Re-Accredited 'B++' 2.86 CGPA by NAAC
VEER NARMAD SOUTH GUJARAT UNIVERSITY
University Campus, Udhna-Magdalla Road, SURAT - 395 007, Gujarat, India.
વીર નર્મદ દક્ષિણ ગુજરાત યુનિવર્સિટી
યુનિવર્સિટી કેમ્પસ, ઉધના-મગદલ્લા રોડ, સુરત - ૩૯૫ ૦૦૭, ગુજરાત, ભારત.
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ક્રમાંક :ઓથો./પરિપત્ર/૯૯૨૯/૨૦૨૬
તા.૦૫/૦૬/૨૦૨૬

પ્રતિ,
વિભાગીય વડાશ્રી,
કોમ્પ્યુટર સાયન્સ વિભાગ,
વીર નર્મદ દક્ષિણ ગુજરાત યુનિવર્સિટી,
સુરત.

વિષયઃ– Master of Science in Artificial Intelligence and Machine Learning (M.Sc. AI / ML) નો સેમેસ્ટર–૧ થી ૪ ના અભ્યાસક્રમ અંગે.

સુજ્ઞશ્રી,

સવિનય જણાવવાનું કે, શૈક્ષણિક વર્ષ ૨૦૨૬–૨૭ થી ક્રમશઃ અમલમાં આવનાર Master of Science in Artificial Intelligence and Machine Learning (M.Sc. AI / ML) સેમેસ્ટર–૧ થી ૪ નો પેટાસમિતિ દ્વારા તૈયાર કરવામાં આવેલ અભ્યાસક્રમ કોમ્પ્યુટર સાયન્સ વિષયની અભ્યાસ સમિતિની તા.૨૫/૦૩/૨૦૨૬ ની સભાના ઠરાવ ક્રમાંકઃ૦૬ થી મંજૂર કરી કોમ્પ્યુટર સાયન્સ ફેકલ્ટીને કરેલ ભલામણ કોમ્પ્યુટર સાયન્સ ફેકલ્ટીની તા.૨૯/૦૪/૨૦૨૬ ની સભાના ઠરાવ ક્રમાંકઃ૦૩ થી મંજૂર કરી એકેડેમિક કાઉન્સિલને કરેલ ભલામણ એકેડેમિક કાઉન્સિલની તા. ૦૭/૦૫/૨૦૨૬ ની સભાનાં ઠરાવ ક્રમાંકઃ૪૬ થી મંજૂર કરેલ છે. જેનો અમલ કરવા આથી જાણ કરવામાં આવે છે.

બિડાણઃ ઉપર મુજબ

કુલસચિવ(ઇ.ચા.)

પ્રતિ,
(૧) ઈ.ચા.ડીનશ્રી, કોમ્પ્યુટર સાયન્સ વિદ્યાશાખા.
(૨) પરીક્ષા નિયામકશ્રી, પરીક્ષા વિભાગ, વીર નર્મદ દ. ગુ. યુનિવર્સિટી, સુરત.

.....તરફ જાણ તેમજ અમલ સારૂ.

M. Sc. (AI & ML)

Veer Narmad South Gujarat University, Surat

About M.Sc. (AI-ML):

The M.Sc. AI (Artificial Intelligence) and ML (Machine Learning) is an exploration to modern and advanced Al and ML concepts and practices on real-world problems. The program will expose the foundations of modern Al along with enough attention to the recent explosion of machine learning techniques such as deep learning, artificial neural network, etc. Students will have a good understanding of the fundamental issues and challenges of machine learning. Students will be able to design and implement various machine learning algorithms in a range of niche real-world applications. This program will make the students understand the strength and weaknesses of many popular machine learning approaches. This program will also impart the knowledge of basic ethical and professional ethics related to the development and application of AI and ML. The program content has the ability to adapt, contribute and innovate new technologies and systems in the key domain of AI and ML. The core knowledge of this program will explore research areas and produce an outstanding contribution in various areas of AI and ML. The students graduating in this program will become expert solution providers and entrepreneurs in the field of Computer Science with Al/ML specialization.

General Information:

Program Name: **M.Sc. (Al-ML)**

Duration of Program: 2 Years (Four Semesters)

Intake: 40

Fees: Rs. 60,000/-per Year (Rs. 30,000/-per Semester) + Examination and University Fees

Admission: On the basis of the Merit of the graduation Marks

Passing Rule: As per the MCA rules of VNSGU

Program Offered By: **Department of Computer Science, Veer Narmad South Gujarat University**

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

M. Sc. (AI & ML)

Name of Program	**M. Sc. in Artificial Intelligence and Machine Learning**
Program Abbreviation	**M. Sc. in AI&ML**
Duration	**2 Years**
Eligibility Criteria	Passed BCA/Bachelor's Degree in Computer Science/Engineering or equivalent degree. OR Passed Graduation or Post Graduation with Mathematics or Statistics as a principal subject OR Passed Graduation or Post Graduation in Engineering
Pre-requisite	Basic computer programming skills, basic mathematics and basic statistics
Medium of Instruction	English
Objective of Program	The core objective of the MSC in AI & ML programme is to prepare the students for productive career in AI and ML, Research and academia by providing an outstanding environment for teaching and research in the core and emerging areas of the discipline.
Program Outcome (PO)	**PO1: Fundamental Knowledge Enrichment** Program trains students with the core AI & ML domain. It also makes students capable of using core concepts in the conceptualization of domain specific application development. **PO2: Critical Thinking Development** The program develops the skills of critical thinking, problem solving, evaluative learning of various techniques, and understanding the essence of the problem. **PO3: Advanced Emerging Technology Awareness** The program trains students with the latest technologies that is being used in the AI & ML industry. The continuous syllabi review adds value to the program for the graduating students and make them ready to face challenging demands of the AI & ML industry. **PO4: Advanced Tools Usage** The program teaches the students to apply the advanced tools of AI & ML to solve real world problems. **PO5: Nurturing Research Oriented Approach** The program trains students to develop research oriented approach which will help them to make user centric applications. **PO6: Real World Problem / Project Development** Real world project provides the candidates, exposure to work in the challenging and demanding environment of the industry. The project training makes students employable and industry ready. **PO7: Team Work and Leadership Development** Trains students to work in a team and also to take leadership of the project management team.
Program Specific Outcomes (PSO)	PSO1: Develop and strengthen the fundamental core concepts that are required to solve complex problems. PSO2: Develop the professional and entrepreneurship skills that need independent logical and analytical thinking, teamwork and leadership.

	PSO3: Nurture the students to investigate for the design and development of workable solutions for real word problems. PSO4: Develop students for self-learning and practicing challenging problem solution. PSO5: Train students to use innovative tools and techniques to solve problems in the area of Deep Learning, Machine Learning and Artificial Intelligence. PSO6: To provide a concrete foundation and enrich the abilities of the students to qualify for employment, pursue higher studies and research in the area of AI & ML; with ethical values.
Mapping between POs and PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
PO1						
PO2						
PO3						
PO4						
PO5						
PO6						
PO7						

Structure of Program

Semester - 1

Course Category TH	Course Code	Course Title	Marksheet Title in English	Level of Course	Teaching Hours/Week		Exam Duration		Credit		Internal Marks		External Marks		Total Marks	
						PR	TH	PR	TH	PR	TH	PR	TH	PR	TH	PR
MAJOR	101	Artificial Intelligence	Artificial Intelligence	500	4	2			2	2	15	15	35	35	50	50
MAJOR	102	Object Oriented Programming	Object Oriented Programming	500	4	2			2	2	15	15	35	35	50	50
MAJOR	103	Statistical Foundations and Data Visualization	Statistical Foundations and Data Visualization	500	4	2			2	2	15	15	35	35	50	50
MAJOR	104	Python Programming - I	Python Programming - I	500	4	2			2	2	15	15	35	35	50	50
MINOR	105	Analysis and Design of Algorithms	Analysis and Design of Algorithms	500	4	-			4	-	30	-	70	-	100	-
MINOR	106	Discrete Mathematics and Algebraic Structures	Discrete Mathematics and Algebraic Structures	500	4	-			2	-	30	-	70	-	100	-

Semester - 2

Course Category TH	Course Code	Course Title	Marksheet Title in English	Level of Course	Teaching Hours/Week		Exam Duration		Credit		Internal Marks		External Marks		Total Marks	
						PR	TH	PR	TH	PR	TH	PR	TH	PR	TH	PR
MAJOR	201	Machine Learning - I	Machine Learning - I	500	4	2			2	2	15	15	35	35	50	50
MAJOR	202	Generative and Agentic AI	Generative and Agentic AI	500	4	2			2	2	15	15	35	35	50	50
MAJOR	203	Machine Learning using .NET / AI Systems Engineering using JAVA	Machine Learning using .NET / AI Systems Engineering using JAVA	500	4	2			2	2	15	15	35	35	50	50
MAJOR	204	Advanced Python Programming with Databases	Advanced Python Programming with Databases	500	4	2			2	2	15	15	35	35	50	50
MINOR	205	Probability, Statistics, and Data Modeling	Probability, Statistics, and Data Modeling	500	4	-			4	-	30	-	70	-	100	-
MINOR	206	Advanced Mathematical Optimization and Operations Research	Advanced Mathematical Optimization and Operations Research	500	4	-			2	-	30	-	70	-	100	-

Semester - 3

Course Category TH	Course Code	Course Title	Marksheet Title in English	Level of Course	Teaching Hours/Week		Exam Duration		Credit		Internal Marks		External Marks		Total Marks	
						PR	TH	PR	TH	PR	TH	PR	TH	PR	TH	PR
MAJOR	301	Machine Learning - II	Machine Learning - II	600	4	2			2	2	15	15	35	35	50	50
MAJOR	302	Intelligent IOT with ML	Intelligent IOT with ML	600	4	2			2	2	15	15	35	35	50	50
MAJOR	303	Natural Language Processing	Natural Language Processing	600	4	2			2	2	15	15	35	35	50	50
MAJOR	304	Digital Image Processing	Digital Image Processing	600	4	2			2	2	15	15	35	35	50	50
MINOR	305	Big Data Analytics / Data Mining & Data Warehousing	Big Data Analytics / Data Mining & Data Warehousing	600	4	-			4	-	30	-	70	-	100	-
MINOR	306	AI with IKS	AI with IKS	600	4	-			2	-	30	-	70	-	100	-

Semester - 4

Course Category TH	Course Code	Course Title	Marksheet Title in English	Level of Course	Teaching Hours/Week		Exam Duration		Credit		Internal Marks		External Marks		Total Marks	
						PR	TH	PR	TH	PR	TH	PR	TH	PR	TH	PR
MAJOR	401	Project	Project	600	-	-			-	16		120		280		400
MAJOR	402	Seminar	Seminar	600	-	-			6	-		30		120		150

[Subjcet code for Theory-2611001701011001]

[Subject code for Practical-2611001701011002]

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
SYLLABUS

Program Name	**Master of Science in Artificial Intelligence and Machine Learning**					
Semester	**1**					
NCrF Credit Level	**6**					
Course Type	**Major**					
Course Subtype	**Employability and Skill Development**					
Subject Type	**Discipline Specific**					
Course Code	**101**					
Course Level	**500**					
Course Title	**Artificial Intelligence**					
Credit	**Theory:**	**2**	**Practical:**	**2**	**Total:**	**4**
Effective From	**Academic Year : 2026-27**					
Course Outcomes	**CO1: Explain to the students the fundamental know-how like the types of machine learning algorithms, applications and various required libraries, model selection etc. required to implement machine learning algorithms.** **CO2: Train students with can utilize various data wrangling techniques, data cleaning, data transformation, data reduction, data discretization, feature selection, and data visualization** **CO3: Train students who can implement supervised learning algorithms utilizing regression and classification algorithms on the real world dataset.** **CO4: Train students to have understanding of Artificial Neural Network and its working. Also, to make them capable of implementing ANN for solving real world problems using it.** **CO5: Explain to the students to use clustering and association rules as unsupervised learning methods to solve complex problems.** **CO6: Train students to use machine learning techniques to solve real life complex problems.**						
Mapping between Cos and PSOs						
Course Content	UNIT I: INTELLIGENT AGENTS & FOUNDATIONS 1.1 What is AI 1.2 Agents 1.3 Rationality 1.4 Environment Types 1.5 Agent Architectures					

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	■		■	■		
CO2	■					■
CO3	■	■	■		■	■
CO4	■		■	■	■	■
CO5	■	■			■	■
CO6	■	■			■	■

	1.6 Ethics in AI UNIT II: PROBLEM SOLVING & SEARCH 2.1 Problem Formulation 2.2 Uninformed Search 2.2.1 BFS 2.2.2 DFS 2.2.3 UCS 2.2.4 Iterative Deepening 2.3 Informed Search 2.3.1 A* 2.3.2 Greedy Best-First 2.4 Heuristics 2.5 Local Search 2.5.1 Hill Climbing 2.5.2 Simulated Annealing 2.5.3 Genetic Algorithms UNIT III: ADVERSARIAL SEARCH & CONSTRAINTS 3.1 Game Theory 3.2 Minimax 3.3 Alpha-Beta Pruning 3.4 MCTS 3.5 Stochastic Games 3.6 Partially Observable 3.7 CSP 3.7.1 Graph colouring 3.7.2 Cryptarithmetic Problems 3.7.3 N-Queens Problem 3.8 Backtracking UNIT IV: KNOWLEDGE REPRESENTATION & REASONING 4.1 Knowledge-Based Agents 4.2 Propositional Logic 4.3 Theorem Proving 4.3.1 Resolution 4.3.2 DPLL 4.4 First-Order Logic (FOL) 4.5 FOL Inference: 4.5.1 Unification 4.5.2 Forward Chaining 4.5.3 Backward Chaining 4.5.4 Resolution 4.6 Uncertain Reasoning 4.6.1 Bayes theorem 4.6.2 Naive Bayes 4.6.3 Bayesian Networks
Reference Books	1. Artificial intelligence, 3rd Edition, Kevin Knight, Elaine Rich, B.Shivashankar Nair,, McGrawHill 2. "Artificial Intelligence: A Modern Approach" (AIMA) 4th Edition (2020) Pearson, by Stuart Russell & Peter Norvig. 3. A First Course in Artificial Intelligence, Deepak Khemani, McGrawHill 4. Introduction to artificial intelligence, Akerkar, Rajendra, PHI Learning 5. Foundation of Artificial Intelligence and Expert Systems by V.S.Janakiraman, K. Sarukesi, P. Gopalakrishnan, McMillan

	6. Expert Systems Principles and Programming(3rd Edition) by Giarratano & Riley,Thomson(Vikas Publishing House) 7. "Introduction to Artificial Intelligence",3rd Edition (2017)Springer by Wolfgang Ertel by. 8. "Artificial Intelligence: Foundations of Computational Agents" ,2nd Edition (2017)Cambridge University Press,by David L. Poole & Alan K. Mackworth. 9. "Artificial Intelligence: Structures and Strategies for Complex Problem Solving", Pearson publication by George F. Luger.
Teaching Methodology	Class work, Discussion, Self-Study, Seminars and/or Assignment and Practical
Evaluation Method	Internal Assessment: 30% Marks External Assessment: 70% Marks

[Subject code for Theory-2611001701022001]

[Subject code for Practical-2611001701022002]

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
SYLLABUS

Program Name	**Master of Science in Artificial Intelligence and Machine Learning**					
Semester	**1**					
NCrF Credit Level	**6**					
Course Type	**Major**					
Course Subtype	**Employability and Skill Development**					
Subject Type	**Discipline Specific**					
Course Code	**102**					
Course Level	**500**					
Course Title	**Object Oriented Programming**					
Credit	**Theory:**	**2**	**Practical:**	**2**	**Total:**	**4**
Effective From	**Academic Year : 2026-27**					

Course Outcomes

CO1: Articulate the principles of Object Oriented Problem solving and programming.

CO2: To demonstrate the differences between traditional imperative design and object Oriented Design

CO3: Outline the essential features and elements of C++ programming language.

CO4: To grasp and apply the concepts of class, method, constructor, abstraction, inheritance and Static Polymorphism. CO5: To understand and apply Dynamic Polymorphism in real world applications.

CO5: To implement Genericity through the usage of Templates.

Mapping between Cos and PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	■		■		■	
CO2	■	■	■		■	
CO3	■		■	■		■
CO4			■	■	■	■
CO5		■	■	■	■	■

Course Content

Unit 1: C++ Basics and Introduction to Object Oriented Programming

- 1.1 Data Types
- 1.2 Pointers
  - 1.2.1 Pointer Arithmetic
  - 1.2.2 Array of Pointers
  - 1.2.3 Dynamic Array
- 1.3 IOS Class
- 1.4 Input and Output
- 1.5 Manipulators
- 1.6 Introduction to Object Oriented Programming
  - 1.6.1 Structure, classes and Objects
  - 1.6.2 Encapsulation & Data Hiding
  - 1.6.3 Constructors
  - 1.6.4 Friend Functions
  - 1.6.5 Inline Functions
  - 1.6.6 Dynamic Object Creation & Destruction
  - 1.6.7 Static Members
  - 1.6.8 This Pointer
  - 1.6.9 Destructors

	Unit 2: Object Oriented Properties 2.1 Introduction to Object Oriented Properties 2.2 Abstraction 2.3 Polymorphism 2.3.1 Operator Overloading 2.3.2 Function Overloading & Type Conversions 2.4 Inheritance 2.4.1 Types of Inheritance 2.4.2 Constructor & Destructor calls during Inheritance 2.5 Dynamic Polymorphism 2.5.1 Overriding 2.5.2 Virtual Functions 2.5.3 Abstract Class Unit 3: Data Files and Exception Handling 3.1 Streams 3.2 File Types and Modes 3.3 File Pointers & their manipulations 3.4 Sequential Input & Output operations 3.5 Random access 3.6 Error handling during File operations 3.7 Exception Handling Unit 4: Generic Programming and C++ Standard Template Library (STL) 4.1 Template Classes 4.2 Template Functions 4.3 Implementation of Object-Oriented Properties on Template Classes 4.4 STL 4.4.1 Algorithms 4.4.2 Containers 4.4.3 Functions 4.4.4 Iterators
Reference Books	1. The C++ Programming Language, Stroustrup, Addison Wesley 2. The Complete Reference C++, Schildt, Tata McGraw Hill 3. OOP in Turbo C++, Robert Lafore, Galgotia Publication 4. C++ Primer,Lippman, Addition Wesley 5. Object Oriented Programming with ANSI and Turbo C++, Kamthane, Pearson Education 6. Thinking in C++,Bruce Eckel, Pearson 7. Object Oriented Modelling & Design, Rumbaugh, PHI 8. Object Oriented Analysis &Design with Application, Grady Booch,LPE 9. Standard C++ with Object Oriented Programming, Paul S.Wang, Thomson 10. C++ Primer Plus, Stephan Prata, Addison Wesley 11. Programming with ANSI C++,Bhushan Trivedi, Oxford University Press
Teaching Methodology	Class work, Discussion, Self-Study, Seminars and/or Assignment and Practical
Evaluation Method	Internal Assessment: 30% Marks External Assessment: 70% Marks

[Subject code for Theory-*2611001701033001*]

[Subject code for Pracrical-*2611001701033002*]

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT SYLLABUS						
Program Name	**M.Sc. in Artificial Intelligence and Machine Learning**					
Semester	**1**					
NCrF Credit Level	**6**					
Course Type	**Major**					
Course Subtype	**Skill Development**					
Subject Type	**Intra-disciplinary**					
Course Code	**103**					
Course Level	**500**					
Course Title	**Statistical Foundations and Data Visualization**					
Credit	**Theory:**	**02**	**Practical:**	**02**	**Total:**	**04**
Effective From	**Academic Year : 2026 – 2027**					
Course Outcomes	Upon completion of this course, students will be able to: CO1: Explain methods of data collection, population sampling, and frequency distribution. CO2: Apply visualization techniques for bivariate and multivariate datasets to identify trends. CO3: Calculate and interpret measures of central tendency and dispersion. CO4: Evaluate data distribution through the study of skewness and kurtosis. CO5: Utilize statistical visualization for applications in Data Science and Business Intelligence.					
Mapping between Cos and PSOs						

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						
CO3						
CO4						
CO5						

Course Content	**Unit 1: Data Foundations and Distribution** 1.1 Population and Sampling: Concepts of finite and infinite populations. 1.2 Data Collection: Primary data (Questionnaires/Schedules) and Secondary data. 1.3 Data Types: Qualitative, Quantitative, Discrete, and Continuous data. 1.4 Frequency Distributions: Univariate, Bivariate, and Cumulative distributions for discrete and continuous variables. **Unit 2: Advanced Data Visualization** 2.1 Visualization Dimensions: Techniques for Bivariate and Multivariate data. 2.2 Graphical Tools: Effective use of Graphs, Diagrams, Histograms (Polygon/Curve), and Ogives. 2.3 Design Principles: Knowledge of perception and cognition in choosing visualization alternatives. **Unit 3: Statistical Analysis – Central Tendency** 3.1 Mathematical Averages: Simple, weighted, and combined Arithmetic Mean; Geometric and Harmonic Mean. 3.2 Positional Averages: Median, Quartiles, Deciles, and Percentiles; Mode.

	3.3 Comparative Analysis: Empirical relationship between mean, median, and mode; merits and demerits of each measure. **Unit 4: Moments, Dispersion, and Skewness** 4.1 Measures of Dispersion: Range, Quartile Deviation, Mean Absolute Deviation, and Standard Deviation. 4.2 Variance: Combined variance and its applications. 4.3 Moments and Shape: Raw vs. Central moments; Concepts and measures of Skewness (Karl Pearson's) and Kurtosis.
Reference Books	1. Data Points: Visualization that means something: Nathan Yau, Wiley 2. Visualizing data: Exploring and explaining data with the processing environment, Ben Fry, O'Reilly 3. Linear Statistical Inference and its Applications: Rao C.R., John Wiley 4. Applied Multivariate Statistical Analysis: Johnson and Wichern 5. Sampling Techniques: Cochran W. G., John Wiley 6. Designing Data Visualizations: Representing Informational Relationships, A Julie Steele and Noah Iliinsky, O'Reilly 7. Data Visualization: A Successful Design Process, Andy Kirk, PAKT 8. An Introduction to Multivariate Statistical Analysis, Anderson T. W., John Wiley 9. Multivariate Statistical Methods, Morrison D.F., McGraw Hill 10. An Introduction to Multivariate Statistics, Srivastava and Khatri C.G., North Holland 11. Sampling Theory and Methods: Murthy M. N., Statistical Publishing Society, Calcutta.
Teaching Methodology	Class Work, Discussion, Self Study, Seminars and/or Assignment
Evaluation Method	Internal Assessment: 30% Marks External Assessment: 70% Marks

[Subject code for Theory-2611001701044001]
[Subject code for Practical-2611001701044002]

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
SYLLABUS

Program Name	**Master of Science in Artificial Intelligence and Machine Learning**					
Semester	**1**					
NCrF Credit Level	**6**					
Course Type	**Major**					
Course Subtype	**Employability and Skill Development**					
Subject Type	**Discipline Specific**					
Course Code	**104**					
Course Level	**500**					
Course Title	**Python Programming 1**					
Credit	**Theory:**	**2**	**Practical:**	**2**	**Total:**	**4**
Effective From	**Academic Year : 2026-27**					

Course Outcomes

CO1: Install and configure Python environments and manage packages effectively.
CO2: Apply Python syntax, control structures, and functions to solve computational Problems.
CO3: Implement data structures and object-oriented programming concepts in Python.
CO4: Perform numerical and scientific computations using NumPy.
CO5: Visualize and interpret data using Matplotlib and Seaborn.
CO6: Develop foundational coding skills required for AI & ML model development.

Mapping between Cos and PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						
CO3						
CO4						
CO5						
CO6						

Course Content

UNIT 1: INTRODUCTION TO PYTHON , PYTHON LIBRARIES AND PACKAGE MANAGEMENT FOR AI & MACHINE LEARNING

1.1 Introduction to Python & Installation (Anaconda, Jupyter)
1.2 Classification of Python Libraries for AI & ML
1.3 Applications and Usage of Major Python Libraries
1.4 Python Package and Environment Management

UNIT 2: FUNDAMENTALS OF PYTHON

2.1 Python Syntax & Indentation
2.2 Variables & Data Types
2.3 Operators
2.4 Input/output
2.5 Conditional Statements
2.6 Loops
2.7 Functions (user-defined, lambda)
2.8 Exception Handling

	UNIT 3: DATA STRUCTURES & OOP 3.1 Lists, Tuples, Sets, Dictionaries 3.2 List Comprehension 3.3 String Manipulation 3.4 File Handling 3.5 Object-Oriented Programming 3.5.1 Classes & Objects 3.5.2 Constructors 3.5.3 Inheritance 3.5.4 Polymorphism 3.5.5 Encapsulation **UNIT 4: SCIENTIFIC COMPUTING** 4.1 NumPy 4.1.1 NumPy arrays 4.1.2 Array creation methods 4.1.3 Indexing & slicing 4.1.4 Broadcasting 4.1.5 Mathematical operations 4.2 Matplotlib and Seaborn 4.2.1 Line plot 4.2.2 Bar chart 4.2.3 Histogram 4.2.4 Scatter plot 4.2.5 Box Plot
Reference Books	1. Lutz, M. (2013). *Learning Python* (5th ed.). O'Reilly Media. 2. Matthes, E. (2019). *Python crash course* (2nd ed.). No Starch Press. 3. Sweigart, A. (2019). *Automate the boring stuff with Python* (2nd ed.). No Starch Press. 4. McKinney, W. (2022). *Python for data analysis* (3rd ed.). O'Reilly Media. 5. Geron, A. (2019). *Hands-on machine learning with Scikit-Learn, Keras & TensorFlow* (2nd ed.). O'Reilly Media. 6. Muller, A. C., & Guido, S. (2016). *Introduction to machine learning with Python*. O'Reilly Media. 7. Ramalho, L. (2022). *Fluent Python* (2nd ed.). O'Reilly Media. 8. Downey, A. B. (2015). *Think Python* (2nd ed.). O'Reilly Media. 9. Lutz, M. (2010). *Programming Python* (4th ed.). O'Reilly Media. 10. Chollet, F. (2021). *Deep learning with Python* (2nd ed.). Manning Publications. 11. Grus, J. (2019). *Data science from scratch* (2nd ed.). O'Reilly Media. 12. Slatkin, B. (2019). *Effective Python* (2nd ed.). Addison-Wesley Professional.
Teaching Methodology	Class work, Discussion, Self-Study, Seminars and/or Assignment and Practicals
Evaluation Method	Internal Assessment: 30% Marks External Assessment: 70% Marks

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
SYLLABUS

Program Name	**Master of Science in Artificial Intelligence and Machine Learning**					
Semester	**1**					
NCrF Credit Level	**6**					
Course Type	Minor					
Course Subtype	**Employability and Skill Development**					
Subject Type	**Emerging Technology**					
Course Code	**105**					
Course Level	**500**					
Course Title	**Analysis and Design of Algorithms**					
Credit	**Theory:**	**4**	**Practical:**		**Total:**	**4**
Effective From	**Academic Year : 2026-27**					

Course Outcomes

CO1: Explain the basics of computational complexity analysis and asymptotic notations that help for fundamental research in algorithm analysis. Students can select the efficient algorithm after analysing a problem and identifying computing requirements for the same.
CO2: Students will be able to work with various searching and sorting techniques and apply the proper technique for a given problem after comparing their computational complexity.
CO3: Explain insight into important algorithmic design paradigms such as Divide and Conquer, Greedy method and the graph algorithms that develop an ability to apply design and development principles in the construction of varying software systems.
CO4: Describe the dynamic-programming paradigm and explain algorithmic design situations where the dynamic-programming approach is required.
CO5: Explain algorithmic approaches such as Backtracking and Branch and Bound; String Matching, NP-Completeness and explain which algorithmic approach is best suited for problems of specific requirement

Mapping between Cos and PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						
CO3						
CO4						
CO5						

Course Content

Unit-1: Basics of Algorithms and Algorithm Techniques

1.1 Introduction to Algorithm
1.2 Analysis of Algorithm
- 1.2.1 The efficient algorithm, Average, Best and worst case analysis
- 1.2.2 Amortized analysis , Asymptotic Notations
- 1.2.3 Analyzing control statement
- 1.2.4 Loop invariant and the correctness of the algorithm
- 1.2.5 Sorting Algorithms and analysis:
  - 1.2.5.1 Bubble sort
  - 1.2.5.2 Selection sort

1.2.5.3 Insertion sort
1.2.5.4 Shell sort
1.2.5.5 Heap sort
1.2.6 Sorting in linear time
1.2.6.1 Bucket sort
1.2.6.2 Radix sort
1.2.6.3 Counting sort
1.3 Divide and Conquer Algorithm
1.3.1 Introduction
1.3.2 Recurrence and different methods to solve recurrence
1.3.3 Multiplying large Integers Problem
1.3.4 Problem Solving using divide and conquer algorithm
1.3.4.1 Binary Search
1.3.4.2 Max-Min problem
1.3.4.3 Sorting (Merge Sort, Quick Sort)
1.3.4.4 Matrix Multiplication
1.3.4.5 Exponential
1.4 Greedy Algorithm
1.4.1 General Characteristics of greedy algorithms
1.4.2 Problem solving using Greedy Algorithm
1.4.3 Activity selection problem
1.4.4 Elements of Greedy Strategy
1.4.5 Minimum Spanning trees
1.4.5.1 Kruskal's algorithm
1.4.5.2 Prim's algorithm
1.4.6 Graphs
1.4.6.1 Shortest paths
1.4.6.2 The Knapsack Problem
1.4.6.3 Job Scheduling Problem
1.4.6.4 Huffman code

Unit-2: Dynamic Programming

2.1 Introduction
2.2 Greedy Algorithm
2.3 The Principle of Optimality
2.4 Problem Solving using Dynamic Programming
2.5 Calculating the Binomial Coefficient
2.6 Making Change Problem
2.7 Assembly Line-Scheduling
2.8 Knapsack problem
2.9 All Points Shortest path
2.10 Matrix chain multiplication
2.11 Longest Common Subsequence

Unit-3: Exploring Graphs

3.1. An introduction using graphs and games
3.2. Undirected Graph
3.3. Directed Graph
3.4. Traversing Graphs
3.5. Depth First Search
3.6. Breath First Search
3.7. Topological sort

	3.8. Connected components **Unit-4: Backtracking and Branch and Bound; String Matching; NP-Completeness** 4.1 The Eight queens problem 4.2 Knapsack problem 4.3 Travelling Salesman problem 4.4 Minimax principle 4.5 The naive string matching algorithm 4.6 The Rabin-Karp algorithm 4.7 String Matching with finite automata 4.8 The Knuth-Morris-Pratt algorithm 4.9 The class P and NP 4.10 Polynomial reduction 4.11 NP- Completeness Problem 4.12 NP-Hard Problems 4.13 Travelling Salesman problem 4.14 Hamiltonian problem 4.15 Approximation algorithms
Reference Books	1. "Algorithm Design", Jon Kleinberg and ÉvaTardos. Addison-Wesley 2. "Introduction to Algorithms" , T. H. Cormen, C. E. Leiserson, R. L. Rivest and C. Stein 3. "Art of Computer Programming", Volume 1-4, Knuth D. - Addison Wesley 4. "The Design and Analysis of Computer Algorithms", A. Aho, J. Hopcroft, and J. Ullman, Addison-Wesley 5. "Algorithmic - Theory and Practice", G. Brassard and P. Bratley, Prentice Hall, 1988.
Teaching Methodology	Class work, Discussion, Self-Study, Seminars and/or Assignment and Practicals
Evaluation Method	Internal Assessment: 30% Marks External Assessment: 70% Marks

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

SYLLABUS

Program Name	**M.Sc. in Artificial Intelligence and Machine Learning**					
Semester	**1**					
NCrF Credit Level	**6**					
Course Type	**Minor**					
Course Subtype	**Skill Development**					
Subject Type	**Intra-disciplinary**					
Course Code	**106**					
Course Level	**500**					
Course Title	**Discrete Mathematics and Algebraic Structures**					
Credit	**Theory:**	**02**	**Practical:**	**00**	**Total:**	**02**
Effective From	**Academic Year : 2026 – 2027**					

Course Outcomes

Upon completion of this course, students will be able to:

CO1: Understand and construct correct mathematical arguments and grasp basic functions needed in discrete mathematics.

CO2: Identify sets, various properties of sets, set operations, and set identities.

CO3: Demonstrate an understanding of relations and functions and determine their specific properties.

CO4: Apply the concepts of Propositional Logic to understand formal logic and theory.

CO5: Demonstrate different traversal methods for trees and graphs.

CO6: Apply fundamental concepts of Group Theory, Counting Theory, Probability, and Induction to AI and ML contexts.

Mapping between Cos and PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						
CO3						
CO4						
CO5						
CO6						

Course Content

Unit 1: Set Theory and Relational Structures

1.1 Sets: Introduction, Finite Sets, Power Set, and Cardinality of finite sets.
1.2 Set Operations: Cartesian Product, Properties of Sets, and Vector Implementations
1.3 Relations: Properties of Relations, Closure, and Equivalence of Relations.
1.4 Advanced Structures: Partial Ordering, Bijections, Posets, and Lattices.
1.5 Overview: Physical and Logical Structures

Unit 2: Algebraic Structures (Group and Ring Theory)

2.1 Group Theory: Definition of a group, Subgroups, and Groups as symmetries.
2.2 Group Properties: Homomorphisms, Quotient groups, Cosets, and Normal subgroups.
2.3 Theorems: Conjugacy classes, Lagrange's theorem, and Isomorphism theorems.
2.4 Ring Theory: Definition and examples of Rings.

	Unit 3: Propositional and Predicate Logic 3.1 Propositional Logic: Propositions, well-formed formulas (wff), Truth tables, Tautology, and Contradiction. 3.2 Inference: Satisfiability, Algebra of proposition, and Theory of Inference. 3.3 Predicate Logic: First-order predicates, quantifiers, and Inference theory of predicate logic. **Unit 4: Graph Theory and Trees** 4.1 Graphs: Introduction, terminology, characteristics, and types of Graph. 4.2 Applications: Real-world applications of Graphs and Trees. 4.3 Trees: Binary trees, Binary search trees, and traversal methods.
Reference Books	1. Discrete Mathematics (Fifth Edition), K. A. Ross and C. R. B. Wright, Prentice Hall, 2003. 2. Discrete and Combinatorial Mathematics (Fifth Edition), R. P. Grimaldi, Addison Wesley, 2003. 3. Discrete Mathematics, N. Chandrasekaren and M. Umaparvathi, Prentice Hall India Pvt. Limited, 2015. 4. A Textbook of Discrete Mathematics, Harish Mittal and Vinay Kumar Goyal, Wiley, 2021. 5. Discrete Mathematics, A. Chetwynd and P. Diggle, Arnold, 1995. 6. Discrete Mathematics: An Open Introduction, Oscar Levin, 2018.
Teaching Methodology	Class Work, Discussion, Self Study, Seminars and/or Assignment
Evaluation Method	Internal Assessment: 30% Marks External Assessment: 70% Marks

[Subject code for Theory-2711001702011001]

[Subject code for Practical-2711001702011002]

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
SYLLABUS

Program Name	**Master of Science in Artificial Intelligence and Machine Learning**					
Semester	**2**					
NCrF Credit Level	**6**					
Course Type	**Major**					
Course Subtype	**Employability and Skill Development**					
Subject Type	**Emerging Technology**					
Course Code	**201**					
Course Level	**500**					
Course Title	**Machine Learning - I**					
Credit	**Theory:**	**2**	**Practical:**	**2**	**Total:**	**4**
Effective From	**Academic Year : 2026 – 2027**					

Course Outcomes

CO1: Explain the fundamental concepts of Machine Learning, including types, applications, tools, model selection, training, and performance evaluation.

CO2: Apply data wrangling techniques, including cleaning, transformation, reduction, discretization, feature selection, and visualization to prepare datasets for modeling.

CO3: Implement supervised learning algorithms for regression and classification problems using techniques like linear regression, logistic regression, K-NN, SVM, decision trees, and Naïve Bayes.

CO4: Apply unsupervised learning methods, including clustering (K-means, hierarchical) and association rule learning (Apriori, FP-Growth), to analyze and extract patterns from unlabeled data.

CO5: Understand and implement reinforcement learning concepts and algorithms, including Q-Learning, SARSA, and the basic principles of agents, environment, rewards, and policies.

Mapping between Cos and PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						
CO3						
CO4						
CO5						

Course Content

Unit 1 : Introduction

1.1 Definition of Machine Learning
1.2 Types of Machine Learning : Supervised , Unsupervised and Semi-supervised
1.3 Applications and tools of Machine Learning (Scikit learn library)
1.4 Data Pre-processing, Selecting a model and training a model
1.5 Evaluating a performance of model and improving performance

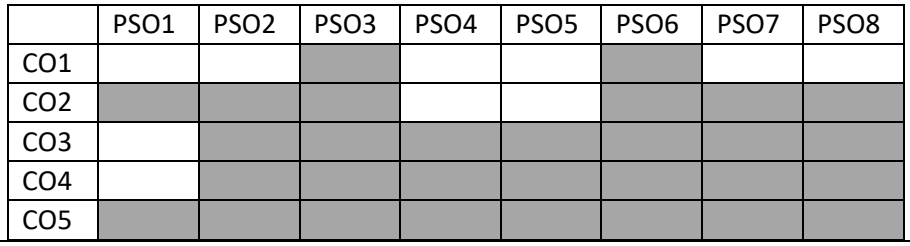
Unit 2 : Data Wrangling

2.1 Definition and goal of Data Wrangling
2.2 Importance of Data Wrangling
2.3 Data Pre-processing and Data Cleaning
2.3.1 Data Cleaning
2.3.2 Data Transformation
2.3.3 Data Reduction

	2.3.4 Data Discretization 2.3.5 Feature Selection 2.4 Data Visualization Unit 3 : Supervised and Unsupervised Learning 3.1 Supervised Learning: Classification and Regression 3.2 Regression 3.2.1 Simple and Multiple Regression 3.2.2 Linear Regression 3.2.3 Gradient Decent 3.2.4 Logistic Regression 3.3 Classification Algorithms 3.3.1 K-nearest Neighbour 3.3.2 Support Vector Machines 3.3.3 Decision Trees 3.3.4 Naïve Bayes Classifier 3.4 Introduction to Support Vector Machine 3.5 Introduction to Unsupervised learning 3.6 Clustering 3.6.1 Selection of Clusters 3.6.2 Algorithms: 3.6.2.1 K–means clustering 3.6.2.2 Hierarchical Clustering 3.7 Association Rule Learning 3.7.1 Algorithms 3.7.1.1 FP-Growth 3.7.1.2 Apriori Algorithm Unit 4 Reinforcement Learning 4.1 **Basic Concepts** 4.1.1 Introduction to Reinforcement Learning 4.1.2 Agent, Environment, State, Action, Reward 4.1.3 Simple idea of Markov Decision 4.1.4 Concept of Policy and Value **4.2 Basic Algorithms** 4.2.1 Q-Learning 4.2.2 SARSA
Reference Books	1. "Machine Learning"by Tom M. Mitchell, McGraw Hill 2. "Understanding Machine Learning" by Shai Shalev-Shwartz, Shai Ben-David 3. "Machine Learning" by Anuradha Srinivasaraghavan, Vincy Joseph 4. "Machine Learning using Python" by UDineshKumar Manaranjan Pradhan 5. "Real-World Machine Learning" by Henrik Brink, Joseph Richards, Mark Fetherolf 6. "Python Machine Learning" by Sebastian Raschka and Vahid Mirjalili 7. "Hands-On Machine Learning with Scikit-Learn and TensorFlow Concepts, Tools, and Techniques to Build Intelligent Systems" by Aurelien Geron 8. "Machine Learning in Action" by Peter Harrington 9. "Introduction to Machine Learning with Python: A Guide for Data Scientists" by Andreas C. Muller, Sarah Guido
Teaching Methodology	Class work, Discussion, Self-Study, Seminars and/or Assignment and Practical
Evaluation Method	Internal Assessment: 30% Marks External Assessment : 70% Marks

[Subject code for Theory-2711001702022001]

[Subject code for Practical-2711001702022002]

<table>
<tr><th colspan="7">VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
SYLLABUS</th></tr>
<tr><td>Program Name</td><td colspan="6">Master of Science in Artificial Intelligence and Machine Learning</td></tr>
<tr><td>Semester</td><td colspan="6">2</td></tr>
<tr><td>NCrF Credit Level</td><td colspan="6">6</td></tr>
<tr><td>Course Type</td><td colspan="6">Major</td></tr>
<tr><td>Course Subtype</td><td colspan="6">Employability and Skill Development</td></tr>
<tr><td>Subject Type</td><td colspan="6">Discipline Specific</td></tr>
<tr><td>Course Code</td><td colspan="6">202</td></tr>
<tr><td>Course Level</td><td colspan="6">500</td></tr>
<tr><td>Course Title</td><td colspan="6">Generative and Agentic AI</td></tr>
<tr><td>Credit</td><td>Theory:</td><td>2</td><td>Practical:</td><td>2</td><td>Total:</td><td>4</td></tr>
<tr><td>Effective From</td><td colspan="6">Academic Year : 2026-27</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">CO1: Describe the fundamental concepts of Transformer-based Large Language Models, including tokens, embeddings, attention mechanisms, and model architectures.
CO2: Explain the limitations of LLMs, including hallucinations, context window constraints, and probabilistic generation behavior.
CO3: Summarise the principles of Retrieval-Augmented Generation (RAG), agentic systems, LangChain/LangGraph workflows, and the Model Context Protocol (MCP).
CO4: Apply prompt engineering techniques (zero-shot, few-shot, role prompting, chain-of-thought, structured outputs) to improve reasoning and response quality.
CO5: Implement RAG pipelines using embeddings, vector databases, chunking strategies, and context injection methods.
CO6: Develop AI agents capable of tool usage, reasoning, reflection, and structured function calling.
CO7: Analyze system performance by evaluating retrieval accuracy, latency, caching strategies, cost–performance trade-offs, and agent failure modes.
CO8: Differentiate and compare reactive agents, planner-executor architectures, multi-agent systems, and deterministic–LLM hybrid workflows.
CO9: Evaluate the robustness, reliability, and safety of generative AI systems, including prompt effectiveness, retrieval quality, agent reasoning stability, and tool integration strategies.
CO10: Design and architect end-to-end generative AI systems that integrate LLM prompting, RAG architectures, agentic workflows, LangChain/LangGraph orchestration, and MCP-based structured tool ecosystems for production deployment.</td></tr>
<tr><td>Mapping between Cos and PSOs</td><td colspan="6"> 
</td></tr>
<tr><td>Course Content</td><td colspan="6">Unit 1: LLM and Prompt Engineering
1.1 LLM Fundamentals
1.1.1 Transformer Architecture
1.1.2 Token and embeddings</td></tr>
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1.1.3 Hallucinations and Limitation
1.1.4 LLM vs SLMs
1.2 Prompt Engineering
1.2.1 Zero-shot and Few-shot prompts
1.2.2 Role Prompting
1.2.3 Chain -of-thought prompt
1.2.4 Structured output

Unit 2: Retrieval Augmented Generation (RAG)
2.1 RAG Architecture
2.1.1. Embeddings
2.1.2. Vector Databases
2.1.3. Chunking
2.1.4. Context Injection
2.1.5. Retrieval Evaluation
2.2 System Design
2.2.1 Memory Design
2.2.2 Latency Optimization
2.2.3 Caching
2.2.4 Streaming Responses
2.2.5 Cost Performance Trade-offs

Unit 3: Agentic Engineering and Tools
3.1 Agent Fundaments
3.1.1 Introduction to RAG
3.1.2 Reactive VS Planner Agents
3.1.3 Tools Usage and Function Calling
3.1.4 Reasoning
3.1.5 Agent failure modes
3.2 Agent Architecture
3.2.1 Planner and Executor Model
3.2.2 Reflection and Self-correction
3.2.3 Debate Agents
3.2.4 Multi-agent collaboration
3.2.5 Persistent Memory System

Unit 4: LangChain, LangGraph and Multi-agent orchestration
4.1 LangChain
4.1.1 Chains
4.1.2 Prompt templates
4.1.3 LCEL
4.1.4 Memory integration
4.1.5 Tools & agents
4.1.6 Output parsers
4.2 LangGraph
4.2.1 Graph-based workflows
4.2.2 State management
4.2.3 Deterministic + LLM hybrid flows
4.2.4 Error handling & retries
4.2.5 Multi-agent orchestration
4.3 Model Context Protocol
4.3.1 Introduction to MCP
4.3.2 Building MCP Server
4.3.3 AI Agent with MCP Tool
4.3.4 Defining tools with a schema
4.3.5 Exposing structured resources
4.3.6 Tool metadata design

Reference Books	1. Agentic AI : Architectures, Intelligence and the Future of Autonomous Systems, Ajit Singh, Shroff Publishers and Distribution Pvt. Ltd., 2025 2. Learning LangChain: Building AI and LLM Applications with LangChain and LangGraph, Mayo Oshin, Nuno Campos, O'Reilly Media, 2025 3. Building Generative AI Agents: Using LangGraph, AutoGen, and CrewAI, Tom Taulli, Gaurav Deshmukh, Apress (Springer-Verlag), 2025 4. Generative AI with LangChain: Build Production-Ready LLM Applications and Advanced Agents, Ben Auffarth, Leonid Kuligin, Packt Publishing, 2025 5. Mastering LangChain: A Comprehensive Guide to Building Generative AI Applications, Sanath Raj B Narayan, Nitin Agarwal, Springer, 2025
Teaching Methodology	Class work, Discussion, Self-Study, Seminars and/or Assignment and Practical
Evaluation Method	Internal Assessment: 30% Marks External Assessment: 70% Marks

[Subject code for Theory-2711001702033001]
[Subject code for Practical-2711001702033002]

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
SYLLABUS

Program Name	**Master of Science in Artificial Intelligence and Machine Learning**					
Semester	**2**					
NCrF Credit Level	**6**					
Course Type	**Major**					
Course Subtype	**Employability and Skill Development**					
Subject Type	**Discipline Specific**					
Course Code	**203**					
Course Level	**500**					
Course Title	**AI Systems Engineering using JAVA**					
Credit	**Theory:**	**2**	**Practical:**	**2**	**Total:**	**4**
Effective From	**Academic Year: 2026-27**					

Course Outcomes

CO1: Understand the fundamentals of Java programming including JVM, JRE, JDK, program structure, exception handling, and file handling.
CO2: Apply Java input/output streams and file operations for efficient data processing and management.
CO3: Develop database-driven applications using JDBC by connecting to databases, executing SQL queries, and managing transactions.
CO4: Perform data handling and preprocessing using Java-based Machine Learning libraries (such as Weka APIs).
CO5: Build, train, and evaluate Machine Learning models using Java, including model validation and prediction on new datasets.
CO6: Design and implement RESTful web services and APIs using Java with proper handling of HTTP methods and JSON data.

Mapping between Cos and PSOs

	PSO1	PSO2	PSO3	POS4	PSO5	PSO6
CO1						
CO2						
CO3						
CO4						
CO5						
CO6						

Course Content

1. Introduction to Java
- 1.1. Java Platform
  - 1.1.1.JVM, JRE, JDK
  - 1.1.2.Program Structure
- 1.2. Basic Java Programming
- 1.3. Console and File IO
  - 1.3.1.IO using Stream classes
  - 1.3.2.Scanner class
  - 1.3.3.File Handling
- 1.4. Exception handling

2. Working with JDBC
- 2.1. Connecting to databases like MySQL, SQL Server, Oracle

	2.2. JDBC Objects 2.2.1.Connection, DatabaseMetaData and Datasource 2.2.2.Statement, PreparedStatement, CallableStatement 2.2.3.ResultSet 2.3. Processing SQL Statements 2.3.1.Executing Queries 2.3.2.Calling Stored Procedures 2.3.3.Managing Transactions 2.4. Handling Errors/Warnings **3. ML with Java** 3.1. Working with ML Libraries (Weka APIs) 3.2. Handling data source 3.2.1.Loading data 3.2.2.Data Preprocessing 3.3. Working with ML models 3.3.1.Model Training 3.3.2.Model Evaluation & Cross-validation 3.3.3.Predicting on new instances 3.4. Model Persistence 3.4.1.Saving model to file 3.4.2.Loading model for prediction **4. Web services and APIs** 4.1. Introduction to Web Services 4.2. Building RESTful web services 4.3. Working with APIs 4.4. HTTP methods (GET, POST, PUT, DELETE) 4.5. JSON object handling
Reference Books	1. Java EE Tutorial Basic Concepts by Oracle Corporation 2. Beginning Java™ EE Platform with Glass Fish™ : From Novice to Professional by Antonio Goncalves 3. Beginning EJB3 Application Development From Novice to Professional by Raghu R. Kodaliand Jonathan Wetherbee with Peter Zadrozny, Apress Publication 4. Pro JPA2:Mastering the Java ™ Persistence API 5. Head First Servlets and JSP By: Bryan Basham, Kathy Sierra, Bert Bates Publisher:' Reilly Media 6. Beginning JSP™ ,JSF™ and Tomcat™ Web Development: From Novice to Professional by Giulio Zambonand Michael Sekler 7. JAVA Complete Reference ,TMH Publication 8. Professional Java Development with Spring Framework, Wrox Publication
Teaching Methodology	Class work, Discussion, Self-Study, Seminars and/or Assignments and Practicals
Evaluation Method	Internal Assessment: 30% Marks External Assessment: 70% Marks

[Subject code for Theory-2711001702033003]

[Subject code for Practical-2711001702033004]

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
SYLLABUS

Program Name	**Master of Science in Artificial Intelligence and Machine Learning**					
Semester	**2**					
NCrF Credit Level	**6**					
Course Type	**Major**					
Course Subtype	**Employability and Skill Development**					
Subject Type	**Discipline Specific**					
Course Code	**203**					
Course Level	**500**					
Course Title	**Machine Learning using .NET**					
Credit	**Theory:**	**2**	**Practical:**	**2**	**Total:**	**4**
Effective From	**Academic Year: 2026-27**					

Course Outcomes

CO1: Understanding .NET Framework, C# & ASP.NET.
CO2: Train students to use various tools and controls available for .NET in application development, how to integrate them, and to get them working as part of a single unit.
CO3: Train students to work with a database using ADO.NET through design alternatives and through coding as well to integrate database and application software.
CO4: Explain and train students to work with a special type of web application called web services development and usage.
CO5: Expose students to the concept of web APIs, their development, and usage.
CO6: Explain to students to utilise tools & techniques available in .NET for Machine Learning and related application development using various NuGet packages.

Mapping between Cos and PSOs

	PSO1	PSO2	PSO3	POS4	PSO5	PSO6
CO1						
CO2						
CO3						
CO4						
CO5						
CO6						

Course Content

Unit 1 : Introduction to .NET Framework, C# and ASP.NET

1.1 NET Architecture
1.2 C# Language
1.3 Web Configuration files
1.4 Exception Handling
1.5 State Management Techniques
1.5.1 Client Side: Hidden fields, Query String, Cookies
1.5.2 Server Side: Session Object, Application Object

Unit 2: .NET Controls & Database Programming

2.1 Web Controls
2.1.1 Common Web Server Controls
2.1.2 Specialized Web Server Controls
2.1.3 Table, Image, FileUpload

	2.1.4 PostBack / Auto PostBack 2.2 Validation and Rich Controls 2.3 Database 2.3.1 ADO.NET Architecture 2.3.2 Direct Data Access 2.3.3 Disconnected Data Access 2.3.4 Data Binding & Data Controls **Unit 3 : WEB Services & API** 3.1 WCF Services 3.1.1 Introduction to Web Services 3.1.2 RESTful API 3.1.3 Working with WCF Services 3.2 API 3.2.1 Introduction to JSON 3.2.2 Web API 3.2.3 API Creation and Consumption **Unit 4 : Machine Learning** 4.1 Introduction to ML.NET 4.2 Machine Learning with Model Builder 4.3 Nuget Packages for ML 4.4 Model building using C# 4.5 Consuming the Model
Reference Books	1. Professional ASP.NET, Wrox Publication 2. ASP.NET – From Novice to Professional, Wrox Publication 3. ASP.NET Bible, By Mridula Parihar 4. Beginning ASP.NET 4.5, Wrox Publication 5. Programming Microsoft ASP.NET, Microsoft Press 6. Beginning AJAX with ASP.NET, Wrox Publication 7. Professional ASP.NET MVC 5, Wrox Publication 8. Professional C# 7 and .NET Core 2.0 , Wrox Publication 9. ASP.NET Core 2 Fundamentals, Packt Publication 10. Pro ASP.NET MVC 5, Apress 11. Programming ASP.NET Core, Microsoft Press 12. Pro C# 7 with .NET and .NET Core, Apress
Teaching Methodology	Class work, Discussion, Self-Study, Seminars and/or Assignments and Practicals
Evaluation Method	Internal Assessment: 30% Marks External Assessment: 70% Marks

[Subject code for Theory-2711001702044001]
[Subject code for Practical-2711001702044002]

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
SYLLABUS

Program Name	**Master of Science in Artificial Intelligence and Machine Learning**					
Semester	**2**					
NCrF Credit Level	**6**					
Course Type	**Major**					
Course Subtype	**Employability and Skill Development**					
Subject Type	**Discipline Specific**					
Course Code	**204**					
Course Level	**500**					
Course Title	**Advanced Python Programming with Databases**					
Credit	**Theory:**	**2**	**Practical:**	**2**	**Total:**	**4**
Effective From	**Academic Year : 2026-27**					

Course Outcomes

CO1: Explain database system concepts and SQL operations.
CO2: Develop Python applications connected with SQLite/MySQL databases.
CO3: Perform data cleaning and analysis using Pandas.
CO4: Apply Tensor Flow basics to build and train simple neural networks.
CO5: Design an end-to-end data-driven application integrating databases and ML tools.

Mapping between Cos and PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						
CO3						
CO4						
CO5						
CO6						

Course Content

UNIT 1: BASICS OF DATABASE SYSTEMS

1.1 Introduction to Database Systems
- 1.1.1 Data vs Information, File System vs Database System
- 1.1.2 Advantages of DBMS
- 1.1.3 Database architecture

1.2 Data Models
- 1.2.1 Relational Model
- 1.2.2 ER Model (Entities, Attributes, Relationships)
- 1.2.3 Schema and Instances

1.3 Relational Database Concepts
- 1.3.1 Tables, Rows, Columns
- 1.3.2 Primary Key & Foreign Key
- 1.3.3 Integrity Constraints

1.4 Introduction to SQL
- 1.4.1 DDL Commands (CREATE, DROP, ALTER)
- 1.4.2 DML Commands (INSERT, UPDATE, DELETE)
- 1.4.3 SELECT Queries, WHERE, ORDER BY, GROUP BY
- 1.4.4 SQL Joins

UNIT 2: DATABASE OPERATION USING PYTHON

2.1 Connecting to a database using python
2.2 CRUD using python

UNIT 3: DATA ANALYSIS USING PANDAS

	3.1 Introduction to Pandas 3.2 Pandas Data Structure- Series and Frame 3.3 Data Wrangling Using Pandas 3.3.1 View and Inspect of Dataset 3.3.2 Column and Row level Operation using pandas 3.3.3 Data Cleaning using pandas 3.3.4 Add, Drop and POP data to data frame 3.3.5 Concatenation, Join, Merge, Rank and Sort Data frame. 3.3.6 Various statistical and text operation with data frame **UNIT 4: INTRODUCTION TO TENSORFLOW** 4.1 Introduction to TensorFlow 4.2 Overview of TensorFlow 4.2.1 Applications of TensorFlow 4.2.2 Basic workflow in TensorFlow 4.3 Tensor Data Types 4.3.1 Scalars, Vectors, and Matrices 4.3.2 Common data types (int, float, etc.) 4.3.3 Creating tensors with different data types 4.4 Tensor Flow Operations 4.4.1 Arithmetic Operations: Addition, Subtraction, Multiplication, Division 4.4.2 Mathematical Operations: Square 4.4.3 Shape Operations: Reshape
Reference Books	1. Geron, A. (2022). Hands-on machine learning with Scikit-Learn, Keras, and TensorFlow (3rd ed.). O'Reilly Media. 2. Chollet, F. (2021). Deep learning with Python (2nd ed.). Manning Publications. 3. Goodfellow, I., Bengio, Y., & Courville, A. (2016). Deep learning. MIT Press. 4. VanderPlas, J. (2016). Python data science handbook. O'Reilly Media. 5. McKinney, W. (2022). Python for data analysis (3rd ed.). O'Reilly Media. 6. Beaulieu, A. (2020). Learning SQL (3rd ed.). O'Reilly Media. 7. Elmasri, R., & Navathe, S. B. (2016). Fundamentals of database systems (7th ed.). Pearson. 8. Ramakrishnan, R., & Gehrke, J. (2003). Database management systems (3rd ed.). McGraw-Hill. 9. Matthes, E. (2023). Python crash course (3rd ed.). No Starch Press. 10. Sweigart, A. (2019). Automate the boring stuff with Python (2nd ed.). No Starch Press. 11. Brownlee, J. (2016). Deep learning with Python: Develop deep learning models on Theano and TensorFlow using Keras. Machine Learning Mastery. 12. Raschka, S., Liu, Y., & Mirjalili, V. (2022). Machine learning with PyTorch and Scikit-Learn. Packt Publishing. 13. Downey, A. (2015). Think Python: How to think like a computer scientist (2nd ed.). O'Reilly Media.
Teaching Methodology	Class work, Discussion, Self-Study, Seminars and/or Assignment and Practicals
Evaluation Method	Internal Assessment: 30% Marks External Assessment: 70% Marks

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
SYLLABUS

Program Name	**M.Sc. in Artificial Intelligence and Machine Learning**					
Semester	**2**					
NCrF Credit Level	**6**					
Course Type	**Minor**					
Course Subtype	**Skill Development**					
Subject Type	**Intra-disciplinary**					
Course Code	**205**					
Course Level	**500**					
Course Title	**Probability, Statistics, and Data Modeling**					
Credit	**Theory:**	**04**	**Practical:**		**Total:**	**04**
Effective From	**Academic Year : 2026 – 2027**					

Course Outcomes

At the end of this course, students will be able to:
CO1: Understand the terminologies of basic probability and the behavior of two-dimensional random variables.
CO2: Analyze and apply various discrete and continuous probability distributions, specifically the Normal Distribution.
CO3: Execute Sampling techniques and perform Tests of Hypothesis to calculate confidence intervals and p-values.
CO4: Evaluate the significance of Type I and Type II errors within different testing situations.
CO5: Compute and interpret results for Bivariate and Multivariate Correlation and Regression analysis.
CO6: Implement these statistical techniques using modern software to solve real-world problems.

Mapping between Cos and PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	■	■				
CO2	■	■				
CO3		■	■	■		
CO4		■	■	■		
CO5			■	■	■	
CO6					■	■

Course Content

Unit 1: Foundations of Probability and Distributions

1.1 Probability Theory: Definition of probability and conditional probability.
1.2 Random Variables: Introduction to random variables, two-dimensional random variables, and their distribution functions.
1.3 Mathematical Expectation: Computation of expected values.
1.4 Distributions: Study of Discrete and Continuous distributions, with a focus on the Normal Distribution and its importance to Computer Science.

Unit 2: Sampling Theory and Estimation

2.1 Fundamentals: Population vs. Sample; sampling with and without replacement.
2.2 Parameters and Statistics: Random samples, population parameters, and sample mean/variance.
2.3 Distributions: Understanding the sampling distribution of means.

	2.4 Estimation: Unbiased and efficient estimates for population parameters. **Unit 3: Inference and Hypothesis Testing** 3.1 Testing Basics: Introduction to Null and Alternate hypotheses. 3.2 Error Analysis: Understanding and mitigating Type I and Type II errors; defining Level of Significance. 3.3 Statistical Tests: Optimum tests under different situations and tests involving the Normal distribution. 3.4 Results: Interpretation of p-values and significance. **Unit 4: Correlation and Regression Analysis** 4.1 Correlation: Definitions, measures of correlation, and finding coefficients via scatter diagrams, Karl Pearson's method, and Rank correlation. 4.2 Regression: Definition of regression and identifying the "best fit" regression line. 4.3 Modeling: Regression equations, coefficients of regression, and the interrelation between correlation and regression.
Reference Books	1. Schaum's Outline of Probability and Statistics: M. Spiegel, J. Schiller and R. Srinivasan, McGraw Hill, 2000. 2. Probability and Statistics for Engineering and the Sciences: J. L. Devore, Cengage Learning. 3. John E. Freund's Mathematical Statistics with Applications: Miller and Miller, Pearson Education. Pearson Education, Asia, 2006. 4. Fundamentals of Statistics: Goon, Gupta, and Dasgupta, Vol. I & II, 8th Edn., The World Press, Kolkata, 2002. 5. Introduction to Probability and Statistics: W. Mendenhall and R. Beaver, Wadsworth Publishing, 1994. 6. Introduction to Probability and Statistics for Engineers and Scientists: S. Ross, John Wiley, 1988. 7. An Introduction to Probability and Stochastic Processes: M. Berger, Springer Verlag, 1992. 8. Introduction to the Theory of Statistics: Mood, A. M. Graybill, F.A. and Boes, D.C., 3rd Edn., (Reprint), Tata McGraw-Hill Pub. Co. Ltd, 2007.
Teaching Methodology	Class Work, Discussion, Self Study, Seminars and/or Assignment
Evaluation Method	Internal Assessment: 30% Marks External Assessment: 70% Marks

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
SYLLABUS

Program Name	**M.Sc. in Artificial Intelligence and Machine Learning**					
Semester	**2**					
NCrF Credit Level	**6**					
Course Type	**Minor**					
Course Subtype	**Skill Development**					
Subject Type	**Intra-disciplinary**					
Course Code	**206**					
Course Level	**500**					
Course Title	**Advanced Mathematical Optimization and Operations Research**					
Credit	**Theory:**	**02**	**Practical:**		**Total:**	**02**
Effective From	**Academic Year : 2026 – 2027**					

Course Outcomes

Upon completion of this course, students will be able to:
CO1: Formulate and solve real-world problems using Linear Programming modeling, including graphical and simplex-based analytical methods.
CO2: Optimize resource allocation and distribution costs through Transportation and Assignment models.
CO3: Apply sequencing techniques for job scheduling and develop deterministic or dynamic inventory control systems.
CO4: Utilize Network Analysis (PERT/CPM) and Meta Heuristics to analyze and optimize project timelines.

Mapping between Cos and PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						
CO3						
CO4						

Course Content

Unit 1: Linear Programming Theory and Solution Methods

1.1 Introduction and Formulation of L.P.P.
1.2 Solution Methods: Graphical Method
1.3 The Simplex Method: Standard form and computational procedure
1.4 Artificial Variable Techniques: Big-M Method and Two-Phase Method

Unit 2: Optimization in Logistics and Resource Allocation

2.1 Transportation Problem: Mathematical formulation and finding initial basic feasible solutions
2.2 Assignment Problem: Hungarian Method and optimization for resource allocation
2.3 Job Sequencing: Processing n jobs through 2 and 3 machines; Processing 2 jobs through m machines

Unit 3: Inventory Systems and Deterministic Modeling
3.1 Introduction to Inventory Control
3.2 Deterministic Inventory Models: EOQ models with and without shortages 3.3 Introduction to Dynamic Inventory Models

Unit 4: Project Management and Meta-Heuristics

	4.1 Network Analysis: Fundamentals of project networking 4.2 PERT (Program Evaluation and Review Technique) 4.3 CPM (Critical Path Method) 4.4 Introduction to Meta-Heuristics: Principles and applications in complex optimization
Reference Books	1. Introduction to Operations Research: Hiller F.S.& Liberman G. J., 2nd Edn., Holand Day Inc. London, 1974. 2. Tara H. A.: Operation Research, 3rd Edn., McMillan Publishing Company, 1982. 3. N. S. Kambo: Mathematical Programming Techniques, Affiliated East-West Press. 4. Handbook of Metaheuristics: Glover, F. & Kochenberger, G. A., Kluwer Academic Publishers. 5. Introduction to Operations Research: A Computer-Oriented Algorithmic Approach: Gillett, B.G., McGraw Hill Book Comp., 1976. 6. Foundations of Optimization: Beightler C. S. & Phillips D.T., Prentice Hall, 1979. 7. Mathematical Programming: Mc Millan Claude Jr., 2nd Edn., Wiley Series, 1979.
Teaching Methodology	Class Work, Discussion, Self Study, Seminars and/or Assignment
Evaluation Method	Internal Assessment: 30% Marks External Assessment: 70% Marks

[Subject code for Theory-2711001703011001]

[Subject code for Practical-2711001703011002]

<table>
<tr><th colspan="7">VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
SYLLABUS</th></tr>
<tr><td>Program Name</td><td colspan="6">Master of Science in Artificial Intelligence and Machine Learning</td></tr>
<tr><td>Semester</td><td colspan="6">3</td></tr>
<tr><td>NCrF Credit Level</td><td colspan="6">6.5</td></tr>
<tr><td>Course Type</td><td colspan="6">Major</td></tr>
<tr><td>Course Subtype</td><td colspan="6">Employability and Skill Development</td></tr>
<tr><td>Subject Type</td><td colspan="6">Discipline Specific</td></tr>
<tr><td>Course Code</td><td colspan="6">301</td></tr>
<tr><td>Course Level</td><td colspan="6">600</td></tr>
<tr><td>Course Title</td><td colspan="6">Machine Learning II</td></tr>
<tr><td>Credit</td><td>Theory:</td><td>2</td><td>Practical:</td><td>2</td><td>Total:</td><td>4</td></tr>
<tr><td>Effective From</td><td colspan="6">Academic Year : 2027-28</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">CO1: Explain the fundamental concepts of Artificial Neural Networks (ANN), including perceptron models, multilayer networks, activation functions, and training mechanisms such as forward and backpropagation.
CO2: Apply deep learning concepts using Keras and TensorFlow to build, preprocess, and train models for regression, binary classification, and multi-class classification problems.
CO3: Design and implement Convolutional Neural Network (CNN) architectures for image representation, feature extraction, classification, and performance evaluation.
CO4: Analyze and implement Recurrent Neural Networks (RNN) and their variants (LSTM and GRU) for sequential data processing, and understand associated training challenges such as vanishing gradients.
CO5: Evaluate and optimize deep learning models using appropriate loss functions, optimizers, performance metrics, and tuning techniques.</td></tr>
<tr><td>Mapping between Cos and PSOs</td><td colspan="6"><table>
<tr><th></th><th>PSO1</th><th>PSO2</th><th>PSO3</th><th>PSO4</th><th>PSO5</th><th>PSO6</th></tr>
<tr><td>CO1</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO2</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO3</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO4</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO5</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table></td></tr>
<tr><td>Course Content</td><td colspan="6">Unit 1: Artificial Neural Network (ANN)
1.1 Concepts of Neurons with reference to the human brain
1.2 Linear Threshold Units
1.3 Perceptron
1.3.1 Representational limitations
1.3.2 Gradient descent training
1.4 Multilayer Networks
1.4.1 Forward Propagation and Backpropagation
1.4.2 Understanding Gradient Descent
1.4.3 Adjusting Weights and Biases
1.4.4 Activation Functions (Binary Step, Linear, Sigmoid, Tanh, ReLU, Leaky ReLU, Softmax)
1.5 Hidden Layers and Intermediate Representations
1.5.1 Distributed Representations</td></tr>
</table>

1.5.2 Overfitting and Underfitting
1.5.3 Learning Network Structure
1.5.4 Introduction to Recurrent Networks

Unit 2: Deep Learning

2.1 Concepts of Deep Learning
2.1.1 Difference between Machine Learning and Deep Learning
2.1.2 Purpose and Applications of Deep Learning
2.2 Libraries for Deep Learning Implementation
2.2.1 Installation and Functions of Keras, Installation and Functions of TensorFlow
2.2.2 Importing Libraries and Modules
2.2.3 Dataset Importing and Preprocessing
2.2.4 Splitting and Feature Scaling of Dataset
2.2.5 Adding Input and Hidden Layers
2.3 Prediction Model with Single Output Node
2.4 Binary Classification Problem (Two Output Nodes)
2.5 Multi-Class Classification (Multiple Output Nodes)

Unit 3: Convolutional Neural Networks (CNN)

3.1 Image Representation
3.1.1 Gray and Color Image Conversion into Arrays and Vectors
3.1.2 Loading Image Dataset
3.2 Keras Methods for Image Processing
3.2.1 Handling 2D and 3D Images
3.2.2 Splitting and Scaling Dataset
3.2.3 Image Augmentation
3.3 Convolution Layers
3.3.1 Feature Detection and Feature Mapping
3.3.2 Applying Activation Functions
3.4 Pooling and Flattening
3.4.1 Types of Pooling (Max, Min, Average)
3.4.2 Flattening Pooled Layers
3.4.3 Generating Tensor for Input Layer
3.5 Model Compilation
3.5.1 Optimizers
3.5.2 Loss Functions and Tuning
3.5.3 Compiling the CNN Model
3.6 CNN Applications and Performance Evaluation
3.6.1 Prediction Models using CNN
3.6.2 Binary and Multi-Class Classification
3.6.3 Model Evaluation and Performance Tuning

Unit 4: Recurrent Neural Networks (RNN)

4.1 Introduction to Sequential Models
4.1.1 Difference between CNN and RNN
4.1.2 Need for RNN in Sequence Data (Text, Time-Series)
4.1.3 Basic Structure and Working of RNN
4.2 Training and Challenges in RNN
4.2.1 Basic Idea of Backpropagation Through Time (BPTT)
4.2.2 Overview of Vanishing Gradient Problem
4.3 Variants of RNN
4.3.1 Introduction to LSTM
4.3.2 Introduction to GRU

Reference Books	1. Horowitz, E., Sahni, S., & Anderson-Freed, S. (2008). *Fundamentals of data structures in C* (2nd ed.). Universities Press. *(Commonly referred to as Ellis Horowitz & Sartaj Sahni Data Structures book)* 2. Rosen, K. H. (2019). *Discrete mathematics and its applications* (8th ed.). McGraw-Hill Education. 3. Brown, M. C. (2018). *Python: The complete reference* (4th ed.). McGraw-Hill Education. 4. Russell, S. J., & Norvig, P. (2021). *Artificial intelligence: A modern approach* (4th ed.). Pearson. 5. Burkov, A. (2019). *The hundred-page machine learning book*. Andriy Burkov. 6. Kosko, B. (1992). *Neural networks and fuzzy systems: A dynamical systems approach to machine intelligence*. Prentice Hall. 7. Flach, P. (2012). *Machine learning: The art and science of algorithms that make sense of data*. Cambridge University Press. 8. Goodfellow, I., Bengio, Y., & Courville, A. (2016). *Deep learning*. MIT Press. 9. Raschka, S., & Mirjalili, V. (2022). *Python machine learning* (3rd ed.). Packt Publishing. 10. Bishop, C. M. (2006). *Pattern recognition and machine learning*. Springer. 11. Hastie, T., Tibshirani, R., & Friedman, J. (2017). *The elements of statistical learning: Data mining, inference, and prediction* (2nd ed.). Springer. 12. Jurafsky, D., & Martin, J. H. (2023). *Speech and language processing* (3rd ed., draft). Pearson.
Teaching Methodology	Class work, Discussion, Self-Study, Seminars and/or Assignment and Practicals
Evaluation Method	Internal Assessment: 30% Marks External Assessment: 70% Marks

[Subject code for Theory-2711001703022001]

[Subject code for Practical-2711001703022002]

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
SYLLABUS

Program Name	**Master of Science in Artificial Intelligence and Machine Learning**					
Semester	**3**					
NCrF Credit Level	**6.5**					
Course Type	**Major**					
Course Subtype	**Employability, Skill Development**					
Subject Type	**Emerging Technology**					
Course Code	**302**					
Course Level	**600**					
Course Title	**Intelligent Internet of Things (IoT) with Machine Learning**					
Credit	**Theory:**	**2**	**Practical:**	**2**	**Total:**	**4**
Effective From	**Academic Year : 2027-28**					
Course Outcomes	**CO1:** Explain IoT architecture, communication protocols, and sensor integration. **CO2:** Develop IoT systems using microcontrollers and microcomputers. **CO3:** Perform signal processing, calibration, and data handling for IoT sensors. **CO4:** Apply supervised and unsupervised machine learning techniques on IoT data. **CO5:** Design and implement intelligent IoT-based applications. **CO6:** Evaluate, optimize, and ensure security of IoT systems for real-world deployment and performance improvement.					

Mapping between Cos and PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						
CO3						
CO4						
CO5						
CO6						

Course Content

UNIT 1: IOT FUNDAMENTALS AND SENSOR TECHNOLOGIES

- 1.1 IoT Foundations
  - 1.1.1 IoT Architecture (Perception, Network, Application Layers)
  - 1.1.2 IoT Communication Protocols: MQTT, CoAP, HTTP
  - 1.1.3 Cloud vs Edge in IoT
- 1.2 Iot Components
  - 1.2.1 Introductions to Sensors
  - 1.2.2 Practical usage of Various Sensors
- 1.3 IoT applications

UNIT 2: MICRO CONTROLLER AND SENSOR COMMUNICTAION

	2.1 Introduction to Microcontrollers and Microcomputer: Architecture, Features, and Programming Basics 2.2 Arduino: Development and Programming 2.3 Arduino IDE Setup 2.4 Arduino Pin Diagram 2.5 Introduction to NodeMCU (ESP8266) 2.6 NodeMCU Specifications and Applications 2.7 NodeMCU ESP8266 Pinout 2.8 Interfacing Sensors with Arduino and Node MCU **UNIT 3: IOT DATA ACQUISITION AND MANAGEMENT** 3.1 Analog and Digital Signal Processing 3.2 2 ADC and DAC in IoT 3.3 Sensor Calibration 3.4 Noise Filtering Techniques 3.5 Time-Series IoT Data 3.6 Data Storage (Firebase, SQL) **UNIT 4: MACHINE LEARNING FOR IOT DATA** 4.1 Data Preprocessing 4.2 Handling Missing Data, Feature Engineering, Normalization & Scaling 4.3 Supervised Learning for IoT: Linear Regression (Temperature Prediction), Logistic Regression (Fault Detection), Decision Tree (Smart Classification), Random Forest 4.4 Unsupervised Learning: K-Means (Energy Pattern Clustering), Anomaly Detection
Reference Books	1 Internet of Things: A Hands-on Approach - By Arshdip Bahga and Vijay Madisetti 2 Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow Aurelien Geron 3 Programming Embedded Systems with C and GNU Development tools - By Michael Barr (O'Reilly Publication) 4 Embedded C Coding Standard - By Michael Barr 5 Getting Started with Internet of Things - By Cuno Pfister, O'Reilly 6 Learning Internet of Things - By Peter Waher , Packt Publication 7 IoT Fundamentals: Networking Technologies, Protocols and Use Cases for the Internet of Things, Cisco Press 8 Fundamentals of IoT Communication Technologies, Springer 9 Microcontrollers - Architecture, Programming, Interfacing and system design - By Raj Kamal , Pearson 10 Make: Getting Started With Arduino - The Open Source Electronics Prototyping Platform, Shroff/Maker Media 11 ESP8266: Get Started With ESP8266 Programming NodeMCU Using Arduino IDE, Createspace Independent Pub 13 Internet of Things Projects with ESP32, Packt Publishing Limited
Teaching Methodology	Class work, Discussion, Self-Study, Seminars and/or Assignment and Practicals
Evaluation Method	Internal Assessment: 30% Marks External Assessment: 70% Marks

[Subject code for Theory-2711001703033001]

[Subject code for Practical-2711001703033002]

<table>
<tr><th colspan="7">VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
SYLLABUS</th></tr>
<tr><td>Program Name</td><td colspan="6">Master of Science in Artificial Intelligence and Machine Learning</td></tr>
<tr><td>Semester</td><td colspan="6">3</td></tr>
<tr><td>NCrF Credit Level</td><td colspan="6">6.5</td></tr>
<tr><td>Course Type</td><td colspan="6">Major</td></tr>
<tr><td>Course Subtype</td><td colspan="6">Employability and Skill Development</td></tr>
<tr><td>Subject Type</td><td colspan="6">Discipline Specific</td></tr>
<tr><td>Course Code</td><td colspan="6">303</td></tr>
<tr><td>Course Level</td><td colspan="6">600</td></tr>
<tr><td>Course Title</td><td colspan="6">Natural Language Processing</td></tr>
<tr><td>Credit</td><td>Theory:</td><td>2</td><td>Practical:</td><td>2</td><td>Total:</td><td>4</td></tr>
<tr><td>Effective From</td><td colspan="6">Academic Year : 2027-28</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">CO1: To understand fundamental concepts of Natural Language Processing.
CO2: To learn text processing and language representation techniques..
CO3: To apply machine learning and deep learning methods in NLP tasks.
CO4: To develop real-world NLP applications.
CO5: Demonstrate the state-of-the-art algorithms and techniques for text-based processing of natural languages.</td></tr>
<tr><td>Mapping between Cos and PSOs</td><td colspan="6">
<table>
<tr><th></th><th>PSO1</th><th>PSO2</th><th>PSO3</th><th>PSO4</th><th>PSO5</th><th>PSO6</th></tr>
<tr><td>CO1</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
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<tr><td>CO4</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO5</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>
</td></tr>
<tr><td>Course Content</td><td colspan="6">Unit 1: Introduction to NLP and Text Processing
1.1. Introduction to NLP and Applications
1.2. Challenges in Natural Language Understanding
1.3. Levels of Language Processing (Morphology, Syntax, Semantics)
1.4. Text Preprocessing Techniques
1.4.1 Tokenization
1.4.2 Stop word removal
1.4.3 Stemming and Lemmatisation
1.5. Regular Expressions
1.6. Corpus and Dataset Preparation

Unit 2: Text Representation and Language Modeling
2.1 Bag of Words Model
2.2 TF–IDF Representation
2.3 N-Gram Language Models
2.4 Probabilistic Language Models
2.5 Word Embeddings
2.5.1 Word2Vec
2.5.2 GloVe
2.6 Evaluation of Language Models</td></tr>
</table>

	Unit 3: NLP using Machine Learning 3.1 Part of Speech (POS) Tagging 3.2 Named Entity Recognition (NER) 3.3 Text Classification 3.4 Sentiment Analysis 3.5 Feature Extraction Techniques 3.6 Machine Learning Algorithms for NLP 3.6.1 Naïve Bayes 3.6.2 Logistic Regression 3.6.3 Support Vector Machine **Unit 4: Deep Learning and Advanced NLP** 4.1 Recurrent Neural Networks (RNN) 4.2 LSTM and GRU 4.3 Attention Mechanism and Transformers 4.4 Pretrained Models (BERT – Overview) 4.5 Applications: 4.5.1 Machine Translation 4.5.2 Text Summarization 4.5.3 Chatbots and Question Answering Systems 4.6 Ethical Issues in NLP
Reference Books	1. Speech and Language Processing , An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition, Daniel Jurafsky and James H. Martin, Pearson 2. Natural Language Processing with Python – Analyzing Text with the Natural Language Toolkit, Steven Bird, Ewan Klein, and Edward Loper, Shroff Publisher & Distributors Pvt. Ltd. 3. The Handbook of Computational Linguistics and Natural Language Processing, Alexander Clark, Chris Fox, Shalom Lappin, Wiley-Blackwell 4. Natural Language Processing and Text Mining, annekao, Springer 5. Natural Language Processing and Information Systems, Helmut Horacek, Springer.
Teaching Methodology	Class work, Discussion, Self-Study, Seminars and/or Assignments and Practicals
Evaluation Method	Internal Assessment: 30% Marks External Assessment: 70% Marks

[Subject code for Theory-2711001703044001]

[Subject code for Practical-2711001703044002]

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
SYLLABUS

Program Name	**Master of Science in Artificial Intelligence and Machine Learning**					
Semester	**3**					
NCrF Credit Level	**6.5**					
Course Type	**Major**					
Course Subtype	**Employability and Skill Development**					
Subject Type	**Discipline Specific**					
Course Code	**304**					
Course Level	**600**					
Course Title	**Digital Image Processing**					
Credit	**Theory:**	**2**	**Practical:**	**2**	**Total:**	**4**
Effective From	**Academic Year : 2027-28**					

Course Outcomes

CO1: Explain students the fundamental aspects of Image processing, the concept of image formation, digitization and the role human visual system plays in perception of image data.

CO2: Train students to use various Libraries to perform different operations related to image processing like image transformation, image enhancement, segmentation etc.

CO3: Explain and train students to work with various phases of Natural language processing by making them practically work on them.

CO4: Analyze and implement image processing algorithms for various real-time applications using artificial intelligence and deep learning.

CO5: Demonstrate the state-of-the-art algorithms and techniques for text-based processing of natural languages.

Mapping between Cos and PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	■			■		
CO2	■	■		■	■	
CO3	■	■	■	■	■	
CO4	■	■	■	■	■	■
CO5	■	■	■	■	■	■

Course Content

Unit – 1 Introduction to Image Processing & Image Enhancement

1.1 Image Fundamentals
1.2 Elements of the Image Processing System
1.3 Applications of Digital Image Processing
1.4 Image Transformation
1.5 Histogram processing
1.6 Spatial & Frequency Domain Methods
- 1.6.1 Image Smoothing
- 1.6.2 Image Sharpening
- 1.6.3 Selective Filtering

Unit – 2 Image Restoration

2.1 Image degradation
2.2 Types of Image Blur
2.3 Restoration in the presence of noise–only spatial filtering
- 2.3.1 Weiner filtering

	2.3.2 Constrained least squares filtering 2.3.3 Geometric transforms 2.3.4 Introduction to the Fourier transform **Unit – 3 Image Segmentation** 3.1 Feature Extraction: pint, line and edge detection 3.2 Region base segmentation techniques 3.2.1 Classification of segmentation techniques 3.2.2 Region approach to segmentation 3.2.3 Clustering technique 3.3 Image segmentation based on thresholding 3.4 Edge based segmentation 3.4.1 Edge detection and linking 3.4.2 Hough Transformation 3.4.3 Active Contour Image **Unit – 4 Image Recognition** 4.1Patterns and Pattern Classes 4.1.1 Pattern definition 4.1.2 Feature vectors 4.1.3 Pattern classes and boundaries 4.2 Recognition based on Decision-Theoretic Methods 4.2.1 Bayesian Decision Theory 4.2.2 Minimum distance classifier 4.2.3 Maximum likelihood estimation 4.3 Object Detection and Feature Description 4.3.1 Structural Methods 4.3.2 Feature Descriptors (HOG, SIFT, ORB) 4.3.3 Object Detection (YOLO, R-CNN, SSD) 4.3.4 Face Recognition (Eigenfaces, FaceNet)
Reference Books	1. Digital Image processing, R. C.Gonzalez, R.E.Woods, Pearson edition 2. Fundamentals of Digital Image Processing, A.K.Jain,PHI 3. Digital Image Processing, Pratt W.K., John Wiley 4. Image Processing , Analysis & Machine Vision, Milan Sonka, Thomson Publication 5. Digital Signal Processing: Principles, Algorithms, and Applications, John G. Proakis, Dimitris and G.Manolakis, Pearson Education 6. Computer Vision and Image Processing, Adrian Low, Second Edition, B.S.Publications 7. Digital Image Processing, Rafeal C.Gonzalez, Richard E.Woods, Second Edition, Pearson Education/PHI.
Teaching Methodology	Class work, Discussion, Self-Study, Seminars and/or Assignments and Practicals
Evaluation Method	Internal Assessment: 30% Marks External Assessment: 70% Marks

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
SYLLABUS

Program Name	**Master of Science in Artificial Intelligence and Machine Learning**					
Semester	**3**					
NCrF Credit Level	**6.5**					
Course Type	**Minor**					
Course Subtype	**Employability and Skill Development**					
Subject Type	**Discipline Specific**					
Course Code	**305**					
Course Level	**600**					
Course Title	**Big Data Analytics**					
Credit	**Theory:**	**4**	**Practical:**		**Total:**	**4**
Effective From	**Academic Year : 2027-28**					

Course Outcomes

CO1: Explain Big Data concepts, types, characteristics (Volume, Variety, Velocity, Variability), and advantages.
CO2: Describe Big Data Analytics evolution, architecture, tools, and implementation challenges.
CO3: Demonstrate understanding of NoSQL databases and perform CRUD operations, indexing, and aggregations using MongoDB.
CO4: Explain Hadoop architecture, HDFS components, commands, and MapReduce processing model.
CO5: Apply HiveQL for querying large datasets and design schema using HBase with indexing techniques.

Mapping between Cos and PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						
CO3						
CO4						
CO5						

Course Content

Unit 1: Introduction to Big Data and Big Data Analytics
- 1.1 Big Data
- 1.2 Importance of Big Data
- 1.3 Types of Big Data
  - 1.3.1 Structured
  - 1.3.2 Unstructured
  - 1.3.3 Semi-Structured
- 1.4 Characteristics of Big Data
  - 1.4.1 Volume
  - 1.4.2 Variety
  - 1.4.3 Velocity
  - 1.4.4 Variability
- 1.5 Advantages of Big Data
- 1.6 Big Data Analytics
  - 1.6.1 History and Evolution of Big Data Analytics
  - 1.6.2 Importance of Big Data Analytics
  - 1.6.3 Typical Analytical Architecture
  - 1.6.4 Challenges in Big Data Analytics

	1.6.5 Big Data Analytics Tools and Technology Unit 2: NoSQL Databases and MongoDB 2.1 Introduction to NoSQL 2.2 Advantages and Disadvantages of NoSQL 2.3 Types of NoSQL Databases 2.4 MongoDB 2.4.1 MongoDB Architecture 2.4.2 Documents and Collections 2.4.3 Queries 2.4.3.1 Simple Queries 2.4.3.2 Complex Queries (Existential Field Values, Aggregations and Groups) 2.4.4 Updates and Deletes 2.4.5 Indexing 2.4.6 MongoDB RESTful API 2.5 NoSQL in Cloud Unit 3: Hadoop and HDFS 3.1 Hadoop Overview 3.2 Hadoop Architecture 3.3 Hadoop Ecosystem Components 3.4 Hadoop Cluster Introduction 3.5 HDFS Overview 3.6 Characteristics of HDFS 3.7 HDFS Architecture and Components 3.8 HDFS Commands 3.9 Introduction to MapReduce Unit 4: Hive and HBase 4.1 Hive 4.1.1 Hive Introduction 4.1.2 Hive Architecture 4.1.3 Hive vs RDBMS 4.1.4 HiveQL Querying Data 4.2 HBase 4.2.1 HBase Concepts 4.2.2 Advanced Usage 4.2.3 Schema Design 4.2.4 Advanced Indexing
Reference Books	1. Chris Eaton,Dirkderooset al. , “Understanding Big data ”, McGraw Hill 2. BIG Data and Analytics , Sima Acharya, Subhashini Chhellappan, Willey 3. Alex Holmes, Hadoop in Practice, Manning Publication 4. Tom White, Hadoop The Definitive Guide, o’Reilly 5. Kristina Chodorow, MongoDB Definitive Guide 2e, O’Reilly 6 Amol Nayak, Instant MongoDB, Packt Publishing Limited 7. Hu, Wen Chen, Big Data Management, Technologies and Applications, IGI Global
Teaching Methodology	Class work, Discussion, Self-Study, Seminars and/or Assignments and Practicals
Evaluation Method	Internal Assessment: 30% Marks External Assessment: 70% Marks

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

SYLLABUS

Program Name	**Master of Science in Artificial Intelligence and Machine Learning**					
Semester	**3**					
NCrF Credit Level	**6.5**					
Course Type	**Minor**					
Course Subtype	**Employability and Skill Development**					
Subject Type	**Discipline Specific**					
Course Code	**305**					
Course Level	**600**					
Course Title	**Data Warehousing and Data Mining**					
Credit	**Theory:**	**4**	**Practical:**		**Total:**	**4**
Effective From	**Academic Year : 2027-28**					

Course Outcomes

CO1: Explain data warehouse concepts, OLTP vs OLAP systems, multidimensional models, and data preprocessing techniques.
CO2: Apply frequent pattern mining techniques such as Apriori and FP-Growth for association rule generation.
CO3: Implement classification and prediction models including Decision Tree, Regression, and Naïve Bayes.
CO4: Apply clustering techniques such as k-Means and hierarchical clustering for data analysis.
CO5: Analyze real-world applications and trends in data mining for knowledge discovery.

Mapping between Cos and PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	■					■
CO2	■	■			■	
CO3	■	■	■		■	■
CO4	■	■	■	■	■	■
CO5	■	■	■	■		■

Course Content

Unit 1: Data Warehousing and Data Pre-processing
- 1.1 Data Warehouse
  - 1.1.1 Introduction to Data Warehouse
  - 1.1.2 Data Warehouse Characteristics
  - 1.1.3 Data Marts
  - 1.1.4 OLTP and OLAP Systems
  - 1.1.5 Star, Snowflake, and Fact Constellation Schemas for Multidimensional Databases
  - 1.1.6 OLAP Operations in the Multidimensional Data Model
  - 1.1.7 Types of OLAP Servers
  - 1.1.8 Developing a Data Warehouse
  - 1.1.9 Building a Data Warehouse
  - 1.1.10 Three-Tier Data Warehouse Architecture
  - 1.1.11 Metadata Repository
- 1.2 Data Pre-processing
  - 1.2.1 Descriptive Data Summarization

	1.2.1.1 Central Tendency 1.2.1.2 Dispersion of Data 1.2.2 Data Cleaning 1.2.2.1 Missing Values 1.2.2.2 Noisy Data 1.2.3 Data Integration and Transformation 1.2.4 Data Reduction 1.2.4.1 Attribute Selection 1.2.5 Data Discretization and Concept Hierarchy Generation Unit 2: Introduction to Data Mining and Frequent Pattern Mining 2.1 Introduction to Data Mining 2.2 Knowledge Discovery and Data Mining 2.3 Data Mining Functionalities 2.3.1 Concept/Class Description 2.3.1.1 Characterization 2.3.1.2 Discrimination 2.3.2 Mining Frequent Patterns, Associations, and Correlations 2.3.3 Classification and Prediction 2.3.4 Cluster Analysis 2.3.5 Outlier Analysis 2.3.6 Evolution Analysis 2.4 Mining Frequent Patterns, Associations, and Correlations 2.4.1 Basic Concepts 2.4.1.1 Frequent Itemsets 2.4.1.2 Closed Itemsets 2.4.1.3 Association Rules 2.4.2 Apriori Algorithm 2.4.2.1 Candidate Generation Method 2.4.3 FP-Growth Algorithm 2.4.4 Generating Association Rules 2.4.5 Multilevel and Multidimensional Association Rules Unit 3: Classification and Prediction 3.1 Introduction to Classification and Prediction 3.2 Prediction Techniques 3.2.1 Linear Regression 3.2.2 Nonlinear Regression 3.3 Decision Tree Algorithm 3.3.1 Decision Tree Induction 3.3.2 Attribute Selection Measures 3.3.2.1 Information Gain 3.3.2.2 Gain Ratio 3.3.3 Tree Pruning 3.4 Bayesian Classification 3.4.1 Bayes' Theorem 3.4.2 Naïve Bayesian Classification 3.5 Accuracy and Error Measures for Classification Unit IV: Cluster Analysis and Applications of Data Mining 4.1 Classification vs Clustering 4.2 Partitioning Methods 4.3 Hierarchical Clustering Methods 4.4 Classical Partitioning Method: k-Means 4.5 Applications and Trends in Data Mining
Reference Books	1. The Data Warehouse Toolkit – Ralph Kimball & Margy Ross, Wiley publication 2. Data Mining: Concepts and Techniques – Jiawei Han & Micheline Kamber

	3. Data Warehousing, Data Mining & OLAP – Alex Berson & Stephen Smith 4. Data Warehousing & Data Mining – Varsha Bhosale & Deepali Vora, Dreamtech Press 5. Data Mining and Warehousing – M. Sudheep Elayidom , Cengage India 6. Data Warehousing and Data Mining – Deepali Kamthania, IK International 7. Data Warehousing and Mining – Manish Pandey & Rakesh Kumar
Teaching Methodology	Class work, Discussion, Self-Study, Seminars and/or Assignments and Practicals
Evaluation Method	Internal Assessment: 30% Marks External Assessment: 70% Marks

[Subject code-2711001703066001]

<table>
<tr><td colspan="7">VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
SYLLABUS</td></tr>
<tr><td>Program Name</td><td colspan="6">Master of Science in Artificial Intelligence and Machine Learning</td></tr>
<tr><td>Semester</td><td colspan="6">3</td></tr>
<tr><td>NCrF Credit Level</td><td colspan="6">6.5</td></tr>
<tr><td>Course Type</td><td colspan="6">Minor</td></tr>
<tr><td>Course Subtype</td><td colspan="6">Employability and Skill Development</td></tr>
<tr><td>Subject Type</td><td colspan="6">Intra-disciplinary</td></tr>
<tr><td>Course Code</td><td colspan="6">306</td></tr>
<tr><td>Course Level</td><td colspan="6">600</td></tr>
<tr><td>Course Title</td><td colspan="6">AI & Indian Knowledge System (IKS)</td></tr>
<tr><td>Credit</td><td>Theory:</td><td>2</td><td>Practical:</td><td>0</td><td>Total:</td><td>2</td></tr>
<tr><td>Effective From</td><td colspan="6">Academic Year : 2027-28</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">CO1: Explain fundamental concepts of IKS and Indian philosophical logic.
CO2: Relate Indian mathematical and logical systems with computational thinking.
CO3: Compare Indian cognitive models with modern AI/ML frameworks.
CO4: Apply ethical principles from IKS in AI system design.</td></tr>
<tr><td>Mapping between Cos and PSOs</td><td colspan="6">
<table>
<tr><th></th><th>PSO1</th><th>PSO2</th><th>PSO3</th><th>PSO4</th><th>PSO5</th><th>PSO6</th></tr>
<tr><td>CO1</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO2</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO3</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO4</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>
</td></tr>
<tr><td>Course Content</td><td colspan="6">Unit 1: Foundations of Indian Knowledge System
1.1 Introduction to Indian Knowledge System
1.1.1 Meaning, Scope and Importance of IKS
1.1.2 Evolution of Indian Knowledge Traditions
1.1.3 Interdisciplinary Nature of IKS
1.2 Knowledge Framework in Indian Philosophy
1.2.1 Pramana (Means of Knowledge)
1.2.1.1 Pratyaksha (Perception)
1.2.1.2 Anumana (Inference)
1.2.1.3 Upamana (Comparison)
1.2.1.4 Shabda (Testimony)
1.2.2 Logic in Nyaya System
1.2.3 Concept of Consciousness in Vedanta
1.3 Ethics and Values in Indian Thought
1.3.1 Dharma and Responsibility
1.3.2 Ethical Decision Making
1.3.3 Relevance to AI Ethics

Unit 2: Indian Mathematics, Logic and Computational Thinking
2.1 Indian Contributions to Mathematics
2.1.1 Concept of Zero and Decimal System
2.1.2 Algebra and Trigonometry
2.1.3 Combinatorics in Ancient Texts</td></tr>
</table>

	2.2 Indian Logic Systems 2.2.1 Nyaya Logic Structure 2.2.2 Five-membered Syllogism 2.2.3 Comparison with Modern Logical Systems 2.3 Computational Thinking in Ancient India 2.3.1 Panini's Grammar as Rule-Based System 2.3.2 Algorithmic Thinking in Sanskrit Grammar 2.3.3 Relevance to Natural Language Processing (NLP) Unit 3: Knowledge Representation and AI Perspectives 3.1 Knowledge Representation in Indian Traditions 3.1.1 Ontology in Indian Philosophy 3.1.2 Categorization Systems (Padartha) 3.1.3 Symbolic Representation 3.2 Indian Approaches to Cognition 3.2.1 Mind (Manas), Intellect (Buddhi), Consciousness (Chitta) 3.2.2 Learning and Memory Concepts 3.2.3 Comparison with Machine Learning Models 3.3 Ayurveda and Systems Thinking 3.3.1 Data-driven Diagnosis in Ayurveda 3.3.2 Pattern Recognition Concepts 3.3 Predictive Models in Traditional Knowledge Unit 4: Applications of IKS in Modern AI & ML 4.1 AI Ethics from an Indian Perspective 4.1.1 Responsible AI 4.1.2 Bias and Fairness 4.1.3 Human-centred AI 4.2 Indian Knowledge and Sustainable Technologies 4.2.1 Ecological Intelligence 4.2.2 Holistic System Design
Reference Books	1. Indian Knowledge System — Kapil Kapoor 2. An Introduction to Indian Philosophy — Chatterjee & Datta 3. Artificial Intelligence: A Modern Approach — Russell & Norvig 4. The Crest of the Peacock — G. G. Joseph 5. Ethics of Artificial Intelligence — Oxford Handbook
Teaching Methodology	Class work, Discussion, Self-Study, Seminars and/or Assignments and Practicals
Evaluation Method	Internal Assessment: 30% Marks External Assessment: 70% Marks

[Subject code-2811001704011001**]**

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT SYLLABUS						
Program Name	**Master of Science in Artificial Intelligence and Machine Learning**					
Semester	**4**					
NCrF Credit Level	**6.5**					
Course Type	**Internship**					
Course Subtype	**Employability & Skill Development**					
Subject Type	**Discipline Specific**					
Course Code	**401**					
Course Level	**600**					
Course Title	**Project**					
Credit	**Theory:**		**Practical:**	**16**	**Total:**	**16**
Effective From	**Academic Year : 2027-28**					
	● At the end of the semester, the students have to submit the project reports in bounded form to the institution. ● Project completion certificate issued by the institute is mandatory for appearing in project presentation and viva - Voce. ● The project presentation and viva-Voce will be conducted as per the university exam schedule. ● Workload for teachers: Guiding 4 students as an internal guide for project work will considered as 1- hr. workload per week.					
Evaluation Method	Internal Assessment : __120___ Marks External Assessment : __280___ Marks					

[**Subject code-***2811001704022001*]

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT SYLLABUS						
Program Name	**Master of Science in Artificial Intelligence and Machine Learning**					
Semester	**4**					
NCrF Credit Level	**6.5**					
Course Type	**Major**					
Course Subtype	**Skill Development**					
Subject Type	**Discipline Specific**					
Course Code	**402**					
Course Level	**600**					
Course Title	**Seminar**					
Credit	**Theory:**	**6**	**Practical:**		**Total:**	**6**
Effective From	**Academic Year : 2027-28**					
	● The students are required to prepare a seminar on a relevant topic concerning the subject of interest of the student; as well as latest technology. ● The students must prepare documentation of the seminar. ● At the end of the semester, the students have to submit the seminar reports in spiral bounded form to the institution. ● Seminar Completion Certificate issued by the institute is mandatory for appearing in Seminar Presentations. ● The Seminar Presentation will be conducted as per the University exam schedule. ● The students have to submit the following reports at the institution: 1. Seminar Topic Chosen 2. Institution Certificate for Seminar					
Evaluation Method	Internal Assessment: __30___ Marks External Assessment: _120___ Marks					