

Gujarat University



School of Emerging Science and Technology

M.Sc. (Integrated) Five Years Program

M.Sc. (Int) Artificial Intelligence & Machine Learning

(For Batches 2023 onwards)

As per NEP 2023

**For students completing 3 years of the above program
with an exit option**

B.Sc. Artificial Intelligence & Machine Learning

**For students completing 4 years of the above program
with an exit option**

B.Sc. (Honours) Artificial Intelligence & Machine Learning

SEMESTER - 2

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Sr No.	Course Code	Course Type	Subject	Credit
1	DSC-C-AIML-121 T	Core	Algorithms and Data Structures	4
2	DSC-C-AIML-122 P	Core	Programming with Python - I	4
3	DSC-M-AIML-123 T	Minor	Object oriented programming with JAVA	2
4	DSC-M-AIML-123 P	Minor	Object oriented programming with JAVA	2
5	MDC-AIML-124 T	Multi	Mathematical Science concepts - II	4
6	AEC-125	AEC	Communication Skills-II	2
7	SEC-126	SEC	Introduction to MS Excel	2
8	VAC-127	VAC	Yoga Education	2
			Total	22

DSC-C-AIML-121 T: Algorithms and Data Structures

Unit - 1

Number System (in context of IKS): Number system in India-Historical evidence, Salient features of the Indian numerical system, Concept of Zero and its importance, Large number and its representation, Place value of Numerals, Decimal System (Bhaskaracharya Lilavati on Decimal System and Place value), Unique approach to represent the numbers: Bhuta-Samkhya system, Pingala and the binary system

Unit - 2 Searching - Sorting Algorithms and Data Structures

Asymptotic Notations and Complexity, Bubble sort, Selection sort, Insertion sort, Quick sort, Merge Sort, Data Management Concepts, Datatype - primitive & non primitive, Performance analysis & measurement, Introduction to data structures, Linear and Non-Linear data structures, Link-Lists: Singly linked list, Doubly link list, Circular link list, Application of linked list

Stack: stack definitions & concepts, Operation on stacks, Application on Stacks, linked list implementation of stack, polish expression, Reverse polish expression and their compilation, recursion, tower of Hanoi

Unit - 3 Hashing & File Structure

Queue: Introduction to Queues, Operations on queue, Circular queue, Priority queue, linked list application of queue, Array representation of priory queue, double ended queue, application of queue, Dequeue

Dictionaries: linear list representation, skip list representation, operations - insertion, deletion and searching

Hash Table Representation: hash functions, collision resolution-separate chaining, open addressing-linear probing, quadratic probing, double hashing, rehashing, extendible hashing

File Structure: Concept of fields, records and files, sequential, indexed and relative/random file, organization, indexing structure for index files, hashing for direct files, multi key file organization and access methods

Unit - 4 Trees and Graphs

Trees: Applications of trees, some balance tree mechanism, Traversal in tree – In-Order, Pre-Order and Post-Order traversal, Weight balance, Height Balance Types of trees – Full binary tree, Complete Binary tree, Perfect binary tree, Introduction to AVL tree, Insertion in AVL tree,

Graphs: Terminologies related to graph, Traversal in graph, Representation of Graph, Prim's, Kruskal's and Dijkstra's algorithms

Reference Books:

1. Introduction to Algorithms, Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein
2. Algorithms Unlocked, Thomas H. Cormen
3. The Algorithm Design Manual, Steven S. Skiena
4. Data Structures and Algorithms Made Easy: Data Structures and Algorithmic Puzzles, Narasimha Karumanchi
5. Grokking Algorithms: An illustrated guide for programmers and other curious people, Aditya Bhargava
6. Algorithms, Robert Sedgewick and Kevin Wayne
7. Advanced Data Structures, Peter Brass
8. Automate This: How Algorithms Came To Rule Our World, Christopher Steiner

Links:

1. <https://www.youtube.com/watch?v=NwenwITjMys>
2. <https://www.hackerearth.com/practice/algorithms/graphs/minimum-spanning-tree/tutorial/>
3. <https://www.gatevidyalay.com/prims-algorithm-prim-algorithm-example/>

DSC-C-AIML-122 P: Programming with Python - I

Unit - 1 Data types and Operators

Download and Installation of Python, Features of Python, Comparison between C and Python, Java and Python, Introduction to IDLE, Keyword and Identifiers, Statement, Type of Comments, Basic Syntax and Input-Output, Variable, Exception Handling

Built-in Data Types: Number, String, List, Tuple, Set, Dictionary

Operators: Arithmetic Operators, Assignment Operators, Relational Operators, Membership Operators, Logical Operators, Boolean Operators, Identity Operators

Unit - 2 Conditional Statements and Functions

Conditional Statements: IF, ELSE, ELIF, Nested IF, Switch Case Statement, For Loop, While Loop, Nested Loop, Enumerate, Break Statement, Continue Statement, Pass Statement, Assert and Return Statement, exception handling

Functions: Definition, Syntax of Function, Difference between Function and Method, Types of Function, defining a Function, Function Calling, Return Statement, Function Argument, Types of Arguments, Global and Local Variables, Recursion, Advantage and disadvantage of Recursion, Anonymous Function or Lambda Function

Unit - 3 OOPs Concepts in Python

OOPS Concepts, Creating Classes and objects, Pass Statement, Self-Parameter, Modify and Delete Object Properties, Creating Methods, Constructors, Inheritance, Super Function, Data Hiding, Data Encapsulation, Polymorphism, Type Identification, Python Operator Overloading, Special Functions, Iterators, Generators

Unit - 4 GUI (Graphical User Interface)

Introduction of Graphical User Interface, Introduction to Tkinter, How to Import Tkinter module, Create the container/main window, Working with Containers, Introduction to Tkinter Widgets and their standard attributes, Tkinter Geometry Management Methods

Tkinter Attributes: Dimensions, Colors, Fonts, Anchors, Relief Styles, Bitmaps, Cursors

Tkinter Widgets: Button, Canvas, Checkbutton, Entry, Frame, Label, Listbox, Menubutton, Menu, Message, Radiobutton, Scale, Scrollbar, Text, Toplevel, Spinbox, Panedwindow, Labelframe, Messagebox, Applications based on GUI

Reference Books:

1. Core Python Programming, By Dr. R. Nageswara Rao.
2. Python Programming: A Modular Approach, By Sheetal Taneja & Naveen Kumar, 2018
3. Fundamentals of Python Programming, Halterman R., Southern Adventist University

4. Introduction to Computation and Programming Using Python, Guttag J.V., Prentice Hall India
5. Core Python Programming, Chun W., Prentice Hall
6. Programming Python: Powerful Object- Oriented Programming by Mark Lutz, O'Reilly; 4th edition
7. Python Cookbook: Recipes for Mastering Python by Brian Jones, David Beazley, O'Reilly Media; 3rd edition

DSC-M-AIML-123 T: Object oriented programming with JAVA

Unit - 1 Introduction to OOPS, Classes and Objects

Basic concepts of OOPS, Characteristics of OOPS, Advantages of OOPS, Java Introduction, Key features of Java, JVM, JDK tools, Variables, Operators, Decision making statements, Array, Class Introduction, Access modifiers, Copying objects, Constructors, This keyword, Final keyword, String and string buffer class

Unit - 2 Inheritance, Packages and Interface, Exception Handling & Thread

Inheritance introduction, Types of inheritance, Super keyword, Abstract class, Introduction, Package types, Interface
Introduction to Exception handling, Use of Exception Handling, Exception classes, Creating your own exception, Creating Thread, Thread Priority

Reference Books:

1. Programming in JAVA , Sachin Malhotra, Saurabh Choudhary, Oxford
2. JAVA Programming, Hari Mohan Pandey, Pearson
3. The Complete reference JAVA, Herbert Schildt, TMH Publication

DSC-M-AIML-123 P: Object oriented programming with JAVA

Unit - 1 Practical List

1. Write a JAVA Program for only print "Hello World" or any sentences.
2. Write a JAVA Program to calculate Sum/Multi/Div/Sub for any two or three numbers manually.
3. Write a JAVA Program to calculate Sum/Multi/Div/Sub for any two or three numbers Runtime.
4. Write a JAVA Program to calculate Average of any two or three floating point numbers.
5. Write a JAVA Program to calculate Area of Square, Triangle and Circle.
6. Write a JAVA Program to find number is positive or not.
7. Write a JAVA Program to find largest of two numbers.
8. Write a JAVA Program to find smallest of three numbers.
9. Write a JAVA Program to find number is even or odd.
10. Write a JAVA Program to display total mark wise class(grade) example:
 - a. 70 above class Distinction
 - b. 60 above class First
 - c. 50 above class Second
 - d. 40 above class Pass
 - e. Fail
11. Write a JAVA Program to using switch case take number as an input.
12. Write a JAVA Program to use switch case take string(word) as an input.
13. Write a JAVA Program to print while / do.. while & for loop.
14. Write a JAVA Program to print any star(*) series using loop.
15. Write a JAVA Program to print any number(1) series using loop.
16. Write a JAVA Program to create default constructor.
17. Write a JAVA Program to print variable using default constructor.
18. Write a JAVA Program to create Sum/Multi/Div/Sub constructor for any two objects.
19. Write a JAVA Program to create average constructor for any two or three object.
20. Write a JAVA Program to create parameterize constructor using if- else.
21. Write a JAVA Program for constructor overloading or using "this" statement.

Unit - 2 Practical List

1. Write a JAVA Program to create inheritance using variable and various method.
2. Write a JAVA Program to create single level and multi-level inheritance.
3. Write a JAVA Program to create two separate JAVA file & use multi-level inheritance.
4. Write a JAVA Program to create Hierarchical Inheritance.
5. Write a JAVA Program to create three separate JAVA file & use Hierarchical inheritance.
6. Write a JAVA Program to calculate Sum/Multi/Div/Sub using Inheritance.
7. Write a JAVA Program to calculate average of two or three numbers using inheritance.
8. Write a JAVA Program to calculate Sum & subtraction using single level inheritance.
9. Write a JAVA Program to find Greatest & Smallest of two numbers using single level inheritance.
10. Write a JAVA Program to create interface for Addition & Subtraction.
11. Write a JAVA Program to use java.lang or java.math package in your program.
12. Write a JAVA Program to use java.io package in your program.

13. Write a JAVA Program for execute only try block.
14. Write a JAVA Program for execute only catch block.
15. Write a JAVA Program for execute only finally block.
16. Write a JAVA Program for execute catch & finally block using array.
17. Write a JAVA Program to use arithmetic exception in your program.
18. Write a JAVA Program to use array index out of bounds in your program.
19. Write a JAVA Program to use number format exception using string in your program.
20. Write a JAVA Program to use null pointer exception.
21. Write a JAVA Program to use string index out of bounds exception in your program.
22. Write a JAVA Program to use file not found exception in your program.
23. Write a JAVA Program to use class not found exception in your program.
24. Write a JAVA Program to execute nested catch in your program.
25. Write a JAVA Program to print multiple catch block in your program.
26. Write a JAVA Program to use throw keyword in your program.
27. Write a JAVA Program to use throws keyword in your program.
28. Write a JAVA Program to create your exception & execute it in your program.

MDC-AIML-124 T: Mathematical Science concepts - II

Unit - 1

Differentiations (in context of IKS): Talyor series, Differentiation of power form (Eknyunen Purven sutra), chain rule by Vedic methods, UV rule (Urdhva Tiryagbhyam- vertical and crosswise methods), Higher order derivatives (Meru Prastara)

Integrations (in context of IKS): Integration of power function (Eknyunen Purven, Ekadhikena Purven), Vedic formula Anurupyen, Integration by parts and partial fractions by Vedic sutras

Unit - 2 Differentiation, Integration and its applications

Differentiation and its applications: Definition of derivatives, properties and formulas, formulas-based examples, chain rule for a composite function, Rate of change, velocity and acceleration-based examples, business problems- application examples, maxima and minima of function based on one variable, mean value theorem and its examples, Maclaurin's and Taylor's series based example

Integration and its applications: Definition of indefinite integral (only statements), Some theorems on antiderivative, formulas based standard integrals and its examples, properties of integration, Definition of definite integral and its based examples, Area bounded by the curve (excluding volume), business problems-based application example

Unit - 3 Vectors, Matrices, Determinants, Correlation and Regression

Vectors and Geometry of Space: Definition of vectors, Approaches of vectors: geometric approach and algebraic approach, position vector, magnitude of a vector, direction cosines, types of vectors, properties of vectors, dot product and cross product of vectors, projection of a vector on a line, work done based problems

Matrices and Determinants: Definition, 2×2 , 3×3 order, Minors and cofactors-based examples, Matrices: definition of matrices, different type of matrices, elementary operations on matrices, adjoint of matrices, Inverse matrices, Boolean matrix

Correlation and Regression: Definition of Correlation, Types of Correlation, Methods of Correlation – (i) Karl Pearson Correlation Coefficient (ii) Spearman Rank Correlation Method, Definition of Regression, Types of Regression (both straight line x on y and y on x) and examples based on data

Unit - 4 Roots of Equations, Interpolation and Curve Fitting

Roots of Equations: Theory of errors, Intermediate value theorem, Bisection method and its examples, Newton- Raphson method and its examples, De'cartes rule of sign, Budan's theorem and its examples

Interpolation: Newton's - forward, backward interpolation formula and its examples, Lagrange formula for equal and unequal intervals, Newton's divided difference formula for unequal intervals, Inverse interpolation formula (Lagrange), Extrapolation

Curve Fitting: Least Square methods, Straight Line fitting to the given data, Quadratic type, Exponential fit of curve

Reference Books:

1. Thomas' Calculus by Hass, Heil, Weir, Pearson 14th edition
2. Calculus by Smith, Milton, Mc. Graw Hill 4th edition
3. An Introduction to Linear Algebra by V. Krishnamurthy
4. Elementary linear Algebra: Application Version, Howard Anton & Chris Rorres (Wiley 10th edition)
5. Mathematics for Management: An Introduction by M Raghavachari, Tata McGraw Hill
6. Numerical Methods, E Balaguruswami, TMH
7. Numerical Analysis and Computational Procedures, S. A. Mollah, Book and Allied Ltd.
8. Fundamentals of Mathematical Statistics, S. C. Gupta & V. K. Kapoor, Sultan Chand & Sons
9. Statistical Methods, S. P. Gupta, Sultan Chand & Sons

AEC-125: Communication Skills - II

Unit - 1

Written Communication: Format and writing of business letters, Precise Writing, and email, other types of letters – enquiry, reply, offer, sales letters, grievances and replies, Business Proposal and Memos (Practical)

Confidence: Confidence to leave behind what makes you comfortable to try new challenges. Identifying your own weaknesses and implementing ways to overcome them.

Unit - 2

Interviews: a structured conversation: one participant questions, and the other provides answers. (Practical)

Group Discussions: ability to speak confidently and convincingly (Practical)

Debates: organized argument or contest of ideas. Participants discuss a topic from two opposing sides. (Practical)

Reference Books:

1. Effective English Communication by Mohan, Raman (Tata Mc. Graw Hill Education)
2. Managerial Communication by Khuman, Gupta (Mahahjan Publication House)
3. English Grammar & Compositions by Wren, Martin (S Chand)
4. Business Communication by Urmila Rai & S. M. Rai, Himalaya Publishing House, Mumbai
5. Business Communication by Asha Kaul, Prentice-Hall, New Delhi
6. Essentials of Business Communication by Rajendra Pal & J. S. Korlahalli, Sultan Chand & Sons, New Delhi
7. Business Communication (Principles, Methods and Techniques) by Nirmal Singh, Deep & Deep Publications, New Delhi
8. Effective Business Communication by Murphy G. A., Hildebrandt W. H., Thomas J. P., Tata McGraw Hill, New Delhi

SEC-126: Introduction to MS Excel

Unit - 1 Basics of Spreadsheets, Data validation and Iteration

Functions: Text, Statistical, Lookup and referencing, Logical, date and time (If, And, Or Max, Min), Count (Count, Countif, Countifs, CountA, countblank, Sum, Sum if, Sum ifs, Product, SumProduct, Average, AverageIfs), (Look up – Choose, Offset, V Lookup, H Lookup, Match, Index), (dates – year, year frac, month, day, date, days360, E date), Financial Functions (FV, IPMT, NPER, NPV, PMT, PV, Rate), Standard Deviation, Variance, Correlation

Charting: Column, Bar, Line, Pie Chart, Stock, XY, Surface, Doughnut, Waterfall, sorting and filtering

Data validation and Iteration: Concept of Data tables, Data Validation, Conditional Formatting and What if analysis - Goal seek, scenario

Unit - 2 Charts and Pivot Tables

Charts: New Charts – Tree map & Waterfall, Sunburst, Box and whisker Charts, Combo Charts –Secondary Axis, Adding Slicers Tool in Pivot & Tables, Using Power Map and Power View, Forecast Sheet, Sparklines -Line, Column & Win/ Loss, Using 3-D Map,

Pivot Tables: Creating Simple Pivot Tables, Basic and Advanced Value Field Setting, Classic Pivot table, Grouping based on numbers and Dates, Calculated Field & Calculated Items, New Controls in Pivot Table – Field, Items and Sets, Various Timelines in Pivot Table, Auto complete a data range and list, Quick Analysis Tool, Smart Lookup and manage Store

Protecting and Sharing the work book: Protecting a workbook with a password Allow user to edit ranges, Track changes, Working with Comments, Insert Excel Objects and Charts in Word Document and Power point Presentation.

Use Macros to Automate Tasks: Creating and Recording Macros, Assigning Macros to the work sheets, Saving Macro enabled workbook

Proofing and Printing: Page setup, Setting print area, Print titles, Inserting custom Header and Footer, Inserting objects in the header and footer, Page Setup, Setting margins, Print Preview, Print, Enable back ground error checking, Setting AutoCorrect Option

Reference Books:

1. Microsoft® Office 2013 Bible
2. John Walkenbach - Excel 2007 Bible-Wiley (2007)
3. Excel Data Analysis for Dummies by Paul McFedries
4. Microsoft Excel 2019 Data Analysis and Business Modeling by Wayne Winston
5. MS Excel 2016 Charts & Basics of Dashboards: The Essentials of Excel 2016 Charts and Simple Steps to Create a Dashboard by Venus LearningLabs

VAC-127: Yoga Education

Unit 1:

Introduction to Yoga, Yoga and Personality Development, Sitting and standing warm-up exercise, Basic stretching, Surya Namaskar, Ardhamatsyendrasana, Vakrasana, Pranayama, Tadasana, Hastotthanasana, Padahastanasana, Pawanmuktasana, Halasana/Ardhalasana, Naukasana, Sky-diving Yoga

Unit 2:

Flexibility Booster, Bhujangasana, Sarpasna (Snake Pose), Shalabhasana, Dhruvasana (Tree Pose), Katiasana, Trikonasana, Marjariasana, Mandukasana (Frog Pose), Ushtrasana, Relaxation, Exercises for Obesity, Meditation, Akarna Dhanurasana, Janushirasana, Bhunamana, Sarvangasana, Shashankasana, Simhasana (Lion Posture), Breathing Modulation, Yoga Mudra, Matsyasana, Relaxation Exercise with Smiley Ball

Reference Books:

1. Yoga: A Healthy way of living (Secondary Stage); New Delhi, India, NCERT, 2015.
2. The Art of Living.
3. Ministry of AYUSH, Government of India.