
- OpenAI Documentation and Tutorials https://platform.openai.com/docs
- MIT OpenCourseWare – Deep Learning https://ocw.mit.edu

7. EVALUATION METHODOLOGY

a) Continuous Internal Evaluation (CIE) = 50 marks
b) Semester End Examination (SEE) = 50 marks
Total = 100 marks

CIE and SEE Framework:

Assessment	Actual Weightage in Marks	Final weightage in Marks
CIE 1	50	Avg of 2 CIEs out of 30
CIE 2	50	
AAT	20	20
SEE	100	50
Total		**100**
Grading Consideration		**50% CIE + 50% SEE**

8. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → / COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	3	3	3	2		2				2
CO2	2	3	3	3	2		2				2
CO3	2	3	3	3	2		2				2
CO4	2	3	3	3	2		2				2
CO5	2	3	3	3	2		2				2

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

9. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → / COs ↓	PSO1	PSO2
CO1	2	2
CO2	2	2
CO3	2	2
CO4	2	2
CO5	2	2

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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Department: **DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**		
Semester: **7**	Course Code: **BAD24704B**	Contact Hrs /week:**3**
Course Description: **AI IN CYBER SECURITY**		No. of Credits:**3** L : T : P : S = **3:0:0:0**
Course Category: **PEC**		Total no. of Hours = **39**
CIE: **50 Marks**	SEE: **50 Marks**	Exam Hours: **03**
Course Pre-requisites: Basic knowledge of Machine Learning concepts, Fundamentals of Computer Networks, Basic understanding of Cyber Security concepts, Knowledge of Python programming and data analysis		

1. PREAMBLE ABOUT THE COURSE

This course introduces the application of Artificial Intelligence and Machine Learning techniques in the field of Cyber Security. It focuses on identifying cyber threats such as malware, network attacks, and system vulnerabilities using intelligent models. Students will learn malware classification, intrusion detection systems, anomaly detection, and security threats against machine learning systems. The course also covers adversarial attacks and modern research trends in AI-based cyber defense systems.

2. COURSE LEVEL OBJECTIVES

CLO1	Students will be able to develop ML models to classify malwares.
CLO2	Able to implement simple intrusion detection systems using deep neural networks.
CLO3	They will be able to demonstrate the vulnerabilities in ML systems and state methods to address adversarial attacks.
CLO4	Students will be able to analyze cyber security threats and apply AI techniques for anomaly detection and cyber defense

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Understand the fundamentals of machine learning and its applications in cyber security.	PO1, PO2, PO3, PO4, PO5. PO7, PO8,PSO1	L2	WK3, WK4	8
CO2	Apply machine learning algorithms for malware classification and malicious event detection.	PO1, PO2, PO3, PO4, PO5. PO7, PO8,PSO1	L3	WK3, WK4	8

CO3	Apply system behaviour using time series and ensemble techniques to detect cyber threats.	PO1, PO2, PO3, PO4, PO5. PO7, PO8,PSO1	L3	WK3, WK4	8
CO4	Develop deep learning based intrusion detection systems for network anomaly detection.	PO1, PO2, PO3, PO4, PO5. PO7, PO8,PSO1	L3	WK3, WK4	8
CO5	Apply adversarial attacks and security vulnerabilities in machine learning systems.	PO1, PO2, PO3, PO4, PO5. PO7, PO8,PSO1	L3	WK3, WK4	7

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	Overview on Machine Learning with use cases from cybersecurity, classification of threats, attacks, vulnerabilities, malware, trojans etc	CO1	8
II	Classification of malware using supervised/unsupervised learning based on signatures and profiling. Decision Tree and context based malicious event detection	CO2	8
III	Time Series Analysis and Ensemble modelling to detect deviation from normal behaviour, case studies in Reconnaissance detection	CO3	8
IV	Efficient Network Anomaly detection: familiarize with various stages of network attack and address using deep neural networks, develop intrusion detection systems	CO4	8
V	Adversarial attacks on ML systems, model poisoning, black box attacks, white box attacks, state-of-art research paper reading on deep learning systems	CO5	7

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	A. Hands-on Machine Learning for Cyber Security	Soma Halder	Packt Publishing Ltd.	1st Edition	1-5
2	Machine Learning and Security	David Freeman, Clarence Chio	O'Reilly Media, Inc	2nd Edition	-
3	Malware Data Science	Joshua Saxe with Hillary Sanders	William Pollock	1st Edition	-
4	Artificial Intelligence for Cybersecurity	Leslie F. Sikos	Springer	1st Edition	-

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCS/WEB RESOURCE

- NPTEL – Introduction to Cyber Security https://nptel.ac.in
- Coursera – AI for Cybersecurity Specialization
- MIT OpenCourseWare – Machine Learning
- Google AI – Machine Learning Crash Course
- Kaggle – Cyber Security datasets and practice projects

7. EVALUATION METHODOLOGY

a) Continuous Internal Evaluation (CIE) = 50 marks
b) Semester End Examination (SEE) = 50 marks
Total = 100 marks

CIE and SEE Framework:

Assessment	Actual Weightage in Marks	Final weightage in Marks
CIE 1	50	Avg of 2 CIEs out of 30
CIE 2	50	
AAT	20	20
SEE	100	50
Total		**100**
Grading Consideration		**50% CIE + 50% SEE**

8. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → / COs ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	2	2	3	3	2		3	3			
CO2	2	2	3	3	2		3	3			
CO3	2	2	3	3	2		3	3			
CO4	2	2	3	3	2		3	3			
CO5	2	2	3	3	2		3	3			

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

9. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → / COs ↓	PSO1	PSO2
CO1	2	
CO2	2	
CO3	2	
CO4	2	
CO5	2	

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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Department: **DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**		
Semester: **7**	Course Code: **BAD24704C**	Contact Hrs /week: **3**
Course Description: **PARALLEL PROGRAMMING**		No. of Credits: **3** L : T : P : S = **3:0:0:0**
Course Category: **PEC**		Total no. of Hours = **39**
CIE: **50 Marks**	SEE: **50 Marks**	Exam Hours: **03**
Course Pre-requisites: Prerequisites: Programming Fundamentals, Web Technologies, Software Engineering		

1. PREAMBLE ABOUT THE COURSE

This course introduces the fundamental concepts and techniques of parallel programming used to improve computational performance in modern computing systems. It covers different parallel architectures such as SIMD, MIMD, and GPU-based systems, along with interconnection networks and memory models. The course emphasizes parallel programming using MPI, OpenMP, and CUDA for distributed, shared, and GPU computing environments. Students will also learn performance analysis concepts such as speedup, efficiency, scalability, and optimization of parallel programs.

2. COURSE LEVEL OBJECTIVES

CLO1	Explore the need for parallel programming
CLO2	Explain how to parallelize on MIMD systems
CLO3	To demonstrate how to apply MPI library and parallelize the suitable programs
CLO4	To demonstrate how to apply OpenMP pragma and directives to parallelize the suitable programs
CLO5	To demonstrate how to design CUDA program

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Understand the need for parallel programming	PO1, PO2, PO5, PSO1	L2	WK1, WK3	8
CO2	illustrate parallelism in the MIMD system.	PO1, PO2, PO3, PO5, PSO1	L2	WK3, WK5	8
CO3	Apply MPI library to parallelize the code to solve the given problem.	PO1, PO2, PO3, PO4, PO5, PSO1	L3	WK3, WK5	8

CO4	Apply OpenMP pragma and directives to parallelize the code to solve the given problem	PO1, PO2, PO3, PO4, PO5, PSO1	L3	WK3, WK5	8
CO5	Design a CUDA program for the given problem.	PO1, PO2, PO3, PO4, PO5, PSO1	L3	WK3, WK4, WK5	7

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	**Introduction to parallel programming, Parallel hardware and parallel software :** Classifications of parallel computers, SIMD systems, MIMD systems, Interconnection networks, Cache coherence, Shared-memory vs. distributed-memory, Coordinating the processes/threads, Shared-memory, Distributed-memory.	CO1	8
II	**GPU programming, Programming hybrid systems, MIMD systems, GPUs, Performance –** Speedup and efficiency in MIMD systems, Amdahl's law, Scalability in MIMD systems, Taking timings of MIMD programs, GPU performance.	CO2	8
III	**Distributed memory programming with MPI –** MPI functions, The trapezoidal rule in MPI, Dealing with I/O, Collective communication, MPI-derived datatypes, Performance evaluation of MPI programs, A parallel sorting algorithm.	CO3	8
IV	**Shared-memory programming with OpenMP –** openmp pragmas and directives, The trapezoidal rule, Scope of variables, The reduction clause, loop carried dependency, scheduling, producers and consumers, Caches, cache coherence and false sharing in openmp, tasking, tasking, thread safety.	CO4	8
V	**GPU programming with CUDA -** GPUs and GPGPU, GPU architectures, Heterogeneous computing, Threads, blocks, and grids Nvidia compute capabilities and device architectures, Vector addition, Returning results from CUDA kernels, CUDA trapezoidal rule I, CUDA trapezoidal rule II: improving performance, CUDA trapezoidal rule III: blocks with more than one warp.	CO5	7

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	An Introduction to Parallel Programming	Peter S Pacheco, Matthew Malensek	Morgan Kauffman	second edition	Module 1,2,3
2	Parallel Programming in C with MPI and OpenMp	Michael J Quinn	McGrawHill.	-	Module 4,5

3	Principles of Parallel Programming	Calvin Lin, Lawrence Snyder	Pearson	-	-
4	Using MPI:Portable Parallel Programing,	William Gropp, Ewing Lusk	Scientific and Engineering Computation	Third edition	-

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCS/WEB RESOURCE

- Introduction to parallel programming: https://nptel.ac.in/courses/106102163

7. EVALUATION METHODOLOGY

a) Continuous Internal Evaluation (CIE) = 50 marks
b) Semester End Examination (SEE) = 50 marks
Total = 100 marks

CIE and SEE Framework:

Assessment	Actual Weightage in Marks	Final weightage in Marks
CIE 1	50	Avg of 2 CIEs out of 30
CIE 2	50	
AAT	20	20
SEE	100	50
Total		**100**
Grading Consideration		**50% CIE + 50% SEE**

8. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → / COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	1			1						
CO2	3	2	1		2						
CO3	3	2	2	1	3						
CO4	3	2	2	1	3						
CO5	3	1	3	1	3						

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

9. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → / COs ↓	PSO1	PSO2
CO1	2	
CO2	2	
CO3	2	
CO4	2	
CO5	2	

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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Department: **DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**		
Semester: **7**	Course Code: **BAD24704D**	Contact Hrs /week: **3**
Course Description: **UI /UX DESIGN**		No. of Credits: **3** L : T : P : S = **3:0:0:0**
Course Category: **PEC**		Total no. of Hours = **39**
CIE: **50 Marks**	SEE: **50 Marks**	Exam Hours: **03**
Course Pre-requisites: Basic knowledge of computers and software applications, Familiarity with graphical user interfaces and web/mobile applications, Interest in design thinking and problem solving.		

1. PREAMBLE ABOUT THE COURSE

This course introduces the principles, guidelines, and methodologies used in designing effective user interfaces and enhancing user experience. It focuses on human–computer interaction concepts, usability principles, and structured approaches for interface design. Students will learn to analyze user requirements, apply design guidelines, and develop interactive interfaces. The course also emphasizes usability evaluation and modern interface design practices.

2. COURSE LEVEL OBJECTIVES

CLO1	To understand the concepts and importance of user interface design, including the evolution of graphical and web-based interfaces.
CLO2	To develop a skill of user characteristics, interaction styles, and principals involved in designing effective graphical and web user interfaces.
CLO3	To describe the user interface design process, usability principles, and methods used to evaluate interface usability.
CLO4	To develop interface design principles to develop effective screen layouts, menus, navigation schemes, feedback mechanisms.

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Understand the importance and evolution of user interfaces, including graphical and web-based interfaces.	PO1,PO2,PO3,PO4, PO5,PO6,PO12,PSO1	L2	WK3, WK4	8
CO2	Explore the different interaction styles and summarize the principles of user interface design.	PO1,PO2,PO3,PO4, PO5,PO6,PO12,PSO1	L2	WK3, WK4	8

CO3	Apply usability principles and demonstrate usability assessment methods in the interface design process.	PO1,PO2,PO3,PO4, PO5,PO6,PO12,PSO1	L3	WK3, WK4	8
CO4	Apply user characteristics and business requirements to support user-centered interface design.	PO1,PO2,PO3,PO4, PO5,PO6,PO12,PSO1	L3	WK3, WK4	8
CO5	Develop effective menus, navigation schemes, screen layouts, and select appropriate feedback and color schemes for user interfaces.	PO1,PO2,PO3,PO4, PO5,PO6,PO12,PSO1	L3	WK3, WK4	7

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	**The Importance of the User Interface:** Defining the User Interface, The Importance of Good Design, The Benefits of Good Design, A Brief History of the Human-Computer Interface, Introduction of the Graphical User Interface, The Blossoming of the World Wide Web, A Brief History of Screen Design. **Characteristics of Graphical and Web User Interfaces:** Interaction Styles, The Graphical User Interface, The Web User Interface, The Merging of Graphical Business Systems and the Web, Principles of User Interface Design	CO1	8
II	**The User Interface Design Process:** Obstacles and Pitfalls in the Development Path, Designing for People: The Seven Commandments, Usability, Usability Assessment in the Design Process, Common Usability Problems, Some Practical Measures of Usability, Some Objective Measures of Usability **Know Your User or Client:** Understanding How People Interact with Computers, Important Human Characteristics in Design, Human Considerations in the Design of Business Systems, Human Interaction Speeds	CO2	8
III	**Understand the Business Function:** Business Definition and Requirements Analysis, Determining Basic Business Functions, Design Standards or Style Guides, System Training and Documentation Needs **Understand the Principles of Good Interface and Screen Design:** Human Considerations in Interface and Screen Design	CO3	8
IV	**Develop System Menus and Navigation Schemes:** Structures of Menus, Functions of Menus, Content of Menus, Formatting of Menus, Phrasing the Menu, Selecting Menu Choices, Web Site Navigation, Kinds of Graphical Menus, Graphical Menu Examples	CO4	8

V	**Provide Effective Feedback and Guidance and Assistance:** Providing the Proper Feedback, Guidance and Assistance, **Choose the Proper Colors:** Color Uses, Possible Problems with Color, Color — What the Research Shows,Color and Human Vision, Choosing Colors for Textual Graphic Screens, Choosing Colors for Statistical Graphics Screens	CO5	7

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	The essential guide to user interface design	Wilbert O.Galitz	wiley	3rd edition	5 Modules
2	Interaction Design	Yvonne Rogers, Helen Sharp, Jenny Preece		3rd edition	

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCS/WEB RESOURCE

- User interface design :https://nptel.ac.in/courses/124107008
- https://nptel.ac.in/courses/110106124

7. EVALUATION METHODOLOGY

a) Continuous Internal Evaluation (CIE) = 50 marks
b) Semester End Examination (SEE) = 50 marks
Total = 100 marks

CIE and SEE Framework:

Assessment	Actual Weightage in Marks	Final weightage in Marks
CIE 1	50	Avg of 2 CIEs out of 30
CIE 2	50	
AAT	20	20
SEE	100	50
Total		**100**
Grading Consideration		**50% CIE + 50% SEE**

8. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → / COs ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	3	3	2	1	2					1
CO2	3	3	3	2	1	2					1
CO3	3	3	3	2	1	2					1
CO4	3	3	3	2	1	2					1
CO5	3	3	3	2	1	2					1

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

9. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → / COs ↓	PSO1	PSO2
CO1	2	
CO2	2	
CO3	2	
CO4	2	
CO5	2	

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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Department: **DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**		
Semester: **7**	Course Code: **BAD24705A**	Contact Hrs /week: **3**
Course Description: **DATA VISUALIZATION**		No. of Credits:**3** L: T: P : S = **3:0:0:0**
Course Category: **OEC**		Total no. of Hours = **39**
CIE: **50 Marks**	SEE: **50 Marks**	Exam Hours: **03**
Course Pre-requisites: Basic understanding of Microsoft Excel		

1. PREAMBLE ABOUT THE COURSE

The course Data Visualization introduces learners to the art and science of presenting data effectively. It focuses on transforming raw data into meaningful visual insights using Tableau's powerful features. Students learn to design interactive dashboards and analytical reports for real-world applications. Emphasis is placed on data interpretation, storytelling, and visual best practices. By the end, Students can create compelling visualizations that drive data-informed decision-making.

2. COURSE LEVEL OBJECTIVES

CLO1	To introduce the principles and best practices of effective data visualization and design.
CLO2	To enable students to create, analyze, and interpret visualizations using Tableau's interactive features.
CLO3	To develop the ability to connect, prepare, and model data for insightful visualization and storytelling.
CLO4	To provide exposure to advanced visualization tools such as Tableau through practical, project-based learning, including dashboard creation and presentation.

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Understand the fundamentals, principles, and techniques of effective data visualization and their importance in data interpretation.	PO1,PO2,PO5, PO9,PO11,PSO1,PSO2	L2	WK3, WK4, WK5	8
CO2	Explore the architecture, features, and core functionalities of Tableau, including	PO1,PO2,PO5, PO9,PO11,PSO1,PSO2	L2	WK3, WK4, WK5	8

	data connections and interface components.				
CO3	Apply data connection, blending, and calculation techniques to prepare and transform data for analysis and storytelling.	PO1,PO2,PO3,PO4,PO5, PO9,PO11,PSO1,PSO2	L3	WK3, WK4, WK5	7
CO4	Implement different types of charts, plots, and maps in Tableau, incorporating sorting and filtering techniques for effective visualization..	PO1,PO2,PO3,PO4,PO5, PO9,PO11,PSO1,PSO2	L4	WK3, WK4, WK5	8
CO5	Develop advanced Tableau solutions by creating interactive dashboards, performing trend analysis, and applying forecasting techniques to derive actionable data insights.	PO1,PO2,PO3,PO4,PO5, PO9,PO11,PSO1,PSO2	L4	WK3, WK4, WK5	8

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	**Introduction to Data Visualization:** Introduction to the Art and Science of Data Visualization, What is Data Visualization?, Importance of Data Visualization, Brief History of Data Visualization, Data Visualization Tools, **Design Fundamentals:** Design Principles, Colors, and "Chart Junk", The Shaffer 4 C's of Data Visualization, Best practices (examples).	CO1	08
II	**Storytelling with Data:** Creating a good data set for analysis, Selecting data for your KPIs, Approaches to storytelling with data, Dashboards vs. Storyboards vs. Infographics. **Tableau:** What is Tableau? History of Tableau, Tableau architecture, Tableau Desktop, Workspace, Connecting to data source, Files and folders, Tableau navigation, Terminologies, Data types, Data aggregation, File types.	CO2	08
III	**Data connection:** Extracting data, Joining, Blending, Sorting, Fields operations. **Tableau calculations**: Operators, Functions, Numeric, string, date, table calculations.	CO3	07
IV	**Sort and filter:** Basic filters, Filter operations, Extract filters, Quick filters, Context filters, Condition filters, Data source filters, Top filters, Build groups, hierarchy, sets.	CO4	08

	Charts: Bar, Line, Pie, Crosstab, Bubble, Bullet, Area, Pareto, Bump chart, Gantt chart, Histogram, Motion charts, Waterfall charts. Plots: Scatter, Boxplot. Maps: Heat map, Tree map.		
V	**Level of Details Expression (LOD) fundamentals:** FIXED, INCLUDE and EXCLUDE LOD's Syntax, Examples. **Advanced Tableau:** Bringing Data on a dual Axis, Creating moving averages chart, Reference bands and distribution bands with parameterization, Dashboard, Formatting, Forecasting, Trend Lines.	CO5	08

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Practical Tableau: 100 Tips, Tutorials, and Strategies from a Tableau Zen Master.	Ryan Sleeper,	O'Reilly Media	2nd Edition, 2023	Module III, IV, V
2	Storytelling with Data: A Data Visualization Guide for Business Professionals,	Cole Nussbaumer Knaflic,	Wiley	2nd Edition, 2020.	Module I and II
3	Learning Tableau 2025	JoshuaN. Milligan,	Packt Publishing,	6th Edition, 2025.	Module II, III, V
Reference Books					
4	Data Visualisation: A Handbook for Data Driven Design	Andy Kirk	Sage Publications	2nd Edition,2020	Module I,II
5	Communicating Data with Tableau	Ben Jones	O'Reilly Media	1st Edition, 2021	Module III
6	The Big Book of Dashboards	Steve Wexler, Jeffrey Shaffer, Andy Cotgreave,	Wiley	2nd Edition,2020	Module IV,V

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCS/WEB RESOURCE]

- https://www.coursera.org/learn/datavisualization.
- https://freevideolectures.com/course/4041/nptel-introduction-to-learning-analytics/11
- https://www.coursera.org/learn/dataviz-dashboards
- https://www.udemy.com/course/the-complete-data-visualization-course/
- https://www.classcentral.com/course/swayam-introduction-to-data-visualization-452115

7. EVALUATION METHODOLOGY

a) Continuous Internal Evaluation (CIE) = 50 marks
b) Semester End Examination (SEE) = 50 marks
Total = 100 marks

CIE and SEE Framework:

Assessment	Actual Weightage in Marks	Final weightage in Marks
CIE 1	50	Avg of 2 CIEs out of 30
CIE 2	50	
AAT	20	20
SEE	100	50
Total		**100**
Grading Consideration		**50% CIE + 50% SEE**

8. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → / COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	1			3				2		2
CO2	3	1			3				2		2
CO3	3	2	2	2	3				2		2
CO4	3	2	2	2	3				2		2
CO5	3	2	2	2	3				2		2

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

9. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → / COs ↓	PSO1	PSO2
CO1	1	3
CO2	1	3
CO3	1	3
CO4	1	3
CO5	1	3

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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Department: **DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**		
Semester: **7**	Course Code: **BAD24705B**	Contact Hrs /week: **3**
Course Description: **INTRODUCTION TO NLP**		No. of Credits: **3** L : T : P : S = **3:0:0:0**
Course Category: **OEC**		Total no. of Hours = **39**
CIE: **50 Marks**	SEE: **50 Marks**	Exam Hours: **03**
Course Pre-requisites: Introduction to Python Programming		

1. PREAMBLE ABOUT THE COURSE

Natural Language Processing (NLP) is a rapidly evolving field that enables computers to understand, interpret, and generate human language. This course introduces students to the fundamental concepts, techniques, and applications of NLP, including text preprocessing, language modeling, word embeddings, syntactic analysis, and information extraction. It also explores real-world applications such as sentiment analysis, text classification, machine translation, dialog systems, and ethical considerations in building responsible NLP systems, preparing students to apply NLP methods in modern AI and data-driven applications.

2. COURSE LEVEL OBJECTIVES

CLO1	To learn the fundamentals of natural language processing.
CLO2	To understand the working of Language based models and apply word embedding algorithms.
CLO3	To understand the role of semantics of sentences and pragmatics and apply them in NER.
CLO4	To perform sentiment analysis and text classification.
CLO5	Facilitate project-based opportunities under machine translation, dialog systems and ethical considerations in NLP.

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Understand NLP foundations, text processing techniques, and practical applications.	PO1,PO2,PO3,PO4, PO5,PO6,PO7,PO11 PSO1, PSO2	L2	WK3 WK4	8
CO2	Apply diverse language models, embeddings; adapt in practical applications.	PO1,PO2,PO3,PO4, PO5,PO6,PO7,PO11 PSO1, PSO2	L3	WK3, WK4, WK5	8
CO3	Implement tagging, parsing, Named Entity Recognition techniques.	PO1,PO2,PO3,PO4, PO5,PO6,PO7,PO11 PSO1, PSO2	L3	WK3, WK4, WK5	8

CO4	Perform classical NLP, sentiment analysis, text classification, and summarization.	PO1,PO2,PO3,PO4, PO5,PO6,PO7,PO11 PSO1, PSO2	L3	WK3, WK4, WK5	8
CO5	Understand competence in machine translation, dialog systems, and ethical NLP practices.	PO1,PO2,PO3,PO4, PO5,PO6,PO7,PO11 PSO1, PSO2	L2	WK3, WK4, WK5	7

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	**Introduction to NLP and Text Processing:** Definition and scope of NLP, Historical overview and milestones in NLP, Components of NLP, NLP applications, Phases of NLP, Tokenization, Stemming, Lemmatization, Stop word removal, Punctuation handling, Text normalization, Case conversion.	CO1	8
II	**Language Modeling:** Bag of Words, Bag of N-grams, TF-IDF, Hashing with HashingVectorizer, Split words, Encoding with one_hot, N-gram models. **Word embeddings:** Word2Vec, Training word embeddings, Applications of word embeddings, Word embedding algorithms, CBOW, Skip-Gram	CO2	8
III	**Syntax, Parsing:** Part-of-speech tagging, Dependency parsing and constituency parsing, Parsing algorithms and techniques. **Named Entity Recognition:** Introduction to NER, NER techniques and tools, Applications of NER in information extraction.	CO3	8
IV	**Applied NLP:** Classical NLP pipeline, Sentiment analysis applications in social media and reviews, Text classification methods, Interpreting Text Classification models, Text summarization.	CO4	8
V	**Machine Translation and Dialog Systems:** Introduction to machine translation, Statistical and neural machine translation, Types of dialog systems, Introduction to chatbots and virtual assistants	CO5	7

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Deep Learning for Natural Language Processing	Jason Brownlee	Machine Learning Mastery	2018	01,02,03
2	Practical Natural Language Processing	Sowmya Vajjala, Bodhisattwa Majumder, Anuj Gupta, Harshit Surana	O'Reilly Media	2020	04, 05

3	Natural Language Processing with Python (Reference Book)	Steven Bird, Ewan Klein, Edward Loper	O'Reilly Media	-	01, 02, 04
4	Speech and Language Processing (Reference Book)	Daniel Jurafsky, James H. Martin	Pearson Prentice Hall	-	03, 04, 05

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCS/WEB RESOURCE)

- https://onlinecourses.nptel.ac.in/noc19_cs56/preview
- https://www.udemy.com/course/data-science-natural-language-processing-in-python/
- https://www.coursera.org/specializations/natural-language-processing

7. EVALUATION METHODOLOGY

a) Continuous Internal Evaluation (CIE) = 50 marks
b) Semester End Examination (SEE) = 50 marks
Total = 100 marks

CIE and SEE Framework:

Assessment	Actual Weightage in Marks	Final weightage in Marks
CIE 1	50	Avg of 2 CIEs out of 30
CIE 2	50	
AAT	20	20
SEE	100	50
Total		**100**
Grading Consideration		**50% CIE + 50% SEE**

8. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → / COs ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	2	2	2	2	3	3				3
CO2	3	2	2	2	2	3	3				3
CO3	3	2	2	2	2	3	3				3
CO4	3	2	2	2	2	3	3				3
CO5	3	2	2	2	2	3	3				3

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

9. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → / COs ↓	PSO1	PSO2
CO1	2	3
CO2	2	3
CO3	2	3
CO4	2	3
CO5	2	3

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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Department: **DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**		
Semester: **7**	Course Code: **BAD24705C**	Contact Hrs /week: **3**
Course Description: **BUSINESS INTELLIGENCE**		No. of Credits: **3** L : T : P : S = **3:0:0:0**
Course Category: **OEC**		Total no. of Hours = **39**
CIE: **50 Marks**	SEE: **50 Marks**	Exam Hours: **03**
Course Pre-requisites: Basics of Artificial Intelligence		

1. PREAMBLE ABOUT THE COURSE

This course introduces students to the evolving landscape of Business Intelligence (BI), Analytics, Data Science, and Artificial Intelligence (AI) and their growing role in supporting modern organizational decision-making. It explores how changing business environments demand data-driven insights and presents the fundamental frameworks that enable effective computerized decision support. The syllabus covers core AI concepts and applications such as conversational AI and chatbots, along with descriptive analytics techniques for understanding and preparing data, including big data technologies and statistical modeling. Students will also learn about business intelligence infrastructure through data warehousing, reporting, and visualization tools that transform raw data into meaningful insights. In addition, the course examines efficiency measurement methods, pattern discovery techniques such as clustering and outlier analysis, and the use of analytics to identify best practices in operations. It concludes with the future of business intelligence by highlighting emerging technologies, machine learning, advanced visualization, and text analytics that will shape the next generation of intelligent business systems.

2. COURSE LEVEL OBJECTIVES

CLO1	Explain the concepts and frameworks of Business Intelligence, Analytics, Data Science, and Artificial Intelligence**,** and evaluate their role in supporting organizational decision-making.
CLO2	Analyze and preprocess different types of data using descriptive analytics techniques**,** including statistical modeling, big data technologies, and stream analytics for business applications.
CLO3	Design and interpret business intelligence systems**,** including data warehousing, reporting tools, dashboards, and data visualization methods to support effective business insights.
CLO4	Apply analytical techniques such as efficiency measurement, clustering, outlier analysis, and emerging machine learning approaches to identify patterns, improve operational performance, and anticipate future business trends.

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Understand the concepts and frameworks of Business Intelligence, Analytics, Data Science, and AI in supporting business decision-making.	PO1, PO2, PO6, PO8, PO11 PSO1, PSO2	L2	WK3, WK4	8
CO2	Explore the fundamentals, technologies, and business applications of Artificial Intelligence, including conversational AI and chatbots.	PO1, PO2, PO6, PO8, PO11 PSO1, PSO2	L2	WK3, WK4	8
CO3	Analyze and preprocess data using descriptive analytics, statistical modeling, and big data technologies.	PO1, PO2, PO6, PO8, PO11 PSO1, PSO2	L3	WK3, WK4	8
CO4	Interpret business data using data warehousing concepts, reporting tools, dashboards, and visualization techniques.	PO1, PO2, PO6, PO8, PO11 PSO1, PSO2	L3	WK3, WK4	8
CO5	Apply efficiency analysis and pattern discovery techniques while understanding emerging trends in Business Intelligence and analytics.	PO1, PO2, PO6, PO8, PO11 PSO1, PSO2	L3	WK3, WK4, WK5	7

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	**An Overview of Business Intelligence, Analytics, Data Science, and AI:** Changing Business Environments and Evolving Needs for Decision Support and Analytics, Decision-Making Processes and Computerized Decision Support Framework, a framework for Business Intelligence, Analytics Overview. **Artificial Intelligence:** Concepts, Drivers, Major Technologies, and Business Applications, Conversational AI—Chatbots.	CO1	8
II	**Descriptive Analytics I -Nature of Data, Big Data, and Statistical Modeling:** The Nature of Data in Analytics, A Simple Taxonomy of Data, The Art and Science of Data Preprocessing, Fundamentals of Big Data Analytics, Big Data Technologies, Big Data and Stream Analytics, Statistical Modeling for Business Analytics, Regression Modeling for Inferential Statistics.	CO2	8
III	**Descriptive Analytics II- Business Intelligence Data Warehousing, and Visualization:** Business Intelligence and Data Warehousing, Data Warehousing Process, Data Warehousing Architectures, Data Management and Warehouse Development, Data Warehouse Administration, Security Issues, and Future Trends, Business Reporting, Data Visualization, Different Types	CO3	8

	of Charts and Graphs, The Emergence of Visual Analytics, Information Dashboards.		
IV	**Efficiency:** Efficiency measures - The CCR model, definition of target objectives, peer groups, identification of good operating practices, cross efficiency analysis, virtual inputs and outputs-other models. pattern matching - cluster analysis, outlier analysis	CO4	8
V	**Future of Business Intelligence:** Emerging Technologies, Machine Learning, Predicting the Future, BI Search & Text Analytics, Advanced Visualization - Rich Report, Future beyond Technology.	CO5	7

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Business Intelligence, Analytics, Data Science and AI – A Managerial Perspective	Ramesh Sharda, Dursun Delen and Efraim Turban	Pearson Education Limited	5	1, 2, 3, 4, 5
2	Business Intelligence Roadmap: The Complete Project Lifecycle of Decision Making (Reference Book)	Larissa T. Moss, S. Atre, Addison Wesley	Addison-Wesley Professional	-	
3	Business Intelligence: Data Mining and Optimization for Decision Making (Reference Book)	Carlo Vercellis	Wiley Publications	-	
4	Business Intelligence: The Savvy Manager's Guide (Reference Book)	David Loshin Morgan, Kaufman	Newnes	2	

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCS/WEB RESOURCE]

- https://www.udemy.com/course/the-business-intelligence-analyst-course-2018/
- https://www.coursera.org/professional-certificates/bi-analyst
- https://www.theknowledgeacademy.com/in/offers/iiba-business-analysis-training-courses/

7. EVALUATION METHODOLOGY

a) Continuous Internal Evaluation (CIE) = 50 marks
b) Semester End Examination (SEE) = 50 marks
Total = 100 marks

CIE and SEE Framework:

Assessment	Actual Weightage in Marks	Final weightage in Marks
CIE 1	50	Avg of 2 CIEs out of 30
CIE 2	50	
AAT	20	20
SEE	100	50
Total		**100**
Grading Consideration		**50% CIE + 50% SEE**

8. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → / COs ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	2				1		1			2
CO2	3	2				1		1			2
CO3	3	2				1		1			2
CO4	3	2				1		1			2
CO5	3	2				1		1			2

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

9. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → / COs ↓	PSO1	PSO2
CO1	2	3
CO2	2	3
CO3	2	3
CO4	2	3
CO5	2	3

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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Department: **DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**		
Semester: **7**	Course Code: **BAD24705D**	Contact Hrs /week: **3**
Course Description: **DATA SECURITY AND PRIVACY**		No. of Credits: **3** L: T: P: S = **3:0:0:0**
Course Category: **OEC**		Total no. of Hours = **39**
CIE: **50 Marks**	SEE: **50 Marks**	Exam Hours: **03**
Course Pre-requisites: Basic knowledge of computer networks and operating systems. Fundamental understanding of mathematics such as number systems, modular arithmetic, and basic algorithms.		

1. PREAMBLE ABOUT THE COURSE

With the rapid growth of digital communication and internet-based services, ensuring the confidentiality, integrity, and authenticity of information has become essential. This course introduces the fundamental concepts of network security, including classical and modern cryptographic techniques, secure communication protocols, key management, and data hiding methods, enabling students to understand and apply security mechanisms for protecting information systems.

2. COURSE LEVEL OBJECTIVES

CLO1	Understand the basics of, Security, its principle and Cryptography.
CLO2	To study various symmetric and asymmetric cryptographic Algorithm.
CLO3	Apply the knowledge of Cryptography to various fields.
CLO4	Study the key management system.
CLO5	Understand the necessity of data security.

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Understand the basic concepts of Security and Cryptography.	PO1, PO2, PO3, PO4, PO5, PSO1, PSO2.	L2	WK3, WK4, WK5	8
CO2	Analyze various Cryptographic Algorithm	PO1, PO2, PO3, PO4, PO5, PSO1, PSO2.	L2	WK3, WK4, WK5	8
CO3	Apply various key management scenarios.	PO1, PO2, PO3, PO4, PO5, PSO1, PSO2.	L3	WK3, WK4, WK5	8

CO4	Understand about IP security and Web security.	PO1, PO2, PO3, PO4, PO5, PSO1, PSO2.	L2	WK3, WK4, WK5	8
CO5	Apply the Data security concepts for Text and images.	PO1, PO2, PO3, PO4, PO5, PSO1, PSO2.	L3	WK3, WK4, WK5	7

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	**A model for Network Security**, Classical encryption techniques: Symmetric cipher model, Substitution ciphers-Caesar Cipher, Monoalphabetic Cipher, Playfair Cipher, Hill Cipher, Polyalphabetic Ciphers, One time pad, Steganography Block Ciphers and Data Encryption Standards: Traditional Block Cipher structures, data Encryption Standard (DES), A DES Example, The strength of DES, Block cipher design principles.	CO1	8
II	**Pseudorandom number Generators:** Linear Congruential Generators, Blum Blum Shub Generator Public key cryptography and RSA: Principles of public key cryptosystems-Public key cryptosystems, Applications for public key cryptosystems, Requirements for public key cryptography, Public key Cryptanalysis, The RSA algorithm: Description of the Algorithm, Computational aspects, The Security of RSA Diffie-Hellman key exchange: The Algorithm, Key exchange Protocols, Man-in-the-middle Attack, Elliptic Curve Cryptography: Analog of Diffie-Hellman key Exchange, Elliptic Curve Encryption/Decryption, Security of Elliptic Curve Cryptography	CO2	8
III	**Key management fundamentals**, Key lengths and lifetimes, Key generation, Key establishment, Key storage, Key usage, Governing key management. Public-Key Management: Certification of public keys, The certificate lifecycle, Public-key management models, Alternative approaches.	CO3	8
IV	**Web security consideration**, Transport layer security. IP Security: IP Security overview, IP Security Policy, Encapsulating Security Payload, Combining security associations, Internet key exchange.	CO4	8
V	**Data Security:** Data hiding in Text-Basic features, Applications of data hiding, Watermarking, Intuitive Methods, Simple Digital methods, Data hiding in Text, Innocuous Text, Mimic Functions. Data hiding in Images: LSB encoding, BPCS Steganography, Lossless data hiding	CO5	7

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Cryptography and Network Security	William Stallings	Pearson Publication	Seventh Edition	1,2,4
2	Everyday Cryptography: Fundamental Principles and Applications	Keith M. Martin	Oxford Scholarship Online	December 2013	3
3	Data Privacy and Security	Salomon, David	Springer	2003	5
4	Cryptography and Network Security	Behrouz A Forouzan, Dedeep Mukhopadhyay	TMH	2nd Edition, 2013	Reference
5	Information Security: Principles and practice	Mark Stamp	Wiley Inter Science	2011	Reference

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCS/WEB RESOURCE

- https://onlinecourses.nptel.ac.in/noc25_cs16/preview
- https://onlinecourses.nptel.ac.in/noc20_cs70/preview
- https://onlinecourses.nptel.ac.in/noc21_cs40/preview
- https://www.geeksforgeeks.org/computer-networks/cryptography-tutorial/
- https://swayam.gov.in/explorer?searchText=cryptography%20and%20network%20security

7. EVALUATION METHODOLOGY

a) Continuous Internal Evaluation (CIE) = 50 marks
b) Semester End Examination (SEE) = 50 marks
Total = 100 marks

CIE and SEE Framework:

Assessment	Actual Weightage in Marks	Final weightage in Marks
CIE 1	50	Avg of 2 CIEs out of 30
CIE 2	50	
AAT	20	20
SEE	100	50
Total		**100**
Grading Consideration		**50% CIE + 50% SEE**

8. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → / COs ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	3	3		1	1					2
CO2	3	3	3		1	1					2
CO3	3	3	3		1	1					2
CO4	3	3	2		2	1					2
CO5	3	3	3		2	1					2

Correlation Weightage: 1 – Low, 2 – Moderate, 3 – High

9. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → / COs ↓	PSO1	PSO2
CO1		2
CO2		2
CO3		2
CO4		2
CO5		2

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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Department: **DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**		
Semester: **7**	Course Code: **BADP24706**	Contact Hrs /week: **2**
Course Description: **PROJECT PHASE-II**		No. of Credits:**7** L: T: P: S = **0:0:14:0**
Course Category: **PROJ**		Total no. of Hours = **91**
CIE: **100 Marks**	SEE: **100**	Exam Hours: **3**
Course Pre-requisites: Knowledge of programming, Mathematical Foundations, Data Structures and Algorithms (DSA), Machine Learning (ML)		

1. MAJOR PROJECT GUIDELINES

1. The project topic, title and synopsis have to be finalized and submitted to their respective internal guide(s) before the beginning of the 6th semester.

2. The detailed Synopsis (approved by the department Project Review Committee) has to be submitted during the last of 6th semester.

2. COURSE LEVEL OBJECTIVES

CLO1	Acquire the ability to make links across different areas of knowledge and to generate, develop and evaluate ideas and information so as to apply these skills to the project task.
CLO2	Acquire the skills to communicate effectively and to present ideas clearly and coherently to a specific
CLO3	Acquire collaborative skills through working in a team to achieve common goals.
CLO4	Self-learn, reflect on their learning and take appropriate action to improve it.

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Apply knowledge of mathematics, science and engineering to solve respective engineering domain problems.	PO1, PO2, PO3, PO4, PO5,PO6,PO7,PO8, PO9, PO10,PO11, PSO1,PSO2	L3-L4	WK1, WK2, WK3, WK4, WK5, WK6	23
CO2	Design, develop, present and document innovative/multidisciplinary	PO1, PO2, PO3, PO4, PO5,PO6,PO7,PO8,	L2-L4	WK1, WK2, WK3, WK4,	23

	modules for a complete engineering system.	PO9, PO10,PO11, PSO1,PSO2		WK5, WK6	
CO3	Use modern engineering tools, software and equipment to solve problem and engage in life long learning to follow technological developments.	PO1, PO2, PO3, PO4, PO5,PO6,PO7,PO8, PO9, PO10,PO11, PSO1,PSO2	L3-L4	WK1, WK2, WK3, WK4, WK5, WK6	23
CO4	Function effectively as an individual, or leader in diverse teams, with the understanding of professional	PO1, PO2, PO3, PO4, PO5,PO6,PO7,PO8, PO9, PO10,PO11, PSO1,PSO2	L3-L4	WK1, WK2, WK3, WK4, WK5, WK6	22

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. EVALUATION METHODOLOGY

a) Continuous Internal Evaluation (CIE) = 100 marks
b) Semester End Evaluation (SEE)=100 marks.

Continuous Internal Evaluation (CIE): The following are the weightings given for the various stages of the project

Sl No.	Activity	Weightage
1	Execution of Project	30%
2	Presentation, Demonstration and Results Discussion	40%
3	Report Writing & Publication	30%

Semester End Evaluation (SEE): The following are the weightings given during Viva Examination

Sl No.	Activity	Weightage
1	Presentation/Demonstration of the project	30%
2	Methodology and Experimental Results & Discussion	30%
3	Report	20%
4	Viva Voce	20%

5. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → / COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	2	2	3	3	3	3	2	3	1
CO2	3	3	2	2	3	3	3	3	2	3	1
CO3	3	3	2	2	3	3	3	3	2	3	1
CO4	3	3	2	2	3	3	3	3	2	3	1

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

6. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → / COs ↓	PSO1	PSO2
CO1	3	3
CO2	3	3
CO3	3	3
CO4	3	3

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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