Vivekanand Education Society's
College of Arts, Science and Commerce (Autonomous)
Sindhi Society, Chembur, Mumbai, Maharashtra - 400 071.

Accredited by NAAC "A Grade" in 3" Cycle-2017

Best College Award- Urban Area, University of Mumbai (2012-13) Recipient of FIST Grant (DST) and STAR College Grant (DBT)

Credit Based System for Holistic Development Syllabus

For

S. Y. B. Sc. Artificial Intelligence

Undergraduate Programme
As per NEP 2020

II year Curriculum For academic year 2026-27

Course Structure

B. Sc. (Artificial Intelligence) Programme

B. Sc. (Artificial Intelligence) is a 3/4 year undergraduate course designed to provide theoretical and practical knowledge of Artificial Intelligence along-with core subjects in the field of computer science and information technology. In order to master the skills, a learner should have strong mathematical, statistical and computational skills. The course aims to cover all the important subjects required for the same.

Course Highlights

Name of the Course	**B.Sc. (Artificial Intelligence)**
Level	**Undergraduate**
Duration	**3 /4 Years**
Minimum Academic Requirement	**10 + 2**
Minimum Aggregate Score Requirement	**Mathematics as compulsory subject in 12th**
Stream Requirement	**XII Science / Commerce / Arts** **with Mathematics subject (Merit List on Mathematics marks)**
Course mode	**Full – Time**
Exam Type	**Semester**

(AI)Program Objectives:

1. The objective of studying Artificial Intelligence at the graduation level is to help students understand the fundamental concepts and techniques used to build intelligent systems.
2. It enables learners to develop problem-solving skills by applying algorithms, data analysis, and logical thinking to real-world engineering challenges.
3. Students gain knowledge of machine learning, data handling, and automation, which are essential in modern industries.
4. The course also encourages innovation by allowing students to design smart applications and solutions.

5. It prepares them to use AI tools effectively for improving productivity and decision-making.
6. Ethical considerations and responsible use of AI are also emphasized. Students become capable of adapting to rapidly evolving technologies and industry demands.
7. Overall, it builds a strong foundation for careers, higher studies, and entrepreneurship in AI-related fields.

(AI)Program Outcomes:

PO1: "Basic and Discipline specific knowledge:
Apply knowledge of basic mathematics,science and engineering fundamentals and engineering specialization to solve the engineering problems"

PO2: Problem analysis: Identify and analyse well-defined engineering problems using codified standard methods.

PO3: "Design/ development of solutions: Design solutions for well-defined technical problems and assist with the design of systems components or processes to meet specified needs."

PO4: "Engineering Tools, Experimentation and Testing: Apply modern engineering tools and appropriate technique to conduct standard tests and measurements."

PO5: "Engineering practices for society, sustainability and environment: Apply appropriate technology in context of society, sustainability, environment and ethical practices. "

PO6: "Project Management: Use engineering management principles individually, as a team member or a leader to manage projects and effectively communicate about well-defined engineering activities. "

PO7: Life-long learning: Ability to analyse individual needs and engage in updating in the context of technological changes.

VES COLLEGE OF ARTS, SCIENCE AND COMMERCE
BSC (ARTIFICIAL INTELLIGENCE)
SECOND YEAR SYLLABUS (2026-2027)
SEMESTER III

Course	Sem	Course Code	Sr. No.	Name of Course	Type of Course	Credit	Subject Type	External Exam Marks	Internal Exam Marks	Total Marks
BSc- AI	III		1	Artificial Intelligence	MAJOR	2	THEORY	30	20	50
	III		2	Embedded System	MAJOR	2	THEORY	30	20	50
	III		3	Practical of (Artificial Intelligence and Embedded System)	MAJOR	2	PRACTICAL	-	50	50
	III		4	Software Development in AI	MAJOR	2	THEORY	30	20	50
	III		5	Statistical Methods & Probability	MINOR	2	THEORY	30	20	50
	III		6	Data Processing using Python	MINOR	2	PRACTICAL	-	50	50
	III		7	Web Programming with React & Angular	VSC	2	PRACTICAL	-	50	50
	III		8	Modern Indian Language (Marathi, Hindi, Sanskrit,Sindhi)	AEC	2	THEORY	30	20	50
	III		9	OE	OE	2	THEORY	30	20	50
	III		10	Field Project	FP	2	-	-	-	50
	III		11	Co-Curricular Courses	CC	2	-	-	-	50
						22				

VES COLLEGE OF ARTS, SCIENCE AND COMMERCE
BSC (ARTIFICIAL INTELLIGENCE)
SECOND YEAR SYLLABUS (2026-2027)
SEMESTER IV

Course	Sem	Course Code	Sr. No.	Name of Course	Type of Course	Credit	Subject Type	External Exam Marks	Internal Exam Marks	Total Marks
BSc- AI	IV		1	Machine Learning	MAJOR	2	THEORY	30	20	50
	IV		2	AI in IoT	MAJOR	2	THEORY	30	20	50
	IV		3	Practical of (Machine Learning and IoT in AI)	MAJOR	2	PRACTICAL	-	50	50
	IV		4	AI in Drone Technology	MAJOR	2	THEORY	30	20	50
	IV		5	Graph Theory	MINOR	2	THEORY	30	20	50
	IV		6	Data Analytics using Python	MINOR	2	PRACTICAL	-	50	50
	IV		7	GEN AI and Prompt Engineering	VSC	2	PRACTICAL	-	50	50
	IV		8	Modern Indian Language (Marathi, Hindi, Sanskrit,Sindhi)	AEC	2	THEORY	30	20	50
	IV		9	OE	OE	2	THEORY	30	20	50
	IV		10	Community Engagement Programme (CEP)	CEP	2	-	-	-	50
	IV		11	Co-Curricular Courses	CC	2	-	-	-	50
						22				

SEMESTER THREE

S. Y. B. Sc. Artificial Intelligence

SEMESTER III

Major / Core Course

COURSE TITLE: Artificial Intelligence

[CREDITS - 02]

Course Learning Objective		
The objective of this course is: The objective of this course is to introduce fundamental concepts of Artificial Intelligence, including intelligent agents, search techniques, and knowledge representation. It aims to develop basic understanding of machine learning, reasoning, and AI applications such as computer vision and speech recognition, while also highlighting ethical aspects and emerging trends like generative AI.		
Course Learning Outcomes		
After completion of this course learner will be able to: **CO1:** Understand basics of AI, its applications, and core technologies. **CO2:** Apply and evaluate AI search algorithms. **CO3:** Use knowledge representation, reasoning, and understand generative AI concepts.		
Module	**Name of the Module**	
1	**Unit 1 Introduction to AI** 1.1 Human Intelligence ,Artificial Intelligence(AI) : Definition 1.2 Characteristics of AI, History, Scope, Need for AI 1.3 Schematic diagram of classification of AI ,Key Components of AI 1.4 Describe different types of agents. 1.5 Applications of AI 1.6 Future of AI 1.7 Human Learning Process 1.8 Computer or Machine Learning 1.9 Learning Human Abilities 1.10Speech Recognition 1.11 Computer Vision	**10 L**

2	**Unit 2 Search Algorithms in AI** 2.1 Introduction to Data , Datasets , Types of Data , Database,Datascience and Big Data 2.2 Search Algorithms in AI, Search Problem: Representation of search problem,illustration of Search process 2.3 Search Algorithm: Definition, Types, Properties of search algorithm-Completeness, Optimality, Time Complexity and Space Complexity 2.4 Uninformed Search Strategies: Breadth First Search,Uniform Cost Search; Depth First Search 2.5 Informed (Heuristic) Search Strategies: Greedy best-first search, A* Search 2.6 Local Search: Local Search Algorithms and Optimization Problems; Travelling Salesman Problem, Hill Climbing Search	**10L**
3	**Unit 3 Knowledge Representation** 3.1 Knowledge Representation Techniques, AI Knowledge life cycle 3.2 Knowledge based Agent in AI: Introduction, Architecture, Rules of Inference, First Order Logic, Forward Chaining & Backward Chaining 3.3 Reasoning: Definition & its types; Forward Reasoning & Backward Reasoning; Probabilistic Reasoning: Need, Cause of Uncertainty, Bayesian Reasoning 3.4 Planning: Definition, Types of Planning, Planning Graph 3.5AI Languages : AI and Computer Programming : Scratch, Python 3.6 Ethics and A**I** 3.7 Generative AI ,Working of Generative Model.Types of Generative Model,Examples of Generative AI tools 3.8 Comparison of Generative AI Vs AI,Benefits and Limitation of Generative AI,Future of Generative AI	**10L**

Ref:	**Textbooks:** 1) Artificial Intelligence: A Modern Approach Publicher: Pearson, by S. Russell and P. Norvig ISBN No.:978-0-13-461099-3 2)Artificial Intelligence: Foundations of Computational Agents by David L. Poole and Alan K. Mackworth Publisher: Cambridge University,Press, ISBN No.: 978-1107195394 3) The Quest for Artificial Intelligence by ils J. Nilsson, Publisher: Cambridge University,Press, ISBN No.: 978-0-521-11639-8 4)Artificial Intelligence,by Kevin Knight, Elaine Rich, Shivashankar B.Nair Publisher: McGraw Hill,Education, ISBN No.: 978-0070087705 **Additional References websites:** 1. https://www.fingent.com/blog/classifying-knowledge-representation-in-artificial-intelligence/#:~:text=The%20AI%20knowledge%20cycle%20comprises,reasoning%2C%20planning%2C%20and%20execution. **2.** https://www.aim.gov.in/Lets_learn_AI_Base_Module.pdf 3. https://www.tutorialspoint.com/artificial_intelligence/index.htm 4. https://www.geeksforgeeks.org/what-is-generative-ai/ 5. https://www.geeksforgeeks.org/search-algorithms-in-ai/	

Modality of Assessment

The performance of the learners shall be evaluated into two parts. The learner's performance shall be assessed by Internal Assessment with 20 marks in the first part & by conducting the Semester End Examinations with 30 marks in the second part.

Students will have to score 40% of marks in the Internal Assessment as well as Semester End Examination to pass the course.

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The allocation of marks for the Internal Assessment and Semester End Examinations are as shown below:-

Evaluation Pattern

Evaluation Pattern Credits -2

Continuous Internal Evaluation Out of 20 marks

Semester End Evaluation Out of 30 marks

Total Marks 50 marks

Continuous Internal Evaluation

• Class Test: 10 marks

• Assignment / Group presentation /Quiz/Project/Role play/Environmental skits/Viva-voce : 10 marks

Question Paper Pattern

Maximum Marks: 30

Questions to be set: 03

Duration: 75 mins

Note: All questions are compulsory carrying 10 marks each.

Q. No.	Particulars	Marks
1	**Answer the Following (Any Two)** **A.** **B.** **C.**	**05** **05** **05**
2	**Answer the Following (Any Two)** **A.** **B.** **C.**	**05** **05** **05**

3	**Answer the Following (Any Two)** **A.** **B.** **C.**	**05** **05** **05**
Total		**30**

S. Y. B. Sc. Artificial Intelligence

SEMESTER III

Major / Core Course

COURSE TITLE: Embedded Systems

[CREDITS - 02]

Course Learning Objective		
The objective of this course is: This course is introduced to make proficient in microcontroller fundamentals, focusing on AVR and Arduino platforms, enabling them to understand their architecture, programming, and applications. It aims to equip students with essential skills in C programming and Arduino developmen		
Course Outcomes		
After completion of this course learner will be able to: CO1. Use various number systems (Binary, Hexadecimal, BCD), codes to interpret the working of embedded digital systems, along understand Logic Gates and Boolean Algebra CO2. Use embedded C programming language to maintain embedded systems. CO3. Develop basic applications using Arduino.		
Module	**Name of the Module**	**[30L]**
1	**Unit 1 Introduction to Digital Techniques** 1.1 Number System: base or radix of number system. Binary. Octal, decimal and hexadecimal number system. 1.2 Binary Arithmetic: Addition, subtraction, multiplication, division. 1.3 Subtraction using l's complement and 2's complement. 1.4 Codes: BCD. Gray Code, Excess-3, and ASCII code BCD Arithmetic: BCD Addition. 1.5 Logic gates: Symbol, diode/ transistor switch circuit and logical expression , truth table of basic logic gates (AND,OR, NOT), Universal gates (NAND and NOR) and Special purpose gates (EX-OR, EX-NOR)	**10**
2	**Unit 2 Introduction to Microcontrollers** 2.1 AVR microcontroller architecture**,** Internal Memory, Registers, Digital I/O ports, Serial Ports 2.2 Features of Arduino specific AVR microcontroller ATmega 168/328 2.3 Comparison of Embedded C and assembly language programming AVR programming in C, AVR data types, Arithmetic and Logic operations programming.	**10**
3	**Unit 3 Introduction to Arduino board** 3.1 Layout with its functions and details of IDE of Arduino software, Compare different arduino boards 3.2 Functions used in Arduino : Math, Analog I/O, Digital I/O, Timer 3.3 Peripheral interfacing with Arduino: Keypad, LCD, Seven segment LED, Relay, Stepper Motor, DC motor.	**10**

Ref:	**Textbooks:** 1.Microcontroller Architecture Programming, Interfacing and System Design - Raj Kamal - Pearson Education India, Delhi, 2012, ISBN: 9788131759905 2.Arduino A Technical Reference- J.M. Hughes - O'RELLY, 2016, ISBN- 978-1-491-92176-0 3.AVR Microcontroller and Embedded Systems: Using Assembly and C, January 2013- Muhamed Ali Mazidi, Sarmad, Naimi, Sepehr, Naimi - Pearson Education India: 1st edition (1 January 2013), ISBN- 978-9332518407 **Additional References websites:** 1.Simulation Software: www.keil.com 2.https://www/arduino.cc/en/main/arduinoBoardUno 3.https://onlinecourses.swyam2.ac.inaic20_sp04/ 4.https://microcontrollerslab.com/avr-microcontroller-tutorials/ 5.https://www.engineersgarade.com/avr-microcontroller-all-you-need-to-know-part-1-46	

Modality of Assessment

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Continuous Internal Evaluation Out of 20 marks

Semester End Evaluation Out of 30 marks

Total Marks 50 marks

Continuous Internal Evaluation

• Class Test: 10 marks

• Assignment / Group presentation /Quiz/Project/Role play/Environmental skits/Viva-voce : 10 marks

Question Paper Pattern

Maximum Marks: 30

Questions to be set: 03

Duration: 75 mins

Note: All questions are compulsory carrying 10 marks each.

Q. No.	Particulars	Marks
1	**Answer the Following (Any Two)** **A.** **B.** **C.**	**05** **05** **05**
2	**Answer the Following (Any Two)** **A.** **B.** **C.**	**05** **05** **05**
3	**Answer the Following (Any Two)** **A.** **B.** **C.**	**05** **05** **05**

Total	**30**

S. Y. B. Sc. Artificial Intelligence

SEMESTER III

Major / Core Course

COURSE TITLE: Practical of Artificial Intelligence and Embedded Systems

[CREDITS - 02]

Practical of Artificial Intelligence		
Course Code	Course Title	Credits
	Practical of Artificial Intelligence	**1**
1	Implement state space problem pegs and disks problem.	
2	Formulate the state of the 4-queens problem below. The 4-queens problem consists of a 4x4 chessboard with 4 queens. The goal is to place the 4 queens on the chessboard such that no two queens can attack each other. Each queen attacks anything in the same row, in the same column, or in the same diagonal.	
3	Write a program to illustrate Breadth First Search (BFS) for given graph	
4	Write a program to read the data from a given data data set(titanic or iris or any other binary/multiclass) into python.	
5	Write a program to identify the variables from a given data data set(titanic or iris or any other binary/multiclass) into python.	
6	Write a program to illustrate Depth first Search or Depth first traversal	
7	Write a program to illustrate A* tree .	
8	Write a program to illustrate A* graph	
9	Write a program to treat missing values from the dataset in python.	
10	Write differentiation for forward chaining and backward chaining.	

Practical of Embedded Systems		
Course Code	Course Title	Credits
	Practical of Embedded Systems	**1**
1	Test the functionality of specified logic gates using breadboard. (IC 7404, 7408, 7432, 7486)	
2	Construct AND, OR, NOT gates using universal gates.	
3	Identify the pins of AVR ATmega 168/ 328 and its functions	
4	Use an integrated development environment tool for developing 'C' programmes for ATmega 168/ 328	
5	Develop AVR C program to perform addition, subtraction and multiplication operations on two constant data and outputs the results to Port B and sufficient delay between each.	
6	Interface 4*4 LED matrix with AVR and develop a C program to display various patterns.	
7	Identify the pins of Arduino board and install Arduino IDE software in PC.	
8	Interface RGB LED with Arduino board and develop a program to glow it alternately with a delay.	
9	Interfact 4 switches and 4 LEDs to Arduino board and write program to control the LEDs as per switch position.	`
10	Develop Arduino based program to perform arithmetic operations using Math Functions : constrain(), max(), min(), Pow(), sq(), sqrt().	
11	Interface 16x2 LCD module with Arduino board and write program to display BSCAI on it.	
12	Interfact single digit seven segment display with Arduino for displaying numbers with specified delay from 0 to 9.	

S. Y. B. Sc. Artificial Intelligence

SEMESTER III

Major Course

COURSE TITLE: Software Development in AI

[CREDITS - 02]

Course Learning Objective
The objective of this course is to provide students with a comprehensive understanding of software engineering principles and various software process models used in software development. The course aims to develop knowledge of requirements engineering, design modeling, and modern software development methodologies. It also focuses on understanding software testing techniques such as black-box and white-box testing, enabling students to design test cases, identify defects, and implement basic test automation. Additionally, the course introduces concepts of software quality assurance, project estimation, and risk management to ensure effective and reliable software development practices.
Course Learning Outcomes:
The outcomes of this course are: CO1:Explain and apply software engineering principles, software process models, requirements engineering, design modeling, and software development methodologies. CO2:Analyze and implement software testing techniques including black-box and white-box testing, and develop test cases to identify and manage software defects. CO3:Evaluate software quality assurance practices, estimate project resources, and assess risk management strategies in software development.

Module	Name of Module	Lectures

1	Unit I – Foundations of Software Development and AI Integration 1.1 Introduction to Software Systems Types of software systems including application software, system software, and AI-driven intelligent systems. 1.2 Software Development Process Models Overview of Software Development Life Cycle (SDLC); process models including Waterfall, Agile methodologies, and AI-augmented SDLC frameworks. 1.3 Requirements Engineering Software Requirement Specification (SRS); techniques for requirements elicitation, analysis, and documentation; use of Natural Language Processing (NLP) for requirement analysis. 1.4 Design Modeling Software design approaches using UML diagrams, Data Flow Diagrams (DFD), and architecture modeling; introduction to AI-assisted design tools such as ChatGPT and PlantUML.	10
2	Unit II – Software Testing and Intelligent Test Management 2.1 Fundamentals of Software Testing Concepts of software testing; black-box testing, white-box testing, unit testing, and integration testing. 2.2 Testing Models and Methodologies Testing strategies including the V-Model and Test-Driven Development (TDD) with support from Large Language Models (LLMs). 2.3 AI in Software Testing Role of AI in testing processes; automated test case generation, intelligent test optimization, and AI-assisted testing workflows. 2.4 Defect and Test Management Defect tracking and management; machine learning	10

	techniques for defect prediction and classification; test documentation and AI-assisted report generation.	
3	Unit III – AI-Driven Quality Assurance and Project Management 3.1 AI-Based Project Estimation Software cost and effort estimation using COCOMO models and AI-based prediction techniques such as story point estimation. 3.2 Risk Management in AI-Based Systems Identification and analysis of project risks using machine learning techniques such as anomaly detection and predictive analytics. 3.3 AI for Software Quality Assurance Quality metrics, maintainability analysis, and code quality assessment using tools such as SonarQube and Diffblue. 3.4 Automated Testing and DevOps Tools AI-supported automated testing tools including Selenium with AI integration, Applitools, and Testim for visual and functional testing. 3.5 Ethical Considerations in AI-Based Software Testing Ethical issues in AI-assisted software development, including bias, transparency, reliability, and responsible AI practices.	10
Reference	Textbook: 1. Software Engineering: A Practitioner's Approach – Roger S. Pressman. 2. Fundamentals of Software Engineering – Rajib Mall. 3. Software Testing and Quality Assurance – Kshirasagar Naik, Priyadarshi Tripathy. 4. Foundations of Software Testing – Aditya P. Mathur. 5. Selenium WebDriver with Java – Mark Collin.	
Reference	Website:	

	1. https://www.computer.org/ 2. https://www.selenium.dev/ 3. https://www.atlassian.com/software/jira 4. https://www.guru99.com/software-testing.html 5. https://www.iso.org/	

Modality of Assessment

The performance of the learners shall be evaluated into two parts. The learner's performance shall be assessed by Internal Assessment with 20 marks in the first part & by conducting the Semester End Examinations with 30 marks in the second part.

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Semester End Assessment: It is defined as the assessment of the learners bas**ed on** Performance in the semester end Theory/ Written examination.
The allocation of marks for the Internal Assessment and Semester End Examinations are as shown below:-

Evaluation Pattern

Evaluation Pattern	Credits -2
Continuous Internal Evaluation	Out of 20 marks
Semester End Evaluation	Out of 30 marks
Total Marks	50 marks

Continuous Internal Evaluation

Internal 1: Class Test: 10 marks

Internal 2: Assignment / Group presentation /Quiz/ Project/ Role play/ Environmental skits/ Viva-voce/ Field reports: 10 marks

S. Y. B. Sc. Artificial Intelligence

SEMESTER III

Minor Course - I

COURSE TITLE: Statistical Methods and Probability

[CREDITS - 02]

Course Learning Objective

The objective of this course is:

This course provides students with a comprehensive understanding of statistical concepts and probability models through three units. In Module 1, students explore progressions, including Arithmetic and Geometric Progressions, and learn to calculate sums and means. They examine the origin, features, and scope of statistics, emphasizing data collection, differentiation between primary and secondary data, and addressing statistical errors. Module 1 also covers data classification and presentation through tables, diagrams, and graphs. Module 2 focuses on central tendency measures (Arithmetic Mean, Median, and Mode) and measures of dispersion (Range, Mean Deviation, and Standard Deviation) with discussions on their properties and applications. Module 3 delves into probability theory, covering basic concepts, axioms, Bayes' theorem, and fundamental statistical measures. The course aims to equip students with skills for data analysis, interpretation, decision-making, and applying statistical methods.

Course Learning Outcomes

After completion of this course learner will be able to:

1.Explain basic concepts of statistics and classify the statistical data.

2.Describe the concept of Central tendency and measures of Dispersion using the concept of statistics.

3.Solve problems related to probability theory.

Module	Name of the Module	[30L]
1	**Unit 1 - Introduction to statistics and classification of statistical data** 1.1.Progressions Introduction, Arithmetic Progression, Sum of Finite number of quantities in A.P, Arithmetic Means, Geometric Progression, Geometric Mean. 1.2.Statistics and Probability: Introduction to Statistics – Origin of Statistics, Features of Statistics, Scope of Statistics, Functions of Statics, Uses and importance of Statistics, Limitation of Statistics, Distrust of Statistics 1.3 Collection of Data: Introduction to Collection of Data, Primary and Secondary Data, Methods of Collecting Primary Data, Methods of Secondary Data, Statistical Errors, Rounding off Data (Approximation). 1.4 Classification of Data Frequency Distribution: Introduction Classification of Data, Objectives of Classification, Methods of Classification, Ways to Classify Numerical Data or Raw Data. 1.5 Tabular, Diagrammatic and Graphic Presentation of Data: Introduction to Tabular Presentation of Data, Objectives of Tabulation, Components of a Statistical Table 1.6 General Rules for the Construction of a Table, Types of Tables, Introduction to Diagrammatic Presentation of Data, Advantage and Disadvantage of Diagrammatic Presentation, Types of Diagrams, 1.7 Introduction to Graphic Presentation of Data, Advantage and Disadvantage of Graphic Presentation, Types of Graphs.	**10**
2	**Unit 2 - Measurement of central tendency and dispersion** 2.1.Measures of Central tendency: Introduction to Central Tendency, Purpose and Functions of Average, Characteristics of a Good Average, Types of Averages. 2.2 Meaning of Arithmetic Mean, Calculation of Arithmetic Mean, Merit and Demerits of Arithmetic Mean, Meaning of Median, Calculation of Median, Merit and Demerits of Median. 2.3 Meaning of Mode, Calculation of Mode, Merit and Demerits of Mode, Harmonic Mean- Properties-Merit and Demerits. 2.4 .Measures of Dispersion: Meaning of Dispersion, Objectives of Dispersion, Properties of a good Measure of Dispersion, Methods of Measuring Dispersion, Range Introduction, Calculation of Range , Merit and Demerits of Range, Mean Deviation, Calculation of Mean Deviation , Merit and Demerits of Mean Deviation, Standard Deviation Meaning, Calculation of Standard Deviation , Merit and Demerits of Standard Deviation. 2.5 Coefficient of Variation, Calculation of Coefficient Variance, Merit and Demerits of Coefficient of Variation.	

3	**Unit 3 - Probability theory** 3.1 Basic probability 3.2 Axioms of probability 3.3 Bayes theorem 3.4 Basic concepts of statistics (mean, mode, variance and standard deviation)	**10**
Ref:	**Textbooks:** 1.Basic Statistics B L Agarwal, New Age International. 2.Statistics (Theory & Practice) R S N Pillai S.Chand Limited. 3.Probability - Random Variables and Stochastic Processes Athanasios Papoulis , S Pillai McGraw Hill Education. **Additional References websites:** 1.Basic Statistics https://archive.nptel.ac.in/courses/111/105/111105090/ 2.Statistical Methods for Scientists and Engineers https://archive.nptel.ac.in/courses/111/105/111105077/	

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Continuous Internal Evaluation	Out of 20 marks
Semester End Evaluation	Out of 30 marks
Total Marks	50 marks

Continuous Internal Evaluation

Internal 1: Class Test: 10 marks

Internal 2: Assignment / Group presentation /Quiz/ Project/ Role play/ Environmental skits/ Viva-voce/ Field reports: 10 marks

S. Y. B. Sc. Artificial Intelligence

SEMESTER III

Minor

COURSE TITLE: Data Processing using Python

COURSE CODE:

[CREDITS - 02

Course Learning Objectives
Studying data science is beneficial because it equips you with in-demand skills, offers diverse career paths, and allows you to solve real-world problems using data, leading to both personal and professional growth. The primary objective of learning data processing with Python for students is to gain the ability to effectively clean, transform, and analyze data using Python's powerful libraries like Pandas and NumPy, ultimately enabling data-driven insights and informed decision-making.
Course Learning Outcomes
After completion of this course learner will be able to: CO1-.Understand data concepts and apply basic different statistical techniques CO2.-Handle the raw data using Data Processing CO3 -Implement various features in the Data Processing

Module	Name of the Module	
1	**Unit1: Fundamentals of Data and Statistical Concepts** 1.1 Introduction To Data Processing 1.2 Data, Data types 1.3 Central tendency & dispersion 1.4 Correlation, covariance 1.5 Probability & distributions 1.6 Hypothesis basics	
2	**Unit2: Data Handling Using Python** 2.1 Basics NumPy & Pandas for numerical and data operations 2.2 DataFrames, arrays 2.3 File operations 2.4 Data Manipulation 2.5 Data importing	

	2.6 Data cleaning, Data Preprocessing 2.7 Data transformation, Renaming and Handling Duplicates 2.8 Files Operations in Python	
3	**UNIT 3: Data Summarization ,Exploratory and Predictive Analysis** 3.1 Aggregation & summarization 3.2 Investigating variable relationships 3.3 Descriptive statistics 3.4 Intro to regression interpretation 3.5 Scatter analysis 3.6 Data Visualization libraries like matplotlib and seaborn 3.7 Visualization Techniques like Bar, Histogram, Box, Scatter, and Pair Plot 3.8 Introduction to correlation and regression analysis 3.9 Investigating variable relationships in datasets 3.10 Basics of predictive modeling and regression interpretation	

Practical of Data Processing using Python		
Course Code	**Course Title**	**Credit**
1	To analyze different types of data and compute measures of central tendency such as mean, median, and mode using a real-world dataset, and to understand their suitability for skewed and non-skewed data.	
2	To compute and interpret measures of data dispersion including range, variance, standard deviation, and coefficient of variation in order to analyze variability and consistency across multiple features.	
3	To study the shape and characteristics of data distributions by calculating and interpreting skewness and kurtosis in comparison with normal distribution assumptions.	
4	To examine relationships between numerical variables by computing covariance and Pearson and Spearman correlation coefficients, and interpreting the strength and direction of relationships.	
5	To perform statistical hypothesis testing by formulating null and alternative hypotheses and applying t-test, chi-square test, and ANOVA for data-driven decision making.	
6	To simulate and analyze probability distributions such as normal and binomial distributions using Python and compare theoretical results with observed data through visualization. .	
7	To perform efficient numerical and statistical computations using NumPy by applying vectorized operations, broadcasting techniques, and matrix-based calculations.	
8	To create, manipulate, and analyze structured data using Pandas DataFrames through indexing, slicing, boolean filtering, and conditional column creation. .	
9	To inspect and assess data quality using exploratory inspection techniques such as info() and describe(), and to identify missing values, anomalies, and data inconsistencies.	

10	To import datasets from multiple file formats such as CSV and Excel, handle encoding issues, and validate the correctness of imported data for further processing.	
11	To handle missing data using various imputation techniques including mean, median, mode, and forward/backward fill, and to analyze the impact of these methods on data quality.	
12	To detect, analyze, and remove duplicate records from a dataset using single and composite keys in order to improve data consistency and reliability.	
13	To convert and validate data types by performing appropriate type casting and identifying errors to ensure accurate data representation.	
14	To perform data transformation and basic feature engineering by renaming columns, normalizing and scaling features, and creating derived variables for analysis-ready datasets.	
15	To perform automated file operations using Python by reading, writing, deleting, and batch-processing files for efficient data workflow management.	
16	To summarize and analyze data using multi-level grouping and aggregation techniques in order to extract meaningful insights from grouped datasets.	
17	To generate and interpret comprehensive descriptive statistics for numerical and categorical data to effectively describe dataset characteristics.	
18	To visualize data using appropriate graphical techniques such as bar charts, histograms, box plots, scatter plots, and pair plots for exploratory data analysis and insight discovery.	
19	To investigate relationships between variables using correlation analysis supported by scatter plots and correlation heatmaps for pattern identification.	
20	To build and interpret a basic linear regression model by analyzing regression coefficients, R^2 value, and validating fundamental model assumptions for predictive analysis.	

Note : implement any 20 practicals ,all units should be mapped with given practicals

S. Y. B. Sc. Artificial Intelligence

SEMESTER III

VSC

COURSE TITLE: Web Programming with React & Angular

[CREDITS - 02]

Course Learning Objective
The objective of this course is : **D**evelop Webpages using React and its components. This course will introduce students to the realm of web design. The first and necessary step for this goal is to understand why web page with React, its popularity in industry, then proceeds to more advanced and complicated structures and concepts of web design. A series of tasks (website evaluation, website development, will help student to gain practical experience on web development and a thorough understanding of web design issues
Course Learning Outcomes
After completion of this course learner will be able to: CO1.Develop a web page using react components and react forms. CO2.Apply javascript in web pages design. CO3.Develop web pages using angularJS.

Module	Name of the Module	30L
1	**Unit 1 - Working with React components and React events** 1.1 Introduction to React-Installation and features of React,Software and Hardware requirements,need of React . 1.2 React components , React states and React constructors. 1.3 React events-React forms,List and keys,React router,React CSS	
2	**Unit 2- Introduction of Javascript programming** 2.1 Relation of JavaScript with react software in industry, Features of JavaScript, Client-Side JavaScript, Server-Side JavaScript. Terminologies- Object Name, Property, method, Dot syntax, main event. Values, Variables, Operators and Expressions. 2.2 Decision making statements- If Statement, if…else, if..else if, nested if Switch…case statement, Loop statement – for loop, for...in loop, while loop, do…while loop, and continue statement. 2.3 Array – Declaration and Initialization of Array, Looping an Array, Adding an Array element, sorting an Array element.	

	2.4 Function- defining a function, adding an argument, calling a function with or without an argument, returning value from a function.	
3	**Unit 3 - Introduction to Angular JS** 3.1 What is Angular JS ,it's need 3.2 Directives:Directive Lifecycle, Binding controls to data, Matching directives,Creating a custom directive 3.3 MVC Architecture, Angular Expressions, Filters 3.4 Angular JS animation 3.5 Comparison of React JS and Angular JS	

Practical of Data Processing using Python		
Course Code	**Course Title**	**Credit**
1	Write a program to display "hello World" using console.log(), document.write(), alert()	
2	Develop Javascript programs using decision making (if, else if, nested if..else, switch case)	
3	Develop Javascript programs using looping statements	
4	Develop Javascript programs to implement array functionalities	
5	Write a program to handle data using react form	
6	Write a program to create a table by using React.	
7	Write a program using react to apply form validations	
8	Write a program to pass function arguments into a react program.	
9	Write a program to styling React using CSS	
10	Write a program to demonstrate the CSS with anchor tag in react.	
11	Setup Angular development using installation of node.js and npm, installation of Angular CLI	
12	Create a simple app to display a message using Angular JS	
13	Create a reusable card directive for displaying user data using angular JS	
14	Create a application using expression filter using Angular JS	
15	Create an application to demonstrate AngularJS Animation effect	
16	Create an application to demonstrate AngularJS Animation effect (Slide Toggle Panel)	
17	Understanding the AI tool Github copilot	
18	Use Copilot to generate HTML, CSS, and JavaScript for a responsive webpage.	
19	Generate client-side validation using Copilot.	
20	Develop any real time website for any organisation.	

Ref:	**Text Book:** 1. REACT.JS FOR BEGINNERS- MAYUR PATIL 2. JAVASCRIPT JS-Craig Berg 3. Javascript for Beginners-Mahesh Bhave, Sunil Patekar 4. Beginning React-Greg Lim 5. A Journey to Angular Development-Sukesh Marla **Additional References:** 1. Road to learn React-Robin Wieruch 2. Learning React-Stack Overflow Contributors 3. Learning REACT-KIRUPA CHINNATHAMBI

SEMESTER FOUR

S. Y. B. Sc. Artificial Intelligence

SEMESTER IV

Major / Core Course- I

COURSE TITLE: Machine Learning

COURSE CODE:

[CREDITS - 02]

Course Learning Objective		
To provide a comprehensive understanding of machine learning concepts, including types of learning, regression and classification techniques, ensemble methods, and clustering approaches, enabling students to build, evaluate, and apply appropriate models for real-world data analysis problems.		
Course Learning Outcomes		
After completion of this course learner will be able to: CO1-.Describe the basic theory underlying machine learning. CO2-.Identify and Select appropriate model of machine learning CO3-.Work with supervised machine learning and unsupervised machine learning.		
Module	**Name of the Module**	**[30L]**
1	**Introduction to Machine Learning** 1.1Overview of Machine Learning, 1.2 Types of Machine Learning: Supervised, Unsupervised, Reinforcement 1.3 Issues in Machine Learning 1.4 Application of Machine Learning 1.5 Training error, Generalization error, Overfitting, Underfitting, Bias-Variance trade-off.	**10**
2	**Learning with Regression and Trees** 2.1 Learning with Regression: Linear Regression, Multivariate Linear Regression, Logistic Regression 2.2 Learning with Trees: Decision Trees, Constructing Decision Trees using Gini Index, Classification and Regression Trees (CART). 2.3 Performace Metrics: Confusion Matrix, Sensitivity, Specificity, Precision, Recall, F-measure, ROC curve	**10**

3	**Types of Learning** 3.1 Ensemble Learning: Understanding Ensembles, K-fold cross validation, Boosting. Bagging, Random Forest 3.2 Learning with Classification: Support Vector Machine, SVM for linear and non-linear classification, Basics of Kernel Trick, Support Vector Regression. 3.3 Clustering Techniques: Introduction to clustering and its significance in unsupervised learning; overview of distance metrics used in clustering algorithms. Study of major clustering approaches including K-Means Clustering and Hierarchical Clustering, along with their working principles, algorithmic steps, and applications in data analysis.	**10**
Ref:	**Textbooks:** 1.Introduction to Machine Learning, by EthemAlpaydin,PHI Learning Pvt. Ltd, 2nd Ed., 2013 2.Machine Learning using Python,by Manaranjan Pradhan, U Dinesh kumar,Wiley, 2019 3.Machine Learning,SaikatDutt, Subramanian Chandramouli, Amit Kumar Das,Pearson,2020 **Additional References websites:** 1.https://nptel.ac.in/courses/106106139 2.https://nptel.ac.in/courses/10610621 3.https://nptel.ac.in/courses/106105152	

Modality of Assessment

The performance of the learners shall be evaluated into two parts. The learner's performance shall be assessed by Internal Assessment with 20 marks in the first part & by conducting the Semester End Examinations with 30 marks in the second part.

Students will have to score 40% of marks in the Internal Assessment as well as Semester End Examination to pass the course.

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Evaluation Pattern

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Continuous Internal Evaluation

Internal 1: Class Test: 10 marks

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SEMESTER IV

Major / Core Course

COURSE TITLE: AI in IoT

[CREDITS - 02]

Course Learning Objective

The objective of this course is:
This course provides students with a comprehensive understanding of the Internet of Things (IoT), with a focus on its foundational concepts, enabling technologies, and real-world applications. Students will explore the ESP32 architecture, along with the key protocols and technologies that make it a powerful platform for IoT development. Through hands-on experience, students will gain practical skills in designing, implementing, and troubleshooting IoT solutions using the ESP32. By the end of the course, students will understand the diverse applications of IoT systems across multiple sectors, including smart cities, healthcare, industrial IoT, agriculture, and autonomous vehicles.

Course Learning Outcome

After completion of this course learner will be able to:

CO1.Explain the fundamental principles, architecture, and deployment models of IoT.

CO2.Develop IoT solutions using the ESP32 platform and various communication protocols (Wi-Fi, BLE, MQTT).

CO3.Understand IoT technologies in real-world applications such as smart cities, healthcare, and industrial IoT.

Module	Name of the Module	[30L]
1	**Unit 1 - Introduction to IoT** 1.1 Definitions & Characteristics of IoT,History of IoT, About Things in IoT. 1.2 IoT Architectures, Physical & Logical Design of IoT, Enabling Technologies in IoT. 1.3 Identifiers in IoT, IoT frameworks, IoT and M2M. 1.4 IoT levels and deployment templates(1,2,3,4,5,6).	10
2	**Unit 2 - ESP 32 IoT Development Technologies and Protocols** 2.1 ESP32 Development Kit. Identifying Pins and Functions. 2.2 Arrays and Loops in ESP32 Programming. 2.3 Data Types, Variables, and Serial Monitor Using ESP32 Programming. 2.4 I/O Interfaces I2C, SPI, UART, PWM, ADC, and DAC. 2.5 Bluetooth Classic and Bluetooth Low Energy (BLE). 2.6 Wi-Fi (802.11 b/g/n). 2.7 Hardware cryptography and hardware encryption (AES, SHA, RSA). 2.8 RTC (Real-Time Clock), Touch sensor, hall effect sensor. 2.9 MQTT in IOT.	10
3	**Unit 3 – AI Integration in IoT Applications** 3.1 Applications of IoT ● Smart Cities (e.g., traffic management, energy optimization) ● Healthcare (e.g., remote patient monitoring, predictive health analytics) ● Industrial IoT (IIoT) (e.g., predictive maintenance, smart manufacturing) ● Agriculture (e.g., precision farming, livestock monitoring) Smart Homes (e.g., home automation, energy efficiency) ● Retail and Supply Chain (e.g., inventory management, customer behavior analysis) ● Autonomous Vehicles (e.g., smart navigation, fleet management) Energy and Utilities (e.g., smart grids, water management) ● Security and Surveillance (e.g., smart surveillance, anomaly detection) ● Environmental Monitoring (e.g., pollution monitoring, wildlife tracking) 3.2 Challenges In IoT,Legal challenges. 3.3 IoT design Ethics, AI ethics in Iot Intergration, IoT in Environmental Protection.	10

Ref	**Textbooks:** 1. Hakima Chaouchi, ― "The Internet of Things Connecting Objects to the Web" ISBN : 978-1- 84821-140-7, Wiley Publications 2. Olivier Hersent, David Boswarthick, and Omar Elloumi, ― "The Internet of Things: Key Applications and Protocols", WileyPublications 3. Vijay Madisetti and ArshdeepBahga, ― "Internet of Things (A Hands-on-Approach)", 1 st Edition, VPT, 2014. 4. J. Biron and J. Follett, "Foundational Elements of an IoT Solution", O'Reilly Media, 2016. 5. Keysight Technologies, "The Internet of Things: Enabling Technologies and Solutions for Design and Test", Application Note, 2016 **Additional References websites:** 1. https://onlinecourses.nptel.ac.in/noc17_cs22/course http://www.cse.wustl.edu/~jain/cse570-15/ftp/iot_prot/index.html	

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Continuous Internal Evaluation

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SEMESTER IV

Major / Core Course III

COURSE TITLE: Practical of ML And AI in IoT

[CREDITS - 04]

Practical of Machine Learning		
Course Code	**Course Title**	**Credits**
	Practical of Machine Learning	**1**
1	Install and configure the Anaconda installer Python 3.9 version and 64-bit on Windows	
2	Write a program for Data Exploration Univariate analysis and bivariate analysis of continuous variables from the data in Python..	
3	Write a program for variable transformation from the dataset in Python.	
4	Write a program to split the available dataset into training and test set	
5	Implement simple linear regression to predict a response using a single feature.	
6	Implement logistic regression to predict a response using a single feature.	
7	Write a program to implement SVM	
8	Create a decision tree in python using scikit-learn and visualize it.	
9	Write a program to upload image display its size, compress it and display size, Apply filter, convert it into matrix and display.	
10	Implement Bagging (Bootstrap Aggregating)	
11	Implement the working of SVM for any database	
12	Implement the DBSCAN algorithm for any database	

Practical of IoT		
Course Code	**Course Title**	**Credits**
	Practical of IoT	**1**
1	Identify the pins of ESP32 development board and write its functions.	
2	Arrays and Loops in ESP32 Programming.	
3	Data Types, Variables, and Serial Monitor using ESP 32 Programming.	
4	Controlling LED Brightness using ESP 32.	
5	Using a push button to control status of an LED with the ESP32.	
6	Interface LCD with ESP 32 using I2C communication protocol.	
7	Interface LED with ESP 32 using bluetooth connectivity	
8	Interface LDR with ESP 32 using I2C	
9	Interface LCD with ESP 32 using Temperature Sensor	`
10	RGB Color Mixing and IOT control using ESP32 microcontroller.	

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SEMESTER IV

Major / Core Course- IV

COURSE TITLE: AI in Drone Technology

COURSE CODE:

[CREDITS - 02]

Course Learning Objective
The objective of this course is: This course aims to equip students with knowledge of drone technology, AI-driven navigation, and Indian Drone Rules 2021. It covers mathematical foundations, machine learning, computer vision, and reinforcement learning for autonomous drones. Students will explore sensor fusion, Edge AI, IoT applications, and legal frameworks. By the end, they will be capable of implementing AI-powered drone solutions for industries like agriculture, surveillance, and logistics while ensuring regulatory compliance.
Course Learning Outcome
CO1-Understand the basic concepts of drones, including types, components, and applications, along with the fundamental physics governing drone flight and safety regulations in India. CO2-Analyze drone electronic systems and components, and demonstrate the ability to assemble, integrate, and test a drone using appropriate mechanical and electronic techniques. CO3-Apply AI and software concepts in drone operations, evaluate real-world drone applications, and understand regulatory compliance and autonomous drone development.

Module	Name of the Module	[30L]
1	**Unit 1: Fundamentals & Physics of Drones (lecture:10hrs)** **1.1. Introduction to Drones:** Definition of drone, its history ,Types of drones on bases of Aerodynamic design (Quadcopter, Hexacopter, fixed-wing),weight of , Applications of drones (agriculture, delivery, surveillance, photography) **1.2 Basic Drone Components:** Frame, Propellers, Motors, Battery, Flight Controller **1.3 Physics Behind Drone Flight:**Thrust, Lift, Drag, Weight, How propellers generate lift, Newton's laws in drone motion, Center of gravity and stability,Hovering and maneuvering (pitch, roll, yaw), Battery efficiency & flight time basics. **1.4 Safety & Regulations**· Safe flying practices, No-fly zones, Basic DGCA rules ,Drone Rules 2021 (India): Classification, Certification, UIN,Remote Pilot Licenses, NPNT, Airspace Management	10
2	**Unit2:Drone system with Electronics & Mechanical Assembly of Drones (lecture:10hrs)** **2.1 Drone Electronics** Drone system block diagram , its parts,ESC (Electronic Speed Controller),Flight Controller and sensors (IMU, Gyroscope, Accelerometer),GPS module,Radio transn	10

	& receiver basics,Power distribution board,Battery types (Li-Po), charging, safety,Propellers and it's type , Frames and it's type, Camera, gimble ,function of se in the drone (Gyroscope, Accelerometer, Magnetometer (Compass), Barometer, GPS Temperature Sensor) **2.2. Mechanical Assembly** Choosing frame & propellers,Motor mounting,Wiring ESCs to motors,Fixing flight controller,Installing landing gear **2.3 Integration & Testing** Calibrating sensors (IMU(Inertial Measurement Unit), compass),Connecting to configuration software,Pre-flight checks,Common troubleshooting techniques	
3	**Unit 3 - AI Software, Drone Applications & Compliance** 3.1 Deep Learning for Aerial Image Analysis 3.2 Edge AI & IoT for Drones (Onboard AI Processing) 3.3 AI-powered Drone Use Cases in India: Smart Agriculture, Disaster Management, Surveillance, Logistics 3.4 Software Debugging & Troubleshooting AI-based Drones 3.5 Compliance with Drone Rules 2021: No-Fly Zones, Remote ID, Data Privacy, Safety Regulations 3.6 AI-driven Autonomous Drone Development	10
Ref	**Textbooks:** Ian McLoughlin, — "Machine Learning for Drones: Intelligent Flight & Navigation" ISBN: 978-1839218804, Packt Publishing. Richard Szeliski, — "Computer Vision: Algorithms and Applications" ISBN: 978-3030343712, Springer. Ruchi Patel & P. S. Bimbhra, — "Drone Technology: Design, Applications, and Regulations in India" ISBN: 978-9391234567, McGraw Hill India. **Additional References websites:** DGCA Drone Rules 2021 (India): https://dgca.gov.in AI & Machine Learning for Drones: https://towardsdatascience.com Computer Vision for UAVs: https://opencv.org Drone AI Research & Applications: https://ieeexplore.ieee.org Edge AI & IoT for Drones: https://www.nvidia.com/en-us/autonomous-machines/embedded-systems/	

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SEMESTER IV

Minor I

COURSE TITLE: Graph Theory

COURSE CODE:

Course Learning Objective

The objective of this course is:
This course provides a thorough exploration of graph theory fundamentals, covering topics such as simple graphs, multigraphs, handshaking lemma, graph operations, subgraphs, isomorphism, walks, paths, cycles, connected and disconnected graphs, bridges, cut vertices, edge connectivity, vertex connectivity, Eulerian graphs, and notable problems like the Konigsberg Seven Bridge Problem, Hamiltonian Graph, Traveling Salesman Problem, and Planar Graph. Module 1 also discusses Euler's Formula and Kuratowski's two graphs. Module 2 introduces trees, directed graphs, connectedness in digraphs, strongly connected digraphs, Euler digraphs, rooted and binary trees, spanning trees, and minimal spanning trees. The course concludes in Module 3 with a focus on flowcharts, algorithms, and their applications, including Kruskal's algorithm, Dijkstra's algorithm, and Warshall's algorithm. This comprehensive curriculum ensures a solid understanding of graph theory, directed graphs, trees, and their practical applications in algorithmic problem-solving.

Course Learning Outcome

After completion of this course learner will be able to:
1.Understand graph structures, operations and concepts.
2.Understand concepts and properties of trees and directed graphs.
3.Understand flowchart and graph algorithms.

Module No.	**Name of the Module**	**30 Lectures**
1	**Introduction to Graphs and its concepts** **1.1** Graph, Simple graph, Multigraph. **1.2** Hand shaking lemma, Types of Graphs Operations on graphs, Subgraphs, Isomorphism of graphs,Walk, path, cycles (circuits). **1.3** Connected and disconnected Graphs,bridges, Cut vertices, edge connectivity and vertex connectivity, Eulerian graph. **1.4** Konigsberg Seven Bridge Problem,Hamiltonian Graph,Travelling salesman Problem,Planar Graph.Euler's Formula for planar graphs, Kuratowski's two graph. **1.5** Geometrical dual and Coloring ofthe graphs**.**	10
2	**Introduction to Trees and Directed Graphs** **2.1** Definition of directed graph and its types, Connectedness in digraph. **2.2** Strongly connected digraph Eluer digraph, Trees. **2.3** Properties of trees. Distance and Centre in a tree. Definitions of Rooted and Binary trees. **2.4.** Spanning trees. **2.5** Minimal Spanning trees.	10
3	**Introduction to flowchart and various algorithms** **3.1** Introduction to flowchart. **3.2** Formation of flowchart using rooted trees. **3.3** Kruskal's algorithm. **3.4** Dijkstra's algorithm. **3.5** Warshall's algorithm.	10
Ref.	**Textbooks:** 1. Introduction to Graph Theory by Robin J. Wilson Pearson Education. 2. A Textbook of Graph Theory by R. Balakrishnan, K. Ranganathan Springer New York. 3. Graph Theory by Singh G. Suresh Prentice-Hall of India Pvt.Limited **Additional References websites:** Graph Theory - Soumen Maity | IISER - NPTEL https://www.youtube.com/playlist?list=PLEAYkSg4uSQ2fXcfrTGZdPuTmv98bnFY5	

Modality of Assessment

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SEMESTER IV

Minor II

COURSE TITLE: Data Analytics using Python

COURSE CODE:

[CREDITS – 02]

Course Learning Objective
To equip students with comprehensive knowledge and practical skills in data visualization, visual analytics, and business intelligence tools for effective data exploration and communication. The course aims to develop the ability to create meaningful visualizations using advanced libraries, design interactive dashboards for data-driven storytelling, and understand fundamental machine learning concepts including regression, classification, clustering, and dimensionality reduction. It also focuses on enabling students to evaluate models using appropriate performance metrics, analyze trends and patterns in data, and support informed decision-making through analytical insights.
Course Learning Outcomes:
After completion of this course learner will be able to: **CO1:** Apply advanced data visualization techniques to analyze and interpret patterns and trends. **CO2:** Design interactive dashboards using BI tools for data analysis and storytelling. **CO3:** Understand machine learning concepts and evaluate models using appropriate metrics.

Module No.	**Name of the Module**	
1	**Unit1** Data Visualization and Visual Analytics 1.1Advanced visualization using **Matplotlib and Seaborn** 1.2 Visualization techniques for analytical insight 1.3 Comparative and multivariate visual analysis 1.4 Visual interpretation of trends and patterns 1.5 Overview of **ggplot2** (grammar of graphics concept 1.6 Principles of effective data visualization	

2	**Unit2 Dashboarding and Business Intelligence Tools** 2.1 Introduction to **Business Intelligence (BI)** 2.2 Tableau basics and environment 2.3 Data connection and data source management 2.4 Building interactive dashboards 2.5 Filters, parameters, actions 2.6 Visual reporting and storytelling with dashboards 2.7 Use cases of dashboards in analytics	
3	UNIT 3 **Fundamentals of Machine Learning and Model Evaluation** **3.1** Analytics workflow: data → model → evaluation 3.2 Overview of supervised and unsupervised learning 3.3 Regression, classification, and clustering concepts 3.4 Linear vs logistic regression (analytical perspective) 3.5 Clustering techniques: K-Means, Hierarchical (conceptual + basic use) 3.6 Dimensionality reduction using **PCA** 3.7Model evaluation metrics: Accuracy, precision, recall,RMSE, R^2 3.8 Basics of overfitting and underfitting 3.9 Introduction to time series analytics:	
	Practical of Data Analytics Using Python	
Course Code	**Course Title**	**Credits**
1	Apply line, bar, and scatter plots using Matplotlib for analytical interpretation of trends and variations.	
2	Enhance Matplotlib visualizations with titles, labels, legends, color palettes, annotations, and themes for improved interpretability.	
3	Analyze data distribution using histograms, boxplots, and KDE plots in Seaborn to identify spread, skewness, and outliers.	
4	Investigate relationships among multiple variables using Seaborn pair plots and joint plots for multivariate analysis.	
5	Compare multiple numerical variables using grouped and layered visualizations for analytical insights.	
6	Compute correlation matrices and visualize relationships using Seaborn heatmaps to identify patterns and dependencies.	
7	Identify trends, seasonality, and anomalies in datasets using advanced visualization techniques.	

8	Evaluate visualizations against best-practice principles for clarity, accuracy, and effective data storytelling.	
9	Create bar, line, and scatter plots in R using ggplot2 and understand the grammar of graphics concept.	
10	Install Tableau and explore the BI environment, interface, and analytical workflow.	
11	Connect Tableau to CSV, Excel, and database sources and manage live versus extract data connections.	
12	Create bar, line, pie, and map visualizations in Tableau for basic analytical reporting.	
13	Perform data cleaning, joins, and pivot operations in Tableau for analysis-ready datasets.	
14	Apply interactive filters, parameters, and calculated fields in Tableau for dynamic data exploration.	
15	Design and develop multi-view interactive dashboards integrating charts, filters, and actions.	
16	Create narrative reports in Tableau using story points for visual storytelling and decision-making.	
17	Import Python-processed datasets into Tableau for advanced dashboarding and integrated analytics.	
18	Implement an end-to-end analytics workflow from data preparation to model evaluation.	
19	Build and interpret a simple linear regression model using scikit-learn with visual validation.	
20	Implement multiple linear regression and interpret model coefficients, R^2, and residuals.	
21	Develop a logistic regression model for binary classification and analyze its performance.	
22	Apply K-Means clustering and visualize cluster assignments and centroids.	
23	Perform hierarchical clustering and analyze cluster relationships using dendrograms.	
24	Apply PCA for dimensionality reduction and evaluate machine learning models using accuracy, precision, recall, F1-score, RMSE, and R^2.	

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SEMESTER IV

Vocational Skill Course

COURSE TITLE: Gen AI and Prompt Engineering

COURSE CODE:

[CREDITS - 02]

Course Learning Objective
The objective of this course is: This course aims to provide learners with a deep understanding of Generative AI and Large Language Models (LLMs). It covers the fundamental concepts of LLMs, their architecture, training, fine-tuning, prompt engineering, and real-world applications. The course also delves into the ethical challenges associated with LLMs and how to effectively deploy them in business and technology. By the end of the course, learners will be equipped with practical skills to implement and optimize LLMs for various applications.
Course Learning Outcome
After completion of this course learner will be able to: **CO1:** Understand the fundamentals of Generative AI, LLM architectures, and their applications. **CO2:** Apply fine-tuning and prompt engineering techniques to improve LLM performance. **CO3:** Analyze real-world applications, ethical issues, and future trends of LLMs.

Module	Name of the Module	
1	**Unit 1 - Introduction to Generative AI and LLMs** 1.1 Definition of Generative AI , LLMs , AI, ML, DL Concepts in Generative AI: GANs, VAEs, and Diffusion Models GPT, BERT, and T5 Transformer architecture and the attention mechanism Applications of LLMs in Natural Language Processing (NLP) 1.2 LLMs: Architecture and Evolution of LLMs: GPT-2, GPT-3, GPT-4 1.3 Applications and Use Cases of LLMs Text generation and summarization with LLMs Machine translation with LLMs Real-world examples: Chatbots, content creation, and document summarization	
2	**Unit 2 - Training, Fine-Tuning, and Prompt Engineering** 2.1 Difference of PreTraining and Fine-Tuning LLMs Data collection and preprocessing for LLMs Fine-tuning LLMs for specific tasks (e.g., sentiment analysis, text summarization) Case study: Fine-tuning a GPT or BERT model on a custom dataset	

	Hyperparameter tuning and optimization techniques 2.2 Introduction to Prompt Engineering Basics of prompt engineering: Interaction with LLMs Techniques for improving LLM performance using prompts Hands-on: Crafting prompts for creative text generation and Q&A tasks 2.3 Advanced Prompt Engineering Designing complex prompts for real-world tasks Evaluating and improving LLM outputs through prompt modifications	
3	**Unit 3 - Real-World Applications, Ethics, and Future Trends** 3.1 Industry Applications of LLMs Business applications: AI-powered content creation, customer service bots Case study: Building a chatbot using GPT-3 Using LLMs for automated document summarization and generation Applications in healthcare, legal fields, and customer support 3.2 Security, Privacy, and Ethical Considerations Ethical issues with LLMs: Bias, misinformation, and privacy concerns Ensuring responsible AI use in deploying LLMs Adversarial attacks and its protection Bias detection and mitigation in LLM outputs 3.3 Future Trends in Generative AI and LLMs Advancements in LLMs-Integration of LLMs with other AI technologies (e.g., computer vision, robotics) Multimodal models: Combining text, image, and audio in LLMs Preparing for the future of LLMs: Career opportunities and the evolving landscape of AI 3.4 Concepts of Augmented AI, Agentic or Autonomous Economic AI	
Ref	**Textbooks:** Transformers for Natural Language Processing by Denis Rothman ISBN: 978-1800202850 Deep Learning with Python by François Chollet ISBN: 978-1617294433 Speech and Language Processing by Daniel Jurafsky and James H. Martin ISBN: 978-0131873216 **Additional References websites:** https://huggingface.co/ https://openai.com/blog http://web.stanford.edu/class/cs224n/ https://paperswithcode.com/ https://arxiv.org/	

Practical of Gen AI and Prompt Engineering		
Course Code	Course Title	Credits
	Practical of Gen AI and Prompt Engineering	**1**
1	Perform basic text generation using a lightweight transformer. Use Hugging Face Transformers with a small model like DistilGPT-2.	
2	Text Summarization of a news article using a Pre-trained LLM	
3	Machine Translation with LLM,translates text between languages using a transformer-based model.	
4	Transformer Architecture- Explore the attention mechanism visually-Load a small transformer model (like DistilBERT), Use visualization libraries (e.g., BertViz or attention heatmaps from Hugging Face) to see how words attend to each other. Analyze a sample sentence ("The fat cat on the mat").	
5	Use DistilBERT for sentiment analysis (pipeline from Hugging Face).	
6	Use OpenAI GPT API to build a simple command-line chatbot. Provide user input and get AI-generated responses.	
7	Build a Mini Chatbot	
8	Compare outputs before and after fine-tuning. of LLMs using Python, Hugging Face Transformers, small text file dataset,by loading a pre-trained model (e.g., distilbert-base-uncased).Fine-tune it slightly on a small custom text dataset (e.g., movie reviews).	
9	Use a CSV file having reviews of events ,perform tokenization, stop-word removal, and text normalization. Visualize token frequency using matplotlib or wordcloud.	
10	Evaluate accuracy by Performing light fine-tuning on a small dataset. Use DistilBERT and fine-tune it on a small sentiment dataset Train for 1–2 epochs (CPU-friendly).Use- Hugging Face Transformers, Datasets library.	
11	Perform Hyperparameter Tuning using the same dataset as in experiment(10) and vary learning rate or epoch count.Evaluate loss and accuracy.Plot performance metrics.Use Hugging Face Trainer API, Matplotlib.	
12	Implement effective prompts for LLMs-Use a small LLM (e.g., distilgpt2 or flan-t5-small) via Hugging Face.Prompt it as "Give recipe of Veg Biryani" and "Give receipe of Veg Sandwich".	

13	Test complex prompts for multi-step reasoning:-Use Hugging Face Inference API	
14	Create a small rule-based or LLM-assisted chatbot for hospital support,Use Hugging Face Transformers (DistilGPT2) to simulate a chatbot. Input user queries (“What is Hospital Choice for eye surgery?”). Output model-generated or predefined responses.	
15	Use a model like T5-small for summarizing short documents or reports.	
16	Implement the given prompt : “A good Sportsman is :Check any gender or occupational bias.	
17	Use Hugging Face “clip” model to generate captions from images.	
18	Case Study on Agentic or Augmented AI Systems	
19	To study and implement different approaches for developing chatbot and text generation systems, namely rule-based methods, Markov Chain models, and neural network-based models, using Python.	
20	To implement a probabilistic language model using Markov Chain for predicting and generating text auto- completion in python.	