

The Poona Gujarati Kelvani Mandal's
Haribhai V. Desai College
of Arts, Science & Commerce, Pune.
(Autonomous)
Faculty of Science and Technology

Four Year Degree Program

B.Sc. (ARTIFICIAL INTELLIGENCE and MACHINE LEARNING) Program

With

Major- ARTIFICIAL INTELLIGENCE (AI) and MACHINE LEARNING (ML)



Syllabus

For

**F.Y. B.Sc. (ARTIFICIAL INTELLIGENCE (AI) and
MACHINE LEARNING (ML))**

Choice Based Credit System (CBCS)

**Syllabus Under National Education Policy (NEP) 2020
with effect from Academic Year 2026-27**

B. Sc. (ARTIFICIAL INTELLIGENCE (AI) and MACHINE LEARNING (ML))

1. Name of Program: ARTIFICIAL INTELLIGENCE (AI) and MACHINE LEARNING (ML)

2. Introduction:

The Bachelor of Science in Artificial Intelligence and Machine Learning (B.Sc. AI & ML) and B.Sc. (AI & ML) Honors and Research programs are designed in accordance with the principles of the National Education Policy (NEP) 2020, with a focus on outcome-based, multidisciplinary, and technology-driven education. The program aims to equip students with strong theoretical foundations, practical skills, and research aptitude in the rapidly advancing domains of Artificial Intelligence and Machine Learning.

Driven by the exponential growth of data, enhanced computational capabilities, and continuous advancements in algorithms, Artificial Intelligence has emerged as a transformative force across industries. The program covers key AI domains including machine learning, natural language processing, computer vision, robotics, and intelligent search systems, preparing students to address real-world problems using data-driven approaches.

The curriculum introduces core Machine Learning paradigms such as supervised learning, unsupervised learning, and reinforcement learning. In supervised learning, students study algorithms trained on labelled datasets to learn mappings from inputs to outputs, such as facial recognition and classification tasks. Unsupervised learning focuses on discovering hidden patterns and structures in unlabelled data, while reinforcement learning emphasizes learning optimal decision-making strategies through interaction with dynamic environments.

In line with NEP 2020's emphasis on experiential learning, research orientation, and flexibility, the program integrates hands-on laboratories, internships, project-based learning, and opportunities for undergraduate research. Students develop a strong understanding of the theoretical relationships among machine learning algorithms while gaining practical exposure to modern tools, frameworks, and ethical considerations in Artificial Intelligence.

3. Objectives:

- Provide fundamental and advanced knowledge of Artificial Intelligence and Machine Learning concepts and techniques.
- Develop analytical, computational, and problem-solving skills required to build intelligent systems.
- Enable students to apply AI and ML methods to real-world and interdisciplinary problems.

- Promote experiential, skill-based, and project-oriented learning in alignment with NEP 2020.
- Foster research aptitude, innovation, and critical thinking among students.
- Encourage ethical awareness, social responsibility, and sustainable use of AI technologies.
- Prepare graduates for higher education, research, industry careers, and entrepreneurship.
- Cultivate lifelong learning skills and adaptability to emerging technologies.

4. Eligibility:

- Passed Standard XII (10+2) or equivalent examination with Physics and Mathematics as compulsory subjects along with one of the Chemistry/ Biotechnology/ Biology/ Technical Vocational subject/ Computer Science/ Information Technology/ Informatics Practices/ Agriculture/ Engineering Graphics/ Business Studies from any recognized Board with a minimum of 50% marks or equivalent grade (45% marks or equivalent grade for Scheduled Caste/ Scheduled Tribes).

PO No.	PO Outcomes
PO-1	Apply fundamental principles of Artificial Intelligence to solve problems involving reasoning, inference, perception, knowledge representation, and learning.
PO-2	Demonstrate awareness and foundational understanding of AI applications, including intelligent agents, expert systems, artificial neural networks, and machine learning models.
PO-3	Identify problem domains where Artificial Intelligence techniques are applicable and participate effectively in discussions on AI technologies, their scope, limitations, and societal implications.
PO-4	Demonstrate proficiency in applying the scientific method to develop, evaluate, and validate machine learning models.
PO-5	Understand and evaluate a wide range of learning algorithms, appreciating their strengths, weaknesses, and suitability for different data-driven problems.
PO-6	Apply AI and ML algorithms to real-world problems, optimize model performance, and assess expected accuracy and effectiveness of the developed solutions.
PO-7	Analyze and compare different AI and ML approaches, considering their advantages, limitations, and appropriateness for specific applications.
PO-8	Appreciate the underlying mathematical and statistical foundations that support Artificial Intelligence and Machine Learning techniques.

PO-9	Conduct investigations of complex problems using research-based knowledge and methods, including experimental design, data analysis, interpretation of results, and synthesis of information to draw valid conclusions.
PO-10	Function effectively as an individual and as a member or leader in multidisciplinary and diverse teams.
PO-11	Communicate effectively on complex technical activities with the scientific and engineering community and with society at large, through clear reports, documentation, presentations, and instructions.

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Structure of UG Program as per NEP-2020

Program Name: - B.Sc. (ARTIFICIAL INTELLIGENCE and MACHINE LEARNING)

Major Course: - ARTIFICIAL INTELLIGENCE and MACHINE LEARNING

SEMESTER-1

Level- 4.5 (First Year)

Course Type	Course Code	Course Title	Credit		Teaching Scheme Hr. / Week		Evaluation Scheme & Max Marks		
			TH	PR	TH	PR	CE	EE	Total
Subject 1 (2T+2P)	AIML-101-MJ-TH	Python Programming	2		2		20	30	50
	AIML-102-MJ-PR	Practical based on AIML-101-MJ-TH		2		4	20	30	50
Subject 2 (2T+2P)	MTC-103-MJ-TH	Discrete Mathematics for AIML	2		2		20	30	50
	MTC-104-MJ-PR	Practical based on MTC-103-MJ-TH		2		4	20	30	50
Subject 3 (2T+2P)	STC-101-MJ-TH	Statistics for AIML -I	2		2		20	30	50
	STC-102-MJ-PR	Practical based on STC-101-MJ-TH		2		4	20	30	50
IKS (2T)	IKS -101- AIML-TH	Generic IKS	2		2		20	30	50
GE/OE* (2T)	OE-101-AIML-TH	From College Basket	2		2		20	30	50
SEC (2T)	SEC-101-AIML-TH	Discrete Probability and Distributions	2		2		20	30	50
AEC (2T)	AEC-104-ENG-TH	Professional Communication Skills – I	2		2		20	30	50
VEC (2T)	VEC-101-ENV-TH	Environmental Education- I	2		2		20	30	50
TOTAL			16	6	16	12			550

* The subjects offered to other faculty students under OE vertical are **OE-101-AIML -TH** and **OE-102-AIML -TH**.

The students of B.Sc. (AI & ML) will opt the subjects offered by other faculty given in College GE/OE Basket.

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Structure of UG Program as per NEP-2020

Program Name: - B.Sc. (ARTIFICIAL INTELLIGENCE and MACHINE LEARNING)

Major Course: - ARTIFICIAL INTELLIGENCE and MACHINE LEARNING

SEMESTER- II

Level- 4.5 (First Year)

Course Type	Course Code	Course Title	Credit		Teaching Scheme Hr. / Week		Evaluation Scheme & Max Marks		
			TH	PR	TH	PR	CE	EE	Total
Subject 1 (2T+2P)	AIML-151-MJ-TH	Advanced Python Programming	2		2		20	30	50
	AIML-152-MJ-PR	Practical based on AIML-151-MJ-TH		2		4	20	30	50
Subject 2 (2T+2P)	MTC-153-MJ-TH	Graph Theory and Network in AIML	2		2		20	30	50
	MTC-154-MJ-PR	Practical based on MTC-153-MJ-TH		2		4	20	30	50
Subject 3 (2T+2P))	STC-151-MJ-TH	Statistics for AIML -II	2		2		20	30	50
	STC-152-MJ-PR	Practical based on STC-151-MJ-TH		2		4	20	30	50
GE/OE * (2T)	OE-151-AIML-TH	From College Basket	2		2		20	30	50
SEC (2T)	SEC-151-AIML-TH	Databases – I	2		2		20	30	50
AEC (2T)	AEC-154-ENG-TH	Professional Communication Skills – II	2		2		20	30	50
VEC (2T)	VEC-151-ENV-TH	Environmental Education-II	2		2		20	30	50
CC (2)	CC-151-PE-TW	From College Basket	2		2		20	30	50
TOTAL			16	6	16	12			550

* The subjects offered to other faculty students under OE vertical are **OE-151-AIML -TH** and **OE-152-AIML -TH**.

The students of B.Sc. (AI & ML) will opt the subjects offered by other faculty given in College GE/OE Basket.

Exit option:

Award of UG Certificate in Major **with 44 credits and an additional 4 credits** as per college guidelines OR Continue with Major and Minor.

ATKT Rules

Minimum number of credits required to take admission to S.Y.B.Sc. (AI & ML) is 22 credits [50%].

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Structure of UG Program as per NEP-2020

Program Name: - B.Sc. (ARTIFICIAL INTELLIGENCE and MACHINE LEARNING)

Major Course: - ARTIFICIAL INTELLIGENCE and MACHINE LEARNING

SEMESTER- III

Level- 5.0 (Second Year)

Course Type	Course Code	Course Title	Credit		Teaching Scheme Hr. / Week		Evaluation Scheme & Max Marks		
			TH	PR	TH	PR	CE	EE	Total
Major Core (4T+2P)	AIML-201-MJ-TH	Data Structures (using Python)	2		2		20	30	50
	AIML-202-MJ-TH	Software Engineering	2		2		20	30	50
	AIML-203-MJ-PR	Lab course on AIML-201-MJ-TH & AIML-202-MJ-TH		2		4	20	30	50
VSC (2T)	AIML-221-VSC-TH	OOPS & Java Programming	2		2		20	30	50
IKS (2T)	AIML-201-IKS-TH	Computing in Ancient India	2		2		20	30	50
FP/OJT/ CEP (2)	AIML-231-FP	Mini Project		2		4	20	30	50
Minor (2T+2P)	MTC-243-MN-TH	Linear Algebra	2		2		20	30	50
	MTC-244-MN-PR	Practical on MTS-243-MN-TH		2		4	20	30	50
GE/OE (2T)	OE-201-AIML-TH	From College Basket	2		2		20	30	50
AEC (2T)	AEC-201-	From College Basket	2		2		20	30	50
CC (2)	CC-201-PE / NSS / NCC	From College Basket	2		2		20	30	50
TOTAL			16	6	16	12			550

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Structure of UG Program as per NEP-2020

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Major Course: - ARTIFICIAL INTELLIGENCE and MACHINE LEARNING

SEMESTER- IV

Level- 5.0 (Second Year)

Course Type	Course Code	Course Title	Credit		Teaching Scheme Hr. / Week		Evaluation Scheme & Max Marks		
			TH	PR	TH	PR	CE	EE	Total
Major Core (6T+2P)	AIML-251-MJ-TH	Microservices using Python	2		2		20	30	50
	AIML-252-MJ-TH	Artificial Intelligence - I	2		2		20	30	50
	AIML-253-MJ-PR	Practical based on AIML-251-MJ-TH & AIML-252-MJ-TH		2		4	20	30	50
VSC (2T/P)	AIML-271-VSC-TH	Databases - II	2		2		20	30	50
FP/OJT/CEP (2)	AIML-281-CEP	Mini Project		2		4	20	30	50
Minor (2T+2P)	MTC-293-MN-TH	Mathematical Logic	2		2		20	30	50
	MTC-294-MN-PR	Practical based on MTC-293-MN-TH		2		4	20	30	50
GE/OE (2P)	OE-251-AIML-TH	From College Basket	2		2		20	30	50
SEC (2P)	SEC-251-AIML-PR	DAA - I		2		4	20	30	50
AEC (2T)	AEC-251-ENG-TH	From College Basket	2		2		20	30	50
CC (2)	CC-251-PE / NSS / NCC	From College Basket	2		2		20	30	50
TOTAL			14	8	14	16			550

Exit option:

Award of UG Diploma in Major and Minor with **88 credits and an additional 4 credits** core as per college guidelines OR Continue with Major and Minor.

ATKT Rules:

Minimum number of credits required to take admission to T.Y.B.Sc. (AI & ML) is 44 credits [100%] to be completed from F.Y.B.Sc. (AI & ML) and at least 22 credits from S.Y.B.Sc. (AI & ML)

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Major Course: - ARTIFICIAL INTELLIGENCE and MACHINE LEARNING

SEMESTER- V

Level- 5.5 (Third Year)

Course Type	Course Code	Course Title	Credit		Teaching Scheme Hr. / Week		Evaluation Scheme & Max Marks		
			TH	PR	TH	PR	CE	EE	Total
Major Mandatory (8T+4P)	AIML-301-MJ-TH	Artificial Intelligence - II	2		2		20	30	50
	AIML-302-MJ-TH	Machine Learning Techniques – I	2		2		20	30	50
	AIML-303-MJ-TH	Data Preparation and Visualization	2		2		20	30	50
	AIML-304-MJ-TH	DAA - II	2		2		20	30	50
	AIML-305-MJ-PR	Practical based on AIML-301-MJ-TH		2		4	20	30	50
	AIML-306-MJ-PR	Practical based on AIML-302-MJ-TH & AIML-303-MJ-TH		2		4	20	30	50
Major Elective (2T+2P)	AIML-310-MJ-TH	Big Data Analytics	2		2		20	30	50
	AIML-311-MJ-PR	Practical based on AIML-310-MJ-TH		2		4	20	30	50
	OR								
	AIML-312-MJ-TH	MEAN – I	2		2		20	30	50
	AIML-313-MJ-PR	Practical based on AIML-312-MJ-TH		2		4	20	30	50
	OR								
	AIML-314-MJ-TH	Mobile app development	2		2		20	30	50
	AIML-315-MJ-PR	Practical based on AIML-314-MJ-TH		2		4	20	30	50
VSC (2T/P)	AIML-321-VSC-PR	Linux Shell Scripting		2		4	20	30	50
FP/OJT/ CEP (2FP/CEP)	AIML-331-FP	Project		2		4	20	30	50
Minor (2T)	MTS-301-MN-TH	Calculus for ML	2		2		20	30	50
TOTAL			12	10	12	20			550

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Major Course: - ARTIFICIAL INTELLIGENCE and MACHINE LEARNING

SEMESTER- VI
Level- 5.5 (Third Year)

Course Type	Course Code	Course Title	Credit		Teaching Scheme Hr. / Week		Evaluation Scheme & Max Marks		
			TH	PR	TH	PR	CE	EE	Total
Major Mandatory (8T+4P)	AIML-351-MJ-TH	Optimization Techniques	2		2		20	30	50
	AIML-352-MJ-TH	Machine Learning Techniques – II	2		2		20	30	50
	AIML-353-MJ-TH	Data Mining Techniques	2		2		20	30	50
	AIML-354-MJ-TH	Evolutionary Algorithms (FL, GA)	2		2		20	30	50
	AIML-355-MJ-PR	Practical based on AIML-351-MJ-TH		2		4	20	30	50
	AIML-356-MJ-PR	Practical based on AIML-352-MJ-TH & AIML-353-MJ-TH		2		4	20	30	50
Major Elective (2T+2P)	AIML-360-MJ-TH	Business Intelligence	2		2		20	30	50
	AIML-361-MJ-PR	Practical based on AIML-360-MJ-TH		2		4	20	30	50
	OR								
	AIML-362-MJ-TH	MEAN II	2		2		20	30	50
	AIML-363-MJ-PR	Practical based on AIML-362-MJ-TH		2		4	20	30	50
	OR								
	AIML-364-MJ-TH	Game Theory	2		2		20	30	50
	AIML-365-MJ-PR	Practical based on AIML-364-MJ-TH		2		4	20	30	50
VSC(2T/P)	AIML-371-VSC-PR	Database Technologies		2		4	20	30	50
FP/OJT/ CEP (4 OJT)	AIML-381-OJT	On Job Training		4		8	20	30	100
TOTAL			10	12	10	24			550

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Structure of UG Program as per NEP-2020

Program Name: - B.Sc. (ARTIFICIAL INTELLIGENCE and MACHINE LEARNING)

Major Course: - ARTIFICIAL INTELLIGENCE and MACHINE LEARNING

SEMESTER- VII

Level- 6 (Fourth Year)

Honors Degree

Course Type	Course Code	Course Title	Credit		Teaching Scheme Hr. / Week		Evaluation Scheme & Max Marks		
			TH	PR	TH	PR	CE	EE	Total
Major Mandatory (10T+4P)	AIML-401-MJ-TH	Deep Learning	4		4		40	60	100
	AIML-402-MJ-TH	Natural Language Processing – I	2		2		20	30	50
	AIML-403-MJ-TH	Software Design and Software Architectures	4		4		40	60	100
	AIML-404-MJ-TH	Practical based on AIML-401-MJ-TH		2		4	20	30	50
	AIML-405-MJ-PR	Practical based on AIML-402-MJ-TH		2		4	20	30	50
Major Elective (2T+2P)	AIML-410-MJ-PR	Cloud computing	2		2		20	30	50
	AIML-411-MJ-PR	Practical based on AIML-410-MJ-TH		2		4	20	30	50
	OR								
	AIML-412-MJ-TH	Theory of Computation (TCS)	2		2		20	30	50
	AIML-413-MJ-PR	Practical based on AIML-412-MJ-TH		2		4	20	30	50
	OR								
	AIML-414-MJ-TH	C# .NET Programming	2		2		20	30	50
	AIML-415-MJ-PR	Practical based on AIML-414-MJ-TH		2		4	20	30	50
RM (4T)	AIML-441-RM-TH	Research Methodology	4		4		40	60	100
TOTAL			16	6	16	12			550

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Structure of UG Program as per NEP-2020

Program Name: - B.Sc. (ARTIFICIAL INTELLIGENCE and MACHINE LEARNING)

Major Course: - ARTIFICIAL INTELLIGENCE and MACHINE LEARNING

SEMESTER- VIII

Level- 6 (Third Year)

Honors Degree

Course Type	Course Code	Course Title	Credit		Teaching Scheme Hr. / Week		Evaluation Scheme & Max Marks		
			TH	PR	TH	PR	CE	EE	Total
Major Mandatory (10T+4P)	AIML-451-MJ-TH	Deep Learning - II	4		4		40	60	100
	AIML-452-MJ-TH	Natural Language Processing - II	2		2		20	30	50
	AIML-453-MJ-TH	Cryptography	4		4		40	60	100
	AIML-454-MJ-PR	Practical based on AIML-451-MJ-TH		2		4	20	30	50
	AIML-455-MJ-PR	Practical based on AIML-452-MJ-TH		2		4	20	30	50
Major Elective (2T+2P)	AIML-460-MJ-TH	DevOps	2		2		20	30	50
	AIML-461-MJ-PR	Practical Based on AIML-460-MJ-TH		2		4	20	30	50
	OR								
	AIML-462-MJ-TH	Theory of Computation (TCS)	2		2		20	30	50
	AIML-463-MJ-PR	Practical Based on AIML-462-MJ-TH		2		4	20	30	50
	OR								
	AIML-464-MJ-TH	C# .NET Programming	2		2		20	30	50
	AIML-465-MJ-PR	Practical Based on AIML-464-MJ-TH		2		4	20	30	50
OJT (4 OJT)	AIML-481-OJT	On Job Training		4		8	40	60	100
TOTAL			12	10	12	20			550

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Structure of UG Program as per NEP-2020

Program Name: - B.Sc. (ARTIFICIAL INTELLIGENCE and MACHINE LEARNING)

Major Course: - ARTIFICIAL INTELLIGENCE and MACHINE LEARNING

SEMESTER- VII

Level- 6 (Fourth Year)

Honors with Research

Course Type	Course Code	Course Title	Credit		Teaching Scheme Hr. / Week		Evaluation Scheme & Max Marks		
			TH	PR	TH	PR	CE	EE	Total
Major Mandatory (6T+4P)	AIML-401-MJ-TH	Deep Learning – I	2		2		20	30	50
	AIML-402-MJ-TH	Natural Language Processing - I	2		2		20	30	50
	AIML-403-MJ-TH	Software Design and Software Architectures	2		2		20	30	50
	AIML-404-MJ-PR	Practical based on AIML-401-MJ-TH		2		4	20	30	50
	AIML-405-MJ-PR	Practical based on AIML-402-MJ-TH		2		4	20	30	50
Major Elective (2T+2P)	AIML-410-MJ-TH	Cloud computing	2		2		20	30	50
	AIML-411-MJ-PR	Practical based on AIML-410-MJ-TH		2		4	20	30	50
	OR								
	AIML-412-MJ-TH	Theory of Computation (TCS)	2		2		20	30	50
	AIML-413-MJ-PR	Practical based on AIML-412-MJ-TH		2		4	20	30	50
	OR								
	AIML-414-MJ-TH	C# .NET Programming	2		2		20	30	50
	AIML-415-MJ-PR	Practical based on AIML-414-MJ-TH		2		4	20	30	50
FP/OJT/ CEP/RP (4 RP)	AIML-431-RP-PR	Research Project		4		8	40	60	100
RM (4T)	AIML-441-RM-TH	Research Methodology	4		4		40	60	100
TOTAL			12	10	12	20			550

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Structure of UG Program as per NEP-2020

Program Name: - B.Sc. (ARTIFICIAL INTELLIGENCE and MACHINE LEARNING)

Major Course: - ARTIFICIAL INTELLIGENCE and MACHINE LEARNING

SEMESTER- VIII
Level- 6 (Fourth Year)
Honors with Research

Course Type	Course Code	Course Title	Credit		Teaching Scheme Hr. / Week		Evaluation Scheme & Max Marks		
			TH	PR	TH	PR	CE	EE	Total
Major Mandatory (6T+4P)	AIML-451-MJ-TH	Deep Learning – II	2		2		20	30	50
	AIML-452-MJ-TH	Natural Language Processing – II	2		2		20	30	50
	AIML-453-MJ-TH	Cryptography	2		2		20	30	50
	AIML-454-MJ-PR	Practical based on AIML-451-MJ-TH		2		4	20	30	50
	AIML-455-MJ-PR	Practical based on AIML-452-MJ-TH		2		4	20	30	50
Major Elective (2T+2P)	AIML-460-MJ-TH	DevOps	2		2		20	30	50
	AIML-461-MJ-PR	Practical based on AIML-461-MJ-TH		2		4	20	30	50
	OR								
	AIML-462-MJ-TH	Data Analytics	2		2		20	30	50
	AIML-463-MJ-PR	Practical based on AIML-462-MJ-TH		2		4	20	30	50
	OR								
	AIML-464-MJ-TH	Computer Vision (Image Processing)	2		2		20	30	50
	AIML-465-MJ-PR	Practical based on AIML-464-MJ-TH		2		4	20	30	50
FP/OJT/ CEP/RP (8 RP)	AIML-481-RP-PR	Research Project		8		16	80	120	200
TOTAL			8	14	8	28			550

Syllabus of Semester-I

Haribhai V. Desai College of Arts, Science and Commerce, Pune (Autonomous) F.Y.B.Sc.(AI & ML) Subject Code: AIML-101-MJ-TH Subject: Python Programming		
Teaching Scheme 2 hours / Week	No. of Credits 2	Examination Scheme CE: 20 marks EE: 30 marks
Prerequisites:- Basic computer literacy (use of operating systems, files, and folders) and basic understanding of mathematics at higher secondary level		
Course Objectives: - The course is designed to teach: • The Python environment, data types, operators used in Python. • The use of control structures and numerous native data types with their methods. • The design and implement user defined functions, modules, and packages and exception handling methods. • Creating and handling files in Python • Object Oriented Programming (OOP) Concepts • The semantics of Python programming language and illustrate the process of structuring the data using lists, dictionaries, tuples, strings and sets.		
Course Outcomes: - Student will be able to: - 1. Students will be able to interpret and explain the basic principles and syntax of the Python programming language 2. Students will be able to articulate Object-Oriented Programming concepts such as encapsulation, inheritance, polymorphism, and code reuse as implemented in Python. 3. Students will be able to solve, test, and debug basic computational problems using Python scripts. 4. Students will be able to manipulate Python programs using built-in data structures such as lists, tuples, dictionaries, strings, and sets. 5. Students will be able to design and develop object-oriented programs using Python classes and objects. 6. Students will be able to identify and apply commonly used file I/O operations, handle I/O exceptions, and use directories and regular expressions in Python.		
Course Contents		
Chapter 1	Introduction to Python	6 hours
Introduction to Python: use of Jupyter / IDLE/ CoLAB to develop programs, Features of Python, Limitations, Major Applications of Python Python Data Types & Input/Output: Keywords, Identifiers, Python Statement, Indentation, Documentation, Variables, Multiple Assignment, Understanding Data Type, Data Type Conversion, Python Input and Output Functions, Import command. Operators and Expressions: Operators in Python, Expressions, Precedence, Associativity of Operators, Non-Associative Operators, Interactive Mode and Script Mode, Order of Operations. Control Structures: Decision making statements, loops, control statements. Python Native Data Types: Numbers, Lists, Tuples, Sets, Dictionary, Functions & Methods of Dictionary		
Chapter 2	Strings & Functions	6 hours
Strings: String as a sequence, traversal with a for loop, string slices and dices, strings Are immutable, searching, looping and counting, string methods, the in operator, string comparison, string operations Python Functions: Function calls, type conversion functions, math functions, user defined functions -		

definitions and uses, parameters and arguments, variables and parameters Are Local, stack diagrams, fruitful functions and void functions, importing with from, return values, composition, boolean functions, recursion, checking types		
Chapter 3	Modules and Classes	9 hours
Python Modules: Module definition, need of modules, creating a module, importing module, Path Searching of a Module, Module Reloading, Standard Modules, Python Packages. Classes in Python: OOPS Concepts, Classes and objects, Classes in Python, Constructors, Data hiding, Creating Classes, Instance Methods, Instances as return values, Special Methods, Class Variables, Inheritance, Polymorphism, Type Identification, Iterators, generators and decorators.		
Chapter 4	File Management, Error Handling and Exception Handling	9 hours
File Management in Python: Operations on files (opening, modes, attributes, encoding, closing), read() & write() methods, tell() & seek() methods, renaming & deleting files in Python, directories in Python. I/O and Error Handling in Python: Introduction, Data Streams, Creating Your Own Data Streams, Access Modes, Writing Data to a File, Reading Data from a File, Additional File Methods, Working with Directories. Exception Handling: Exceptions, Built-in exceptions, Exception handling, User defined exceptions in Python, Handling IO Exceptions, Errors, Run Time Errors, The • Exception Model, Exception Hierarchy, Handling Multiple Exceptions.		
Reference Books:		
1. Pooja Sharma, Programming in Python, BPB Publications, 2017, ISBN: 978-9386551276 2. R. NageswaraRao, Core Python Programming, Dreamtech Press, 3rd Edition, ISBN: 978-9390457151 3. Dr. Marlapalli Krishna, S. Jaya Prakash, K. Varada Rajkumar, Basic Python Programming for Beginners, Bluerose Publishers Pvt. Ltd., 2021, ISBN: 978- 9354720604 4. Martin C. Brown, Python: The complete Reference, McGraw Hill Education, 2018, ISBN: 978-9387572942 5. Martelli A., A. Ravenscroft, S. Holden, Python in a Nutshell, OREILLY. 6. Reema Thareja, Python Programming, OUP India, Oxford University Press India, 2nd edition, 2023, ISBN: 978-9354973765 7. Christos Manola, Dimitrios Xanthidis, Han-I Wang, Ourania K. Xanthidou, Handbook of Computer Programming with Python, CRC Press; 1st edition, 2022, ISBN: 978-0367687779		

Haribhai V. Desai College of Arts, Science and Commerce, Pune
(Autonomous)
F.Y.B.Sc.(AI & ML)

Subject Code: AIML-102-MJ-PR

Subject: Practical Based on AIML-101-MJ-TH

Teaching Scheme 4 hours / Week	No. of Credits 2	Examination Scheme CE: 20 marks EE: 30 marks
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Course Objectives: -

The course is designed to teach:

1. The Use of Python IDE, data type, I/O
2. The use of decision statements and loop statements
3. Ways of Implementing functions, parameter passing, returning value from function and the types of functions
4. The use of strings and string manipulations
5. The use of arrays and array operations
6. Implementation of python modules
7. Handling files, reading and writing to files and other file operations
8. Implementing Object Oriented programming (OOP) concepts in Python

Course Outcomes: - Student will be able to: -

1. Solve simple problems using basic python
2. Use control statements for decision making and looping
3. Use arrays to store related data
4. Apply OOP concepts to solve problems related to real-world applications
5. Use files manipulation statements to store data on secondary device
6. Handle runtime-errors using exceptions and Use python IDE effectively

Practical	
Unit	Practical
1, 2,3, 4	Python IDE, anaconda/pip, Basic python – datatypes, control statements – decision making, loops, Operators, I/O, native data types
5,6	Python functions
7,8	Python Strings and string manipulation
9, 10	Python arrays and operations on arrays (slice n dice etc.)
11	Modules – standard modules, user defined
12, 13	File handling
14, 15	OOP concept implementation

Haribhai V. Desai College of Arts, Science and Commerce, Pune (Autonomous) F.Y.B.Sc.(AI & ML) Subject Code: MTC-103-MJ-TH Subject: Discrete Mathematics for AIML		
Teaching Scheme 2 hours / Week	No. of Credits 2	Examination Scheme CE: 20 marks EE: 30 marks
Prerequisites None		
Course Objectives: The course is designed to teach: • The basic concepts of sets, set operations, principle of inclusion-exclusion • The concepts of relations and its properties • Functions and its types • Elementary combinatorics • The concept of recurrence relations, modelling a recurrence relation and obtaining its solution		
Course Outcomes (COs) After successful completion of the course, students will be able to: CO1: <i>Understand</i> and <i>describe</i> fundamental concepts of set theory and operations on sets. CO2: <i>Analyze</i> relations and functions and <i>apply</i> them in problem-solving. CO3: <i>Apply</i> principles of counting, permutations and combinations. CO4: <i>Solve</i> problems involving recurrence relations using appropriate methods. CO5: <i>Interpret</i> discrete structures for practical and computational applications. CO6: <i>Evaluate</i> mathematical solutions using logical reasoning		
Course Contents		
Unit 1	Set Theory	8 Hours
Set Theory – • Revision of Describing Sets Mathematically, Set Membership, Equality of Sets, Finite and Infinite Sets, Power Set, Cartesian Product, Properties of Sets, Vector Implementations of Sets. Operations on Sets- • Union and Intersection, Set Difference, Complements, and DeMorgan's Laws, Power Sets and Products. The Principle of Inclusion-Exclusion – • Finite Cardinality, Principle of Inclusion-Exclusion for Two Sets. • Principle of Inclusion-Exclusion for Three Sets, Principle of Inclusion- Exclusion for Finitely Many Sets. Pigeon- hole principle and its applications, Generalized pigeon hole.		
Unit 2	Relations	8 Hours
Relations: • Properties of Binary Relations, Equivalence Relation, Transitive closure. • Partial ordering relations, Poset and Hasse diagram. • Functions: inverse Function, Composition of functions, Recursive Functions.		

Unit 3	Elementary Combinatorics	6 Hours
• Basis of counting, • basics Combinations & Permutations, • addition and multiplication principle.		
Unit 4	Recurrence Relations	8 Hours
• Introduction Recurrence relations and modelling of a recurrence relation. • solving homogenous linear recurrence using characteristic polynomial. • Solving recurrence relation by substitution. • Recurrence tree method, Masters' theorem		
Reference Book:-		
1. Kenneth H. Rosen, <i>Discrete Mathematics and its Applications</i>, Tata McGraw Hill Publishers, seventh Edition, 2007 2. Ralph P. Grimaldi, <i>Discrete and Combinatorial Mathematics</i>, Pearson, 2006, 5th Edition, ISBN: 9788177584240 3. Ronald Graham, Donald Knuth, and Oren Patashnik, <i>Concrete Mathematics</i>, Pearson Education Publishers, 2nd Edition, 1996. 4. Peter J. Cameron, <i>Combinatorics: Topics, Techniques, Algorithms</i>, Cambridge University Press, 1994 (reprinted 1996).		

Haribhai V. Desai College of Arts, Science and Commerce, Pune (Autonomous) F.Y.B.Sc.(AI & ML) Subject Code: MTC-104-MJ-PR Subject : Practical Based on MTC-103-MJ-TH		
Teaching Scheme 4 hours / Week	No. of Credits 2	Examination Scheme CE: 20 marks EE: 30 marks
Prerequisites:- None		
Objectives: The course is designed to teach: 1. Solve problems based on set theory 2. Solve problems based on relations and functions 3. Solve problems based on elementary Combinatorics 4. Derive a recurrence relation, obtain a solution to a recurrence relation using different methods		
Course Outcomes: After completing this course, a student will be able to: 1. Solve problems on sets and set operations 2. Solve problems on relations and functions 3. Define recurrence relations and obtain solution to it 4. Solve problems related to counting and combinatorics		
List of Practical:-		
Unit	Practical based on AIML-103-MJ-TH	
1	Problems based on Set theory, Operations on sets	
2,3	Problems based on Principle of Inclusion-exclusion	
4,5	Problems based on Relations and Functions	
6	Problems based on Pigeon hole principle	
7,8	Problems based on Counting, Combinatorics	
9 to 11	Problems based on Addition and multiplication principle	
12 to 15	Problems based on Deriving a recurrence relation, solving a recurrence relation using different methods	

Haribhai V. Desai College of Arts, Science and Commerce, Pune (Autonomous) F.Y.B.Sc.(AI & ML) Subject Code: STC-101-MJ-TH Subject: Statistics for AIML -I		
Teaching Scheme 2 hours / Week	No. of Credits 2	Examination Scheme CE: 20 marks EE: 30 marks
Prerequisites None		
Objectives: The course is designed to teach: 1. methods in descriptive statistics 2. the use of concepts in descriptive statistics as applied to real data 3. methods for finding correlation between variables 4. fitting an equation for prediction and apply the same for real data		
Course Outcomes: After completing the course, the student will be able to: • summarize data visually and numerically • analyse a problem, identify methods in descriptive statistics and define the computing requirements appropriate to its solution • identify correlation between variables, and fit an equation for prediction and apply the same for real data and assess data-based models • execute statistical analysis with any software tool		
Course Contents		
Chapter 1	Data condensation and Graphical methods	5 Hours
Raw data, attributes and variables, discrete and continuous variables. Presentation of data using frequency distribution and cumulative frequency distribution. (Construction of frequency is not expected) Graphical Presentation of frequency distribution – histogram, stem and leaf chart, less than and more than type ogive curves. Numerical problems related to real life situations.		
Chapter 2	Descriptive Statistics	7 Hours
Measures of Central tendency: Mean, Mode, Median. Examples where each one of these is most appropriate. Partition values: Quartiles, Box-Plot. Measures of Dispersion: Range, Coefficient of range, Quartile deviation, Coefficient of quartile deviation, Variance, Standard Deviation, Coefficient of Variation.		
Chapter 3	Descriptive Statistics for grouped data	7 Hours
Measures of Central tendency: Mean, Mode, Median. Examples where each one of these is most appropriate. Partition value: Quartiles. Measures of Dispersion- Quartile deviation, Coefficient of quartile deviation, Variance, Standard Deviation, Coefficient of Variation.		
Chapter 4	Graphical properties of data	11 Hours

Raw and Central moments: definition, computations for ungrouped and grouped data (only up to first four moments). Relation between raw and central moments up to fourth order. Numerical problems related to real life situations. Concept of symmetric frequency distribution, skewness, positive and negative skewness. Measures of skewness-Pearson's measure, Bowley's measure, β_1, γ_1. Kurtosis of a frequency distribution, types of kurtosis: leptokurtic, platykurtic and mesokurtic, measure of kurtosis (β_2, γ_2) based upon moments. Numerical problems related to real life situations		
Reference Books:		
1) Statistical Methods, G.W. Snedecor, W.G. Cochran, John Wiley & sons, 1991, Eight Edition 2) Fundamentals of Applied Statistics, Gupta and Kapoor, S.Chand and Sons, New Delhi, 2014, Fourth Edition 3) An Introductory Statistics, Kennedy and Gentle. 4) Introduction to Linear Regression Analysis, Douglas C. Montgomery, Elizabeth A. Peck, G. Geoffrey Vining, Wiley, 2012, Fifth Edition		

Haribhai V. Desai College of Arts, Science and Commerce, Pune (Autonomous) F.Y.B.Sc.(AI & ML) Subject Code: STC-102-MJ-PR Subject : Practical Based on STC-101-MJ-TH		
Teaching Scheme 4 hours / Week	No. of Credits 2	Examination Scheme CE: 20 marks EE: 30 marks
Prerequisites :- None		
Objectives: The course is designed to teach: - the concept of descriptive statistics for real data. - methods for finding correlation between variables. - fitting of linear equation and nonlinear curve for prediction and apply the same for real data. - implementation all above methods using R software		
Course Outcomes: After competing this course, a student will be able to: - Use various graphical methods to represent data - Obtain measures of central tendency on data sets - Obtain moments, skewness, kurtosis on data sets		
List of Practical:-		
Unit	Practical based on STC-101-MJ-TH	
1,2	Introduction to R software.	
1,2	Graphical methods of data presentation	
2-3	Measures of Central Tendency and Dispersion for raw data.	
2-3	Box plot, variance, coefficient of variation	
4	Moments Computation	
4	Skewness and kurtosis	
Reference Book :-		
1) Statistical Methods, G.W. Snedecor, W.G. Cochran, John Wiley & sons, 1991, Eight Edition 2) Fundamentals of Applied Statistics, Gupta and Kapoor, S.Chand and Sons, New Delhi, 2014, Fourth Edition 3) An Introductory Statistics, Kennedy and Gentle. 4) Introduction to Linear Regression Analysis, Douglas C. Montgomery, Elizabeth A. Peck, G. Geoffrey Vining, Wiley, 2012, Fifth Edition		

Haribhai V. Desai College of Arts, Science and Commerce, Pune (Autonomous) F.Y.B.Sc.(AI & ML) Subject Code: SEC-101-AIML-TH Subject: Discrete Probability and Distributions		
Teaching Scheme 2 hours / Week	No. of Credits 2	Examination Scheme CE: 20 marks EE: 30 marks
Prerequisite:		
Objectives: - To teach basic probability theory - To teach basics of conditional probability, Bayes theorem and its applications - To teach concepts of discrete random variables - To teach the concept, types and use of discrete probability distributions		
Course Outcomes: After successful completion of this course, student will be able to: - analyse a problem, identify the methods in basic probability theory - use of conditional probability - apply bayes theorem in real-life situations - identify the various distribution for given data sets		
Course Content		
Chapter 1	Basic Theory of Probability	5 Hours
Counting Principles, Permutations and Combinations, Deterministic and non-deterministic models. Random Experiment, Sample Spaces (finite and countably infinite) Events: types of events, Operations on events. Probability - classical definition, probability models, axioms of probability, probability of an event. Theorems of probability (with proof) i) $0 \leq P(A) \leq 1$ ii) $P(A) + P(A') = 1$ iii) $P(A) \leq P(B)$ when $A \subset B$ iv) $P(A \cup B) = P(A) + P(B) - P(A \cap B)$ Numerical problems related to real life situations.		
Chapter 2	Basic Notion of Probability Theory	10 Hours
Concepts and definitions of conditional probability, multiplication theorem $P(A \cap B) = P(A) \cdot P(B A)$ Bayes' theorem (without proof) Concept of Posterior probability, problems on posterior probability. Definition of sensitivity of a procedure, specificity of a procedure. Application of Bayes' theorem to design a procedure for false positive and false negative. Concept and definition of independence of two events. Numerical problems related to real life situations		
Chapter 3	Discrete Random variable and Standard Discrete Distributions	15 Hours
Definition of a random variable and discrete random variable. Definition of probability mass function, distribution function and its properties. Definition of expectation and variance, theorem on expectation. Numerical problems related to real life situations. Discrete Uniform Distribution: definition, mean, variance. Bernoulli Distribution: definition, mean,		

variance, additive property.

Binomial Distribution: definition, mean, variance, additive property.

Geometric Distribution (p.m.f $p(x) = pq^x$, $x = 0, 1, 2, \dots$):

definition, mean, variance.

Poisson Distribution: definition, mean, variance, mode, additive property, limiting case of B (n, p)

Illustration of real- life situations. Numerical problems related to real life situations

Reference Books :-

- 1) Statistical Methods, G.W. Snedecor, W.G. Cochran, John Wiley & sons, 1991, Eighth Edition
- 2) Fundamentals of Applied Statistics, Gupta and Kapoor, S.Chand and Sons, New Delhi, 2014, Fourth Edition
- 3) An Introductory Statistics, Kennedy and Gentle.
- 4) Modern Elementary Statistics, Freund J.E., Pearson Publication, 2006, Twelfth Edition.
- 5) Probability, Statistics, Design of Experiments and Queuing theory with applications Computer Science, Trivedi K.S., Prentice Hall of India, New Delhi, 2001, Second Edition.
- 6) A First course in Probability, Ross, Pearson Publication, 2013, Ninth Edition.
- 7) A First Course in Probability and Statistics, L. S. Prakasa Rao, World Scientific Publishing Co Pte Ltd, 2008.
- 8) Applied Probability Models, D. L. Minh, Brooks/Cole, 2000.

Syllabus of Semester-II

Haribhai V. Desai College of Arts, Science and Commerce, Pune (Autonomous) F.Y.B.Sc.(AI & ML) Subject Code: AIML-151-MJ-TH Subject: Advanced Python Programming		
Teaching Scheme 2 hours / Week	No. of Credits 2	Examination Scheme CE: 20 marks EE: 30 marks
Prerequisites:-		
Course Objective :- The course is designed: 1) To enhance programming skills using advanced Python concepts. 2) To introduce functional programming techniques using decorators. 3) To provide hands-on experience in data handling and manipulation using NumPy and pandas. 4) To enable database interaction using Python. 5) To introduce Django framework for web application development		
Outcomes: After completing this course, a student will be able to: CO1: Implement reusable and modular code using decorators. CO2: Apply NumPy and Pandas for data analysis. CO3: Perform database operations using Python connectors. CO4: Develop basic web applications using Django CO5: Integrate Python skills into complete data-to-web pipelines		
Course Contents		
Chapter 1	Advanced Function & Decorators	4 Hours
• Functions as first-class objects, • Closures and inner functions, • Function and class-based decorators, • Built-in decorators (@staticmethod, @classmethod, @property)		
Chapter 2	Introduction to NumPy & Pandas	10 Hours
• Introduction to NumPy: Arrays and their Types – Indexing and Slicing - Array Operations - Reading and Writing Data using NumPy, shape, reshape, iterating, join, split, search, sort, filter • Data Handling with Pandas: Series and DataFrame - Indexing and Filtering - Data Cleaning and Transformation - Aggregation and Grouping - Importing and Exporting Data		
Chapter 3	Database Connectivity in Python	7 Hours
• Python Database API (DB-API) • Connecting to PostgreSQL • CRUD operations, • Transactions & Error handling, • Basic ORM Overview		

Chapter 4	Introduction to Django Framework	9 Hours
• Django Installation and Setup • Project Structure and App Creation • Models, Views, Templates (MVT Pattern) • Simple Web Application Development • Admin Interface Basics		
Reference Books:-		
1. Samir Madhavan, Mastering Python for Data Science, Packt publishing, ISBN 978-1-78439-015-0 2. Mark Lutz, Learning Python, O'Reilly Media, 5th Edition, ISBN: 978-1-449-35573-9 3. Antonio Mele, Django by Example, Packt publishing, ISBN 978-1-78439-191-1 4. Luciano Ramalho, Fluent Python, O'Reilly Media, 2nd Edition, ISBN: 978-1-492-05635-5 5. Eric Matthes, Python Crash Course, 2nd Edition, ISBN-13: 978-1-59327-928-8 6. Wes McKinney, Python for Data Analysis, O'Reilly Media, 2nd Edition, ISBN: 978-1-449-31979-3 7. Mark Lutz, Programming Python, 4th Edition, O'Reilly, ISBN:978-0-596-15810-1 8. William S. Vincent, Django for Beginners, 2nd Edition		

Haribhai V. Desai College of Arts, Science and Commerce, Pune (Autonomous) F.Y.B.Sc.(AI & ML) Subject Code: AIML-152-MJ-PR Subject: Practical based on AIML-151-MJ-TH		
Teaching Scheme 4 hours / Week	No. of Credits 2	Examination Scheme CE: 20 marks EE: 30 marks
Course Objective :- • To understand advanced Python programming concepts such as functions, closures and decorators. • To perform numerical computations and data manipulation using NumPy. • To analyze and process datasets using Pandas library. • To implement database connectivity and perform database operations using Python. • To develop basic web applications using Django framework		
Course Outcomes (CO) CO1 :- Apply advanced Python programming concepts including decorators and closures. CO2 :- Perform numerical and array operations using NumPy. CO3 :- Manipulate and analyze data using Pandas. CO4 :- Develop database applications using Python and PostgreSQL. CO5 :- Build simple web applications using Django framework		
Practicals		
1. Write a Python program to demonstrate functions as first-class objects. 2. Write a Python program to demonstrate closures and inner functions. 3. Write a Python program to implement function decorators. 4. Write a Python program to demonstrate class-based decorators and built-in decorators (@staticmethod, @classmethod, @property). 5. Write a Python program to create NumPy arrays and perform indexing and slicing. 6. Write a Python program to perform NumPy array operations such as reshape, shape, and iteration. 7. Write a Python program to perform joining and splitting of arrays using NumPy. 8. Write a Python program to demonstrate sorting, searching, and filtering in NumPy arrays. 9. Write a Python program to create and manipulate Pandas Series and DataFrame. 10. Write a Python program to perform indexing and filtering in Pandas DataFrame. 11. Write a Python program to perform data cleaning and transformation using Pandas. 12. Write a Python program to perform aggregation and grouping using Pandas. 13. Write a Python program to import and export data using Pandas. 14. Write a Python program to demonstrate Python DB-API and connect to PostgreSQL database. 15. Write a Python program to perform CRUD operations using PostgreSQL database in Python. 16. Write a Python program to demonstrate transactions and error handling in database operations. 17. Install Django and create a new Django project and application. 18. Create a simple Django application using Models, Views and Templates (MVT). 19. Develop a simple web application with Django and use Django Admin Interface.		

Haribhai V. Desai College of Arts, Science and Commerce, Pune (Autonomous) F.Y.B.Sc.(AI & ML) Subject Code: MTC-153-MJ-TH Subject: Graph Theory and Network in AIML		
Teaching Scheme 2 hours / Week	No. of Credits 2	Examination Scheme CE: 20 marks EE: 30 marks
Prerequisites:		
Course Objectives The objectives of this course are to: 1. Introduce students to the fundamental concepts of graph theory and tree structures. 2. Develop problem-solving skills using graph models and algorithms. 3. Enable students to apply graph theory concepts in computer science, AI, and real-world applications. 4. Provide a foundation for advanced studies in Artificial Intelligence and Machine Learning. 5. Strengthen logical thinking and analytical ability in computational problem solving		
Course Outcomes (CO'S) CO1 (Remember/Understand): Describe fundamental concepts, definitions, and terminology of graphs and trees. CO2 (Understand/Analyze): Classify and analyze different types of graphs and tree structures based on their properties. CO3 (Apply): Implement basic graph algorithms such as BFS, DFS, Kruskal's, Prim's, and Dijkstra's algorithms to solve computational problems. CO4 (Analyze/Evaluate): Examine and solve problems using graph models, including spanning trees, shortest paths, and network flows. CO5 (Apply/Evaluate): Apply graph coloring and domination concepts to optimization, scheduling, and network problems. CO6 (Create): Model real-world problems in AI using appropriate graph-based representations and techniques		
Course Contents		
Chapter 1	Fundamentals of Graph Theory	10 hours
Fundamentals of Graph Theory: • Introduction to Graph Theory • Directed and Undirected Graphs • Degree of a vertex, Handshaking Property and problems • Walks, Paths, Trails, Cycles, Circuits, cycles • Connected and Disconnected Graphs, Complement of a graph • Subgraphs and Spanning Subgraphs • Adjacency Matrix • Incidence Matrix • Matrix representation of undirected and directed graphs • Operations on graphs • Isomorphism of two graphs — definition and problems • Euler Graphs — definition and problems		

• Hamiltonian Graphs — definition and problems • Planar, Dual Graphs and Kuratowski's graphs • Königsberg Bridge Problem • Travelling Salesman Problem		
Chapter 2	Trees and Network Structures	6 hours
• Trees and properties (no proofs) • Rooted and binary trees • Spanning trees in weighted graphs • Binary tree traversals: Pre-order, Post-order • Prefix codes and optimal trees • Cut-sets and fundamental circuits • Network flows • Max-Flow Min-Cut Theorem (statement only) • Related problems		
Chapter 3	Tree algorithms	6 hours
• Tree Traversal Algorithms • Breadth First Search (BFS) • Depth First Search (DFS) • Minimum Cost Spanning Tree Problem • Greedy method • Kruskal's Algorithm • Prim's Algorithm • Dijkstra's Shortest Path Algorithm		
Chapter 4	Coloring and Dominating sets	8 hours
• Graph Coloring • Chromatic Number • Simple coloring problems • Chromatic Polynomial. Finding Chromatic polynomial by Decomposition Theorem and by Multiplication Theorem (without Proofs). • Dominating Set and Domination Number • Applications in scheduling, networks, AI		
Reference Books:		
1. Narasingh Deo, <i>Graph Theory with applications to engineering and Computer Science</i>, Printice Hall of India Private Limited, 2009. ISBN: 9788120301450 2. Douglas B. West, <i>Introduction to Graph Theory</i>, 2nd edition		

Haribhai V. Desai College of Arts, Science and Commerce, Pune
(Autonomous)
F.Y.B.Sc.(AI & ML)

Subject Code: MTC-154-MJ-PR

Subject:- Practical Based on MTC-153-MJ-TH

Teaching Scheme 4 hours / Week	No. of Credits 2	Examination Scheme CE: 20 marks EE: 30 marks
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Course Objectives:

The course is designed to teach:

1. Representation of different types of graphs
2. Graph traversals viz. DFS and BFS
3. Tree traversals and finding minimum cost spanning trees using various algorithms
4. Computing shortest path cost from a source vertex to all other vertices
5. methods to color vertices in a graph

Course Outcomes:

After completing this course, a student will be able to:

1. Understand various graph representations and implement them
2. Use graph traversals like DFS and BFS
3. Represent a tree and traverse it
4. Find MCST of a graph using Prims, Kruskals and Dijkstras' algorithms
5. Solve graph coloring problem and find minimal dominating sets

Practicals	
Unit	Practical based on
1,2,3	Graph representations
4, 5	Graph traversals
6, 7	Tree traversals
8, 9	MCST – Prims and Kruskals algorithms
10, 11	Dijkstra's Shortest path
12	Graph Coloring
13-15	Dominating sets

Haribhai V. Desai College of Arts, Science and Commerce, Pune (Autonomous) F.Y.B.Sc.(AI & ML) Subject Code: STC-151-MJ-TH Subject: Statistics for AIML – II		
Teaching Scheme 2 hours / Week	No. of Credits 2	Examination Scheme CE: 20 marks EE: 30 marks
Objectives: The course is designed to teach: • To teach continuous probability distributions and its applications. • To teach various concepts of testing of hypothesis. • To teach large and small sample tests. • To teach various nonparametric tests.		
Course Outcomes: After successful completion of this course, student will be able to: 1. acquire knowledge on various continuous probability distributions and its applications in real life situations. 2. understand the concept of Testing of Hypothesis. 3. understand the concept of Test of significance and apply the same to test Population parameters by using large and small sample tests. 4. Identify problems and apply appropriate non parametric test and interpret the conclusion		
Course Content		
Chapter 1	Continuous Random Variable and Standard Continuous Probability Distributions	10 Hours
Continuous Random Variable and Standard Continuous Probability Distributions Definition of continuous random variable (r. v.) Probability density function (p.d.f.) Cumulative distribution function (c.d.f.), its properties. Calculation of mean, mode, median, variance, standard deviation for continuous r. v. Numerical problems related to real life situations. Uniform Distribution: statement of p.d.f., mean, variance, nature of probability curve. Exponential Distribution: statement of p.d.f. of the form, $f(x) = (1/\theta) e^{(-x/\theta)}$, mean, variance, nature of probability curve, lack of memory property. Normal Distribution: statement of p.d.f., identification of parameters, nature of probability density curve, standard normal distribution, symmetry, distribution of $aX+b$, $aX+bY+c$ where X and Y are independent normal variables, computations of probabilities using normal probability table, normal approximation to binomial and Poisson distribution, central limit theorem (statement only), normal probability plot. Pareto Distribution: p.d.f., mean, variance, applications. Numerical problems related to real life situations.		
Chapter 2	Testing of hypothesis	2 Hours
Definitions: population, sample, random sample from a probability distribution, parameter, estimator, statistic, sampling distribution of statistic, standard		

error of estimator. Concept of null hypothesis and alternative hypothesis, critical region, level of significance, type I and type II error, one sided and two-sided tests, p-value.		
Chapter 3	Tests based on some distributions	14 Hours
Tests based Normal distribution Test for population mean, Test for equality of two population means, Test for population proportion Test for equality of two population proportions Numerical problems related to real life situations. Tests based on t, Chi-square and F-distribution Test for population mean for small sample size, Test for equality of two population means for small sample sizes, Paired t-test. Chi square test for goodness of fit. Test for independence of attributes, Test for significance of variation for a population. Test for equality of population variances Numerical problems related to real life situations.		
Chapter 4	Non parametric Tests	4 Hours
RUN test, SIGN test, Kolmogrov - Smirnov test. Mann – Whitney test, Numerical problems related to real life situations		
Reference Books:- 1) Statistical Methods, G.W. Snedecor, W.G. Cochran, John Wiley & sons, 1991, Eight Edition 2) Statistical Methods, J. Medhi, New Age International, 2016. 3) A First course in Probability, Ross, Pearson Publication, 2013, Ninth Edition. 4) Modern Elementary Statistics, Freund J.E., Pearson Publication, 2006, Twelfth Edition. 5) Probability, Statistics, Design of Experiments and Queuing theory with applications Computer Science, Trivedi K.S., Prentice Hall of India, New Delhi, 2001, Second Edition. 6) A First Course in Probability and Statistics, L. S. Prakasa Rao, World Scientific Publishing Co Pte Ltd, 2008. 7) Applied Probability Models, D. L. Minh, Brooks/Cole, 2000		

Haribhai V. Desai College of Arts, Science and Commerce, Pune
(Autonomous)
F.Y.B.Sc.(AI & ML)

Subject Code: STC-152-MJ-PR

Subject: Practical course based on STC-151-MJ-TH

Teaching Scheme 4 hours / week	No. of Credits 2	Examination Scheme CE: 20 Marks EE: 30 Marks
Objectives: The course is designed to teach: 1. The problems based on continuous probability distributions 2. Testing of hypothesis – large sample tests 3. Testing of hypothesis – small sample tests 4. application of hypothesis on any open-source data		
Course Outcomes: After completing this course, a student will be able to: 1. Solve problems on continuous probability distributions 2. Apply large sample tests to test a hypothesis 3. Apply small sample tests to test a hypothesis 4. Apply the methods on a data set and use inference methods on large data sets		
Practicals		
Unit	Practicals based on	
1, 2	Problems based on continuous probability distributions	
3, 4, 5	Problems based on testing of hypothesis – large sample tests	
6, 7, 8	Problems Based on small sample tests - Chi square distribution, t and F distribution	
9, 10	Problems based on non-parametric tests	

Haribhai V. Desai College of Arts, Science and Commerce, Pune**(Autonomous)****F.Y.B.Sc.(AI & ML)****Subject Code: SEC-151-AIML-TH****Subject: Databases - I**Teaching Scheme
2 hours / weekNo. of Credits
2Examination Scheme
CE: 20 Marks
EE: 30 Marks**Prerequisites****Objectives:**

The course is designed to:

1. teach data processing using computers to students.
2. introduce principles of databases.
3. teach the conversion of ER model into relational tables
4. teach the basic concepts of data model, entity relationship model, database design
5. The course is designed to teach creation, manipulation, and querying of data in databases.
6. teach different normalization methods to model a database
7. introduce PostgreSQL for manipulating the data

Course Outcomes:

After completing this course, a student will be able to:

1. Describe the fundamental elements of relational database management systems
2. Analyse database requirements and identify the entities involved in the system along with their relationship to one another.
3. Apply the basic concepts of relational data model, entity-relationship model, relational database design and SQL.
4. Convert the ER-model to relational tables, design a relational database and develop SQL queries on data using PostgreSQL
5. Apply database design techniques and tools to create a database schema and database instance for a database related software application

Course Contents

Chapter 1	Introduction of DBMS	3 hours
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- Overview
- File system Vs. DBMS,
- Levels of abstraction,
- Data independence,
- Structure of DBMS,
- Users of DBMS,
- Advantages of DBMS

Chapter 2	Conceptual Design (E-R model)	10 hours
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Overview of DB design, Conceptual Design using ER data model (entities, attributes, entity sets, relations, relationship sets), Constraints - Key constraints, Integrity constraints, referential integrity, unique constraint, Null/Not Null constraint, Domain, Check constraint, Mapping constraints, Keys Concept with Examples: Primary Key, Candidate Keys and Super Keys, Extended features – Specialization, Aggregation, Generalization, Structure of Relational Databases (concepts of a table, a row, a relation, a Tuple and a key in a relational database), Examples on ER Model.

Chapter 3	SQL	9 hours
Introduction, Basic structure, DDL and DML commands, Aggregate functions, Date and String functions, Null values, SQL mechanisms for joining relations (inner joins, outer joins and their types), Examples on SQL		
Chapter 4	Relational Database Design	8 hours
Introduction to Relational- Database Design (undesirable properties of a RDB design), Functional dependencies (Basic concepts, F+, Closure of an Attribute set, Armstrong's AXIOMS), Keys Concept with Examples: Candidate Keys and Super Keys, Concept of Normalization, Normal forms - 1NF, 2NF, 3NF. Examples		
Reference Books:		
1) Database System Concepts, Henry F. Korth, Abraham Silberschatz, S. Sudarshan, Tata McGraw-Hill Education, ISBN:9780071289597 2) Fundamentals of Relational Database Management Systems - S. Sumathi & S. Esakkirajan, Springer Berlin Heidelberg New York, ISBN-13 978-3-540-48397-7 3) Beginning Databases with PostgreSQL: From Novice to Professional, Richard Stones, Neil Matthew, APress, Second Edition, ISBN: 9781590594780 4) Database Management Systems, Raghu Ramakrishna, McGraw-Hill, Second Edition, ISBN:9780071254342 5) Database Systems, Shamkant B. Navathe, Ramez Elmasri, PEARSON, ISBN: 9780132144988 6) An introduction to Database systems, Bipin C Desai, Galgotia Publications 7) PostgreSQL, Korry Douglas, SAMS, Second Edition, ISBN:9780672327568 8) PostgreSQL Introduction and Concepts by Bruce Momjian, Addison Wesley, ISBN 0- 201-70331-9 9) Practical PostgreSQL, By Joshua D. Drake, John C Worsley, O'Reilly, ISBN 1-56592- 846-6		

The Poona Gujarati Kelvani Mandal's
Haribhai V. Desai College of Arts, Science and Commerce, Pune
(Autonomous)

Structure of UG Program as per NEP-2020

Program Name: - B.Sc. (ARTIFICIAL INTELLIGENCE and MACHINE LEARNING)

Major Course: - ARTIFICIAL INTELLIGENCE and MACHINE LEARNING

Eligibility:

- Passed Standard XII (10+2) or equivalent examination with Physics and Mathematics as compulsory subjects along with one of the Chemistry/ Biotechnology/ Biology/ Technical Vocational subject/ Computer Science/ Information Technology/ Informatics Practices/ Agriculture/ Engineering Graphics/ Business Studies from any recognized Board with a minimum of 50% marks or equivalent grade (45% marks or equivalent grade for Scheduled Caste/ Scheduled Tribes).

Objectives:

- Provide fundamental and advanced knowledge of Artificial Intelligence and Machine Learning concepts and techniques.
- Develop analytical, computational, and problem-solving skills required to build intelligent systems.
- Enable students to apply AI and ML methods to real-world and interdisciplinary problems.
- Promote experiential, skill-based, and project-oriented learning in alignment with NEP 2020.
- Foster research aptitude, innovation, and critical thinking among students.
- Encourage ethical awareness, social responsibility, and sustainable use of AI technologies.
- Prepare graduates for higher education, research, industry careers, and entrepreneurship.
- Cultivate lifelong learning skills and adaptability to emerging technologies.

The Poona Gujarati Kelvani Mandal's
Haribhai V. Desai College of Arts, Science and Commerce, Pune
(Autonomous)

Structure of UG Program as per NEP-2020

Program Name: - B.Sc. (ARTIFICIAL INTELLIGENCE and MACHINE LEARNING)

Major Course: - ARTIFICIAL INTELLIGENCE and MACHINE LEARNING

Workload

1. Each theory credit is equivalent to 15 clock hours of teaching (i.e. for 2 Credits – 30 Clock Hours) and each practical credit is equivalent to 30 clock hours (i.e. for 2 Credits – 60 Clock Hours) of teaching in a semester.
2. There is 15 weeks of teacher-student interaction during the semester.
3. The 15 week is divided into 12 weeks teaching and 3 weeks for continuous assessment including preparation time to students during the semester.
4. The workload will be calculated based on 12 weeks teaching only.
5. For the purpose of computation of work-load the following mechanism may be adopted as per UGC guidelines.
6. Workload as per credit is as follows:
 - i. 1 Credit = 1 Theory period of one hour duration per week.
 - ii. 1 Credit = 1 Tutorial period of one hour duration per week.
 - iii. 1 Credit = 1 Practical period of two-hour duration per week.
7. Each theory Lecture time for FY, SY, TY is of 60 min. (2 Lectures per week for 2 credit courses)
8. Each practical session time for FY/ SY /TY is of 4 hour i.e. 240 min.

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(Autonomous)

Structure of UG Program as per NEP-2020

Program Name: - B.Sc. (ARTIFICIAL INTELLIGENCE and MACHINE LEARNING)

Major Course: - ARTIFICIAL INTELLIGENCE and MACHINE LEARNING

Credit Framework

Level /Difficulty	Sem	Subject-1				Subject-2	Subject-3	GE/ OE	SEC	IKS	AEC	VEC	CC	Total
4.5/100	I	2(T)+2(P)				2(T)+2(P)	2(T)+2(P)	2(T)	2(T/P)	2(T) Generic	2(T)	2	-	22
	II	2(T)+2(P)				2(T)+2(P)	2(T)+2(P)	2(P)	2(T/P)	-	2(T)	2	2	22
Exit Option: Award of UG <i>Certificate</i> in Major with 44 credits and an additional 4 credits core NSQF Course/Internship OR Continue with Major and Minor Continue Option: Student will select one subject among the (Subject-1, Subject-2, and Subject-3) as major and another as minor and third subject will be dropped.														
Level /Difficulty	Sem	Credits related to major				Minor		GE/ OE	SEC	IKS	AEC	VEC	CC	Total
		Discipline Specific Core (DSC) Major Core	Discipline Specific Elective (DSE) Major Elective	VSC	FP/ OJT /CEP									
5.0/200	III	4(T)+2(P)	-	2(T/P)	2 (FP)	2(T)+2(P)	-	2(T)	-	2(T)	2(T)	-	2	22
	IV	4(T)+2(P)	-	2(T/P)	2(CEP)	2(T)+2(P)	-	2(P)	2(T/P)	-	2(T)	-	2	22
Exit Option: Award of UG <i>Diploma</i> in Major and Minor with 88 credits and an additional 4 credits core NSQF Course/Internship OR Continue with Major and Minor.														
5.5/300	V	8(T)+4(P)	2(T)+2(P)	2(T/P)	(FP/ CEP)	2(T)	-	-	-	-	-	-	-	22
	VI	8(T)+4(P)	2(T)+2(P)	2(T/P)	4(OJT)	-	-	-	-	-	-	-	-	22
Total 3 Years		44	8	8	10	18	8	8	6	4	8	4	6	132
Exit Option: Award of UG <i>degree</i> in Major with 132 credits OR Continue with Major and Minor.														
6.0/400	VII	6(T)+4(P)	2(T)+2(P)	-	4(RP)	4(T)(RM)	-	-	-	-	-	-	-	22
	VIII	6(T)+4(P)	2(T)+2(P)	-	8(RP)	-	-	-	-	-	-	-	-	22
Total 4 Years		64	16	8	22	22	8	8	6	4	8	4	6	176
Exit Option: Award of UG <i>Honors with Research</i> Degree in Major and Minor with 176 credits. -OR-														
6.0/400	VII	10(T)+4(P)	2(T)+2(P)	-	-	4(T)(RM)	-	-	-	-	-	-	-	22
	VIII	10(T)+4(P)	2(T)+2(P)	-	4(OJT)	-	-	-	-	-	-	-	-	22
Total 4 Years		72	16	8	14	22	8	8	6	4	8	4	6	176
Exit Option: Award of UG <i>Honors Degree</i> in Major and Minor with 176 credits.														

The Poona Gujarati Kelvani Mandal's
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(Autonomous)

Structure of UG Program as per NEP-2020

Program Name: - B.Sc. (ARTIFICIAL INTELLIGENCE and MACHINE LEARNING)

Major Course: - ARTIFICIAL INTELLIGENCE and MACHINE LEARNING

Reference & Text Book

1. Python Programming

- Pooja Sharma, Programming in Python, BPB Publications, 2017, ISBN: 978-9386551276
- R. NageswaraRao, Core Python Programming, Dreamtech Press, 3rd Edition, ISBN: 978-9390457151
- Dr. Marlapalli Krishna, S. Jaya Prakash, K. Varada Rajkumar, Basic Python Programming for Beginners, Bluerose Publishers Pvt. Ltd., 2021, ISBN: 978- 9354720604
- Martin C. Brown, Python: The complete Reference, McGraw Hill Education, 2018, ISBN: 978-9387572942
- Martelli A., A. Ravenscroft, S. Holden, Python in a Nutshell, OREILLY.
- Reema Thareja, Python Programming, OUP India, Oxford University Press India, 2nd edition, 2023, ISBN: 978-9354973765
- Christos Manola, Dimitrios Xanthidis, Han-I Wang, Ourania K. Xanthidou, Handbook of Computer Programming with Python, CRC Press; 1st edition, 2022, ISBN: 978- 0367687779
- Graph Theory and Network in AIML

2. Discrete Mathematics for AIML

- Kenneth H. Rosen, *Discrete Mathematics and its Applications*, Tata McGraw Hill Publishers, seventh Edition, 2007
- Ralph P. Grimaldi, *Discrete and Combinatorial Mathematics*, Pearson, 2006, 5th Edition, ISBN: 9788177584240
- Ronald Graham, Donald Knuth, and Oren Patashnik, *Concrete Mathematics*, Pearson Education Publishers, 2nd Edition, 1996.
- Peter J. Cameron, *Combinatorics: Topics, Techniques, Algorithms*, Cambridge University Press, 1994 (reprinted 1996).

3. Statistics for AIML -I

- Statistical Methods, G.W. Snedecor, W.G. Cochran, John Wiley & sons, 1991, Eight Edition
- Fundamentals of Applied Statistics, Gupta and Kapoor, S.Chand and Sons, New Delhi, 2014, Fourth Edition
- An Introductory Statistics, Kennedy and Gentle.
- Introduction to Linear Regression Analysis, Douglas C. Montgomery, Elizabeth A. Peck, G. Geoffrey Vining, Wiley, 2012, Fifth Edition

4. Discrete Probability and Distributions

- Statistical Methods, G.W. Snedecor, W.G. Cochran, John Wiley & sons, 1991, Eighth Edition
- Fundamentals of Applied Statistics, Gupta and Kapoor, S.Chand and Sons, New Delhi, 2014, Fourth Edition

- An Introductory Statistics, Kennedy and Gentle.
- Modern Elementary Statistics, Freund J.E., Pearson Publication, 2006, Twelfth Edition.
- Probability, Statistics, Design of Experiments and Queuing theory with applications Computer Science, Trivedi K.S., Prentice Hall of India, New Delhi, 2001, Second Edition.
- A First course in Probability, Ross, Pearson Publication, 2013, Ninth Edition.
- A First Course in Probability and Statistics, L. S. Prakasa Rao, World Scientific Publishing Co Pte Ltd, 2008.
- Applied Probability Models, D. L. Minh, Brooks/Cole, 2000.

5. Statistics for AIML -II

- Statistical Methods, G.W. Snedecor, W.G. Cochran, John Wiley & sons, 1991, Eight Edition
- Statistical Methods, J. Medhi, New Age International, 2016.
- A First course in Probability, Ross, Pearson Publication, 2013, Ninth Edition.
- Modern Elementary Statistics, Freund J.E., Pearson Publication, 2006, Twelfth Edition.
- Probability, Statistics, Design of Experiments and Queuing theory with applications Computer Science, Trivedi K.S., Prentice Hall of India, New Delhi, 2001, Second Edition.
- A First Course in Probability and Statistics, L. S. Prakasa Rao, World Scientific Publishing Co Pte Ltd, 2008.
- Applied Probability Models, D. L. Minh, Brooks/Cole, 2000

6. Databases – I

- Database System Concepts, Henry F. Korth, Abraham Silberschatz, S. Sudarshan, Tata McGraw-Hill Education, ISBN:9780071289597
- Fundamentals of Relational Database Management Systems - S. Sumathi & S. Esakkirajan, Springer Berlin Heidelberg New York, ISBN-13 978-3-540-48397-7
- Beginning Databases with PostgreSQL: From Novice to Professional, Richard Stones, Neil Matthew, APress, Second Edition, ISBN: 9781590594780
- Database Management Systems, Raghu Ramakrishna, McGraw-Hill, Second Edition, ISBN:9780071254342
- Database Systems, Shamkant B. Navathe, Ramez Elmasri, PEARSON, ISBN: 9780132144988
- An introduction to Database systems, Bipin C Desai, Galgotia Publications
- PostgreSQL, Korry Douglas, SAMS, Second Edition, ISBN:9780672327568
- PostgreSQL Introduction and Concepts by Bruce Momjian, Addison Wesley, ISBN 0-201-70331-9
- Practical PostgreSQL, By Joshua D. Drake, John C Worsley, O'Reilly, ISBN 1-56592-846-6

The Poona Gujarati Kelvani Mandal's
Haribhai V. Desai College of Arts, Science and Commerce, Pune
(Autonomous)

Structure of UG Program as per NEP-2020

Program Name: - B.Sc. (ARTIFICIAL INTELLIGENCE and MACHINE LEARNING)

Major Course: - ARTIFICIAL INTELLIGENCE and MACHINE LEARNING

Examination Pattern

1. Exam pattern is 60-40 i.e. Semester End Examination (SEE) is of 60 % and Continuous Internal Assessment is of 40 %.

Theory, Practical/Project: -

Continuous Internal Assessment (CIA): 40 % [20 Marks]

1. Written Test- 50 % [10 Marks]
2. Presentation/Assignment: - 25% [5 Marks]
3. Project/Activity Oriented Learning: -25 % [05 Marks]

Semester End Examination (SEE): - 60 % [30 Marks]

2. For Internal examination, written test should be conducted of 10 marks for 2 credits.

Paper Pattern

Internal Examination

Que-1: Answer the following questions (Short answer questions) (any 4 out of 5) – **4 Marks.**

Que-2: Answer the following questions (Short answer questions) (any 2 out of 3)- **4 Marks**

Que-3: Answer the following questions (Logical Question) (any 1 out of 2)– **2 Marks.**

External Examination

Que-1: [06 Marks]

Answer the following questions (Short answer/Definition/Problems/Diagram, etc.) (Any 6 out of 8)

Que-2: [08 Marks]

A] Answer the following questions (Short answer questions- 2 Que out of 3) [6 Marks]

B] Answer the following questions (Long answer questions/Problems- 1 Que out of 2) [2 Marks]

Que-3: [08 Marks]

A] Answer the following questions (Short answer questions- 1 Que out of 2 [3 Marks]

B] Answer the following questions (Long answer questions/Problems- 1 Que out of 2) [5 Marks]

Que-4: [08Marks]

A] Answer the following questions (Short answer questions- 1 Que out of 2 [3 Marks]

B] Answer the following questions (Long answer questions/Problems- 1 Que out of 2) [5 Marks]

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Structure of UG Program as per NEP-2020

Program Name: - B.Sc. (ARTIFICIAL INTELLIGENCE and MACHINE LEARNING)

Major Course: - ARTIFICIAL INTELLIGENCE and MACHINE LEARNING

Completion of Degree

1. A student who earns 44 credits at First year with additional 4 credits core NSQF Course/Internship shall be eligible for the award of UG Certificate in Major subject. OR May continues with Major and Minor.
2. A student who earns 88 credits at Second year with additional 4 credits core NSQF Course/Internship shall be eligible for the award of UG Diploma in Major subject with Minor (Selected at SY). OR May continues with Major and Minor.
3. A student who earns 132 credits at Third year shall be eligible for the award of UG Degree in Major subject with Minor (Selected at SY). OR May continues with Major and Minor.
4. A student who earns 176 credits in Four years shall be eligible for the award of UG Honors or Honors with Research in Major subject with Minor (Selected at SY).

Award of Degree:

CGPA will be calculated for students who completed 132/176 credits, grades are given as per the following table.

Sr. No.	Grade Letter	Grade Point	Marks
1.	O (Outstanding)	10	90<= Marks <= 100
2.	A+ (Excellent)	9	75<= Marks <= 89
3.	A (Very Good)	8	60<= Marks <= 74
4.	B+ (Good)	7	55<= Marks <= 59
5.	B (Above Average)	6	50<= Marks <= 54
6.	C (Average)	5	45<= Marks <= 49
7.	D (Pass)	4	40<= Marks <= 44
8.	F (Fail)	0	Marks <40
9.	AB (Absent)	0	-