FACULTY OF COMPUTER APPLICATION

Proposed Course Structure aligned with NEP-2020

MASTER OF COMPUTER APPLICATION (MCA)

in Deep Learning & Artificial Intelligence

(in Association with IBM)

[Academic Session 2025-26 onwards]

UNITED UNIVERSITY

विद्या कल्पलतेव

PRAYAGRAJ

[Established under the U. P. Private Universities Act. No. 12 of 2019]

FACULTY OF COMPUTER APPLICATION

Master of Computer Application (MCA)

in Deep Learning & Artificial Intelligence

(in Association with IBM)

2 Year (4 Semester) Programme

[Academic Session 2025-26 onwards]

CREDITS DISTRIBUTION

S.N.	Category	Number of Courses	Credit
1	Professional Core (PC)	25	52
2	Professional Elective (PE)	2	4
3	Humanities and Social Sciences (HS)	4	8
4	Project Work, Seminar, Internship (PWSI)	4	24
5	Audit Courses (AU)	1	-
Total		**36**	**88**

COURSE STRUCTURE
Master of Computer Application (MCA)
in Deep Learning & Artificial Intelligence
(in Association with IBM)
2 Year (4 Semester) Programme
[Academic Session 2025-26 onwards]
Entry Level-1

Sr. No.	Course Code	Course Title	Category	Teaching			Credit
				L	T	P	
Semester I							
1	CAPCMC105T	Full Stack Development	PC	3	-	-	3
2	CAPCMC121T	Data Structures using 'C'	PC	3	-	-	3
3	CAPCMC123T	Database Management Systems	PC	3	-	-	3
4	CAPCMC125T	Software Engineering	PC	3	-	-	3
5	CAUIMC101T	Data Visualization with Python	PC	3	-	-	3
6	PTSPMCA12T	Professional Proficiency	HS	2	-	-	2
7	CAPCMC121P	Data Structures using 'C' Lab	PC	-	-	4	2
8	CAPCMC105P	Full Stack Development Lab	PC	-	-	2	1
9	CAPCMC123P	Database Management Systems Lab	PC	-	-	2	1
10	CAUIMC101P	Data Visualization with Python Lab	PC	-	-	2	1
11	UUSCVA001P	Yoga/NSS/Music/Sports	AU	-	-	2	0
Total				**17**	**0**	**12**	**22**

Note: Students exiting the program after securing 44 credits will be awarded PG Diploma in the Discipline provided they secure additional 4 credit in skill based/vocational courses (**internship also**) offered during first year summer semester. These students are allowed to re-enter the degree program within TWO years and complete the degree program within the stipulated maximum period of FOUR years.

COURSE CODE & NAME: CAPCMC105T / Full Stack Development

COURSE OUTCOMES

1. Manipulate elements on a webpage and responding to user interactions
2. Identify the basis of designing a Web site and adding additional functionality using
3. jquery, Bootrap and React.
4. Describe and identify the use of Bootstrap and successfully place it into Web

UNIT I:

Introduction to Web and Hyper Text Markup Language: Internet, Intranet, WWW, Static and Dynamic Web Page; Web Clients; Web Servers; Client Server Architecture: Single Tier, Two-Tier, Multi-Tier; HTTP: HTTP Request and Response; URL, Client Side Scripting, Server Side Scripting, Web 1.0, Web 2.0.

Introduction to HTML; Elements of HTML Document; HTML Elements and HTML Attributes, Headings, Paragraph, Division, Formating: b, i, small, sup, sub; Spacing: Pre, Br; Formatting Text Phrases: span, strong, tt; Image element; Anchors; Lists: Ordered and Unordered and Definition; Tables; Frames; Forms: Form Elements, ID attributes, Class Attributes of HTML Elements; Meta Tag, Audio, Video, Canvas, Main, Section, Article, Header, Footer, Aside, Nav, Figure Tags; HTML Events: Window Events, Form Element Events, Keyboard Events, Mouse Events

UNIT II:

Cascading Style Sheets: Introduction; Cascadding Style Sheets (CSS); CSS Syntax; Inserting CSS: Inline, Internal, External, ID and Class Selectors; Colors; Backgrounds; Borders; Text; Font; List; Table; CSS Box Model; Normal Flow Box Layout: Basic Box Layout, Display Property, Padding, Margin; Positioning: Relative, Float, Absolute; CSS3 Borders, Box Shadows, Text Effects and shadow; Basics of Responsive Web Designs; Media Queries.

UNIT III:

Client Side Scripting with JavaScript: Structure of JavaScript Program; Variables and Data Types; Statements: Expression, Keyword, Block; Operators; Flow Controls, Looping, Functions; Popup Boxes: Alert, Confirm, Prompt; Objects and properties; Constructors; Arrays; Built-in Objects: Window, String, Number, Boolean, Date, Math, RegExp, Form, DOM; User Defined Objects; Event Handling and Form Validation, Error Handling, Handling Cookies,

UNIT IV:

jQuery Syntax; jQuery Selectors, Events and Effects; Introduction to JSON.

Introduction to Bootstrap, Bootstrap Setup, Bootstrap Containers, Bootstrap Grids, Bootstrap Tables, Bootstrap Buttons, Navbars, Alerts, Bootstrap Carousel, Bootstrap Forms

Intro to ReactJS, Environment Setup and folder structure, JSX, Components, State, Props Overview

UNIT V:

Node Js : Introduction, Environment Setup, First Application, REPL Terminal ,Package Manager (NPM), Call backs Concept, Event Loop, Event Emitter, Buffers, Streams , File System, Global Objects, Utility Modules, Web Module, Express Framework.

TEXTBOOKS

1. The Complete Reference HTML & XHTML' by Thomas Powell, 5th Edition, Tata McGraw-Hill Company Limited.
2. Learning web designing: a beginner's guide to HTML, CSS, JavaScript,and web graphics' by Niederst Robbins, 4th Edition, Oreilly Publication
3. 'The Complete Reference HTML & XHTML' by Thomas Powell, 5th Edition, Tata McGraw-Hill Company Limited.

REFERENCE BOOKS

1. Mastering HTML, CSS & JAVAScript Web Publishing' by Laura Lemay, Rafe Coburn, Jennifer Kyrnin, 7th edition, SAMS publication.
2. Web Enabled Commercial Application Development using HTML, JavaScript, DHTML and PHP' by Ivan Bayross, 4th Edition, BPB Publications.

COURSE CODE & NAME: CAPCMC121T/ Data Structures Using 'C'

COURSE OUTCOMES

1. Students demonstrate an ability to apply knowledge of computing and mathematics appropriate to the discipline including computer science theory, recursion, and order N analysis.
2. Implement an N-way tree with correct insertion and deletion such that it stores words that are displayed in alphabetical order given an in-order traversal, will display the words in alphabetical order.
3. Given a cyclic-directed graph with weighted lengths, determine the shortest path between two nodes. Then generate the transitive closure given a starting node.
4. Students can measure complexity of algorithms and performance of algorithms.

UNIT I:

Introduction: Basic Terminology, Elementary Data Organization, Abstract Data Types (ADT), Arrays: Definition, Single and Multidimensional Arrays, Representation of Arrays: Row Major Order, and Column Major Order, Application of arrays, Sparse Matrices and their representations.

UNIT II:

Linked Lists: Array Implementation and Dynamic Implementation of Singly Linked Lists, Doubly Linked List, Circularly Linked List, Operations on a Linked List. Insertion, Deletion, Traversal, Polynomial Representation and Addition, Generalized Linked List.

Stacks and Queues: Abstract Data Type, Primitive Stack operations: Push & Pop, Array and Linked Implementation of Stack in C, Application of stack: Prefix and Postfix Expressions, Evaluation of postfix expression, Recursion, Tower of Hanoi Problem, Simulating Recursion, Principles of recursion, Tail recursion, Removal of recursion Queues, Operations on Queue: Create, Add, Delete, Full and Empty, Circular queues, Array and linked implementation of queues in C, De-queue and Priority Queue.

UNIT III:

Trees: Basic terminology, Binary Trees, Binary Tree Representation: Array Representation and Dynamic Representation, Complete Binary Tree, Algebraic Expressions, Extended Binary Trees, Array and Linked Representation of Binary trees, Tree Traversal algorithms: Inorder, Preorder and Post-order, Threaded Binary trees, Traversing Threaded Binary trees, Huffman algorithm.

UNIT IV:

Graphs: Terminology, Sequential and linked Representations of Graphs: Adjacency Matrices, Adjacency List, Adjacency Multi list.

Graph Traversal: Depth First Search and Breadth First Search, Connected Component, Spanning Trees, Minimum Cost Spanning Trees: Prims and Kruskal algorithm. Transistive Closure and Shortest Path algorithm: Warshal Algorithm and Dijikstra Algorithm.

UNIT V:

Searching: Sequential search, Binary Search, Comparison and Analysis Internal Sorting: Insertion Sort, Selection, Bubble Sort, Quick Sort, Two Way Merge Sort, Heap Sort, Radix Sort, Practical consideration for Internal Sorting. Search Trees: Binary Search Trees (BST), Insertion and

Deletion in BST, Complexity of Search Algorithm, AVL trees, Introduction to m-way Search Trees, B Trees & B+ Trees. Hashing: Hash Function, Collision Resolution Strategies. Storage Management: Garbage Collection and Compaction.

TEXTBOOKS

1. Aaron M. Tenenbaum, Yedidyah Langsam and Moshe J. Augenstein, "Data Structures Using C and C++", PHI Learning Private Limited, Delhi India
2. Lipschutz, "Data Structures" Schaum's Outline Series, Tata McGraw-hill Education (India) Pvt. Ltd.

REFERENCE BOOKS

1. Thareja, "Data Structure Using C" Oxford Higher Education.

COURSE CODE & NAME: CAPCMC123T/ Database Management Systems

COURSE OUTCOMES

1. Understand database concepts and structures and query language
2. Understand the E R model and relational model
3. Functional Dependency and Functional Decomposition.
4. Apply various Normalization techniques.

UNIT I:

Introduction: An overview of database management system, Database System Vs File System, Database system concepts and architecture, data models schema and instances, data independence and data base language and interfaces, Data definitions language, DML, Overall Database Structure.

Data Modelling using the Entity Relationship Model: ER model concepts, notation for ER diagram, mapping constraints, keys, Concepts of Super Key, candidate key, primary key, Generalization, aggregation, reduction of an ER diagrams to tables, extended ER model, relationships of higher degree.

UNIT II:

Relational data Model and Language: Relational data model concepts, integrity constraints: entity integrity, referential integrity, Keys constraints, Domain constraints, relational algebra, relational calculus, tuple and domain calculus.

Introduction to SQL: Characteristics of SQL, Advantages of SQL, SQL data types and literals, Types of SQL commands, SQL operators and their procedure, Tables, views and indexes, Queries and sub queries, Aggregate functions, Insert, update and delete operations, Joins, Unions, Intersection, Minus, Cursors in SQL.PL/SQL, Triggers and clusters.

UNIT III:

Data Base Design & Normalization: Functional dependencies, normal forms, first, second, third normal forms, BCNF, inclusion dependencies, loss less join decompositions, normalization using FD, MVD, and JDs, alternative approaches to database design.

UNIT IV:

Transaction Processing Concepts: Transaction system, Testing of serializability, Serializability of schedules, conflict & view serializable schedule, recoverability, Recovery from transaction failures, log based recovery, checkpoints, deadlock handling.

UNIT V:

Concurrency Control Techniques: Concurrency control, locking Techniques for concurrency control, Time stamping protocols for concurrency control, validation based protocol, multiple granularity, Multi-version schemes, Recovery with concurrent transaction. Transaction Processing in Distributed system, data fragmentation. Replication and allocation techniques for distributed system, overview of concurrency control and recovery in distrusted database.

TEXTBOOKS

1. Understand database concepts and structures and query language Date C J, "An Introduction To Database System", Addision Wesley
2. Korth, Silbertz, Sudarshan, "Database Concepts", Tata Mcgraw-hill Education (India) Pvt. Ltd.
3. Elmasri, Navathe, "Fundamentals Of Database Systems", Pearson Education New Delhi India.
4. Bipin C. Desai, "An introduction to Database Systems", Galgotia Publication Pvt. Ltd. New Delhi.
5. Majumdar& Bhattacharya, "Database Management System", Tata Mcgraw-hill Education (India) Pvt. Ltd.

REFERENCE BOOKS

1. G.K. Gupta, "Database Management System", Tata Mcgraw-hill Education (India) Pvt. Ltd.
2. Ramakrishnan, Gehrke, "Database Management System", McGraw Hill (India) Pvt Ltd. New Delhi.
3. Chakravarti, "Advanced Database Mnagement System" Wiley Dreamtech Publications.

COURSE CODE & NAME: CAPCMC125T/ Software Engineering

COURSE OUTCOMES

1. Apply the principles of the engineering processes in software development.
2. Demonstrate software project management activities such as planning, scheduling and estimation.
3. Model the requirements for the software projects.
4. Design and Test the requirements of the software projects.
5. Implement the software development processes activities from requirements to validation and verification.
6. Apply and evaluate the standards in process and in product.

UNIT I:

Introduction: Introduction and overview of Software Engineering, Software Crisis, Scope and necessity of software engineering, Software Engineering Processes, Software Development Life Cycle (SDLC) model: Water Fall Model, Prototype Model, Spiral Model, Evolutionary Development Models, Iterative Enhancement Models.

UNIT II:

Software Requirement Analysis & Specification: Requirement Engineering, Problem Analysis: Data Flow Diagram, Data Dictionaries, ER Diagram, Approaches to Problem Analysis, SRS Document. Software Quality Assurance (SQA): Verification and Validation, SQA Plans, Software Quality Frameworks, ISO 9000 Models, SEI-CMM Model.

UNIT III:

System Design: Conceptual and Technical Design, Objectives of Design, Modularization, Design Structure Charts, Pseudo Codes, Flow Charts, Coupling and Cohesion Measures, Design Strategies: Function versus Object Oriented Design, Top-Down and Bottom-Up Design. Bootstrap: Introduction to Bootstrap, Bootstrap Setup, Bootstrap Containers, Bootstrap Grids, Bootstrap Tables, Bootstrap Buttons, Navbars, Alerts, Bootstrap Carousel, Bootstrap Forms.

Software Measurement and Metrics: Various Size Oriented Measures: Halestead's Software Science, Function Point (FP) Based Measures, Cyclomatic Complexity Measures: Control Flow Graphs.

UNIT IV:

Software Testing: Software verification & validation, Strategic Approach to Software Testing, Testing Fundamentals Test Plan, Test Design, Test Execution, Reviews, Inspection Auditing, Alpha and Beta Testing of Products, Recent Trends in Software Design/Specialized Software Testing, Related Tools and Standards.

UNIT V:

Software Maintenance and Software Project Management: Software Maintenance, Types of Maintenance, Overview of RE-engineering Reverse Engineering, Software Configuration Management, Cost Estimation-Constructive Cost Models (COCOMO), Project Scheduling, Resource Allocation Models, Software Risk Analysis and Management.

TEXTBOOKS

1. Roger Pressman, Software Engineering: A Practitioner‟s Approach, 7th Edition, McGraw Hill
2. Ian Sommerville, Software Engineering, 9th Edition, Addision-Wesley, 2016

REFERENCE BOOKS

1. Pankaj Jalote, A Concise Introduction to Software Engineering, Springer, 2008
2. William E. Lewis Software Testing and Continuous Quality Improvement, Third Edition, Auerbach Publications, 2008

COURSE CODE & NAME: CAUIMP101T / Data Visualization with Python

COURSE OUTCOMES

1. Enhance data interpretation skills through advanced visual techniques.
2. Train students in building interactive and real-time visual dashboards using modern libraries.
3. Teach how to handle and visualize complex datasets effectively.
4. Introduce geospatial, 3D, and animation-based data visualization.
5. Provide hands-on experience with real-world projects and storytelling.

UNIT I:

Fundamentals & Principles of Advanced Visualization : Data-ink ratio, chart selection, color theory, encoding types, storytelling with data, data-to-insight pipeline, anatomy of a good chart

UNIT II:

Interactive Visualizations in Python : Introduction to Plotly, Plotly Express: bar, line, scatter, pie, sunburst, treemap; Interactivity: hover, slider, dropdowns; Animation in charts

UNIT III:

Dashboards with Dash, Streamlit & Bokeh: Introduction to Dash and Streamlit; Layouts and Components; Callbacks and Interactions; Dashboard deployment; Bokeh for interactive plotting

UNIT IV:

Specialized Visualizations : Time Series visualizations, Geospatial data visualization using Plotly, Folium, Geopandas; Network graphs (NetworkX); Word clouds; Heatmaps

UNIT V:

Capstone Projects and Visual Storytelling : Designing data-driven stories; Case studies (COVID-19, sales analysis, education stats); Mini-projects using public datasets (Kaggle, UCI); Best practices in presenting dashboards and insights

TEXTBOOKS

1.Storytelling with Data – Cole Nussbaumer Knaflic
2.Interactive Data Visualization for the Web – Scott Murray
3.Python Data Science Handbook – Jake VanderPlas
4.Fundamentals of Data Visualization – Claus Wilke (Free Online)

Further suggested Readings

1.Coursera: Data Visualization with Python (offered by IBM)
https://www.coursera.org/learn/python-for-data-visualization
2.YouTube Channel: StatQuest with Josh Starmer (excellent for intuitive understanding of data visualization and statistics) https://www.youtube.com/user/joshstarmer

COURSE CODE & NAME: PTSPMCA12T/ Professional Proficiency

COURSE OUTCOMES

1. Learner can demonstrate understanding by their ability to describe various parts of speech like noun, pronoun, verb adverb, adjective, conjunction, interjection and preposition.
2. Learner will be able to understand the articles and use effectively.
3. Learner can demonstrate understanding by their ability to describe various parts of speech like noun, pronoun, verb adverb, adjective, conjunction, interjection and preposition.
4. Learner will be able to understand the articles and use effectively.
5. Students will learn advance tricky approaches for solving Quant.
6. It will enhance student's skill to appear in various aptitude test within limited time constrain.

UNIT-1
One word substitution , synonyms antonyms ,suffix -prefix , emphasis on correct usage.

UNIT-2
Networking skills cross cultural communication LSRW skills

UNIT-3
Simplification & Approximation
Alphanumeric Series & Miscellaneous
Coding-Decoding

Reference Books:

1. Quantitative Aptitude- R.S Agarwal
2. Analytical Reasoning –Peeyush Bhardwaj
3. English Grammar, Composition and Usage by N.K. Agrawal & F.T. Wood, Macmillan India Ltd., New DelhiAshraf Rizvi, "Effective Technical Communication", 2ndEdition, McGraw Hill Education, 2017.

COURSE CODE & NAME: CAPCMC121P/ Data Structures Using 'C' Lab

List of Experiments:

1. Write C Programs to illustrate the concept of the following:
2. Sorting Algorithms-Non-Recursive.
3. Sorting Algorithms-Recursive.
4. Searching Algorithm.
5. Implementation of Stack using Array.
6. Implementation of Queue using Array.
7. Implementation of Circular Queue using Array.
8. Implementation of Stack using Linked List.
9. Implementation of Queue using Linked List.
10. Implementation of Circular Queue using Linked List.
11. Implementation of Tree Structures, Binary Tree, Tree Traversal, Binary Search Tree, Insertion and Deletion in BST.
12. Graph Implementation, BFS, DFS, Minimum cost spanning tree, shortest path algorithm.

COURSE CODE & NAME: CAPCMC123P/ Database Management Systems Lab

List of Experiments:

1. Student should decide on a case study and formulate the problem statement.
2. Conceptual Designing using ER Diagrams (Identifying entities, attributes, keys and relationships between entities, cardinalities, generalization, specialization etc.)
   Note: Student is required to submit a document by drawing ER Diagram to the Lab teacher.
3. Converting ER Model to Relational Model (Represent entities and relationships in Tabular form, Represent attributes as columns, identifying keys)
   Note: Student is required to submit a document showing the database tables created from ER Model.
4. **Normalization** -To remove the redundancies and anomalies in the above relational tables, Normalizeup to Third Normal Form
5. **Creation of Tables using SQL-** Overview of using SQL tool, Data types in SQL, Creating Tables(along with Primary and Foreign keys), Altering Tables and Dropping Tables
6. **Practicing DML commands-** Insert, Select, Update, Delete
7. Practicing Queries using ANY, ALL, IN, EXISTS, NOT EXISTS, UNION, INTERSECT,
8. CONSTRAINTS etc.
9. Practicing Sub queries (Nested, Correlated) and Joins (Inner, Outer and Equi).
10. Practice Queries using COUNT, SUM, AVG, MAX, MIN, GROUP BY, HAVING, VIEWS Creation and Dropping.
11. **Practicing on Triggers -** creation of trigger, Insertion using trigger, Deletion using trigger, Updating using trigger
12. **Procedures-** Creation of Stored Procedures, Execution of Procedure, and Modification of Procedure.

COURSE CODE & NAME: CAUIMC101P / Data Visualization with Python Lab

COURSE OUTCOMES

1.Understand advanced visualization principles including chart anatomy and storytelling.
2.Create interactive visualizations using modern Python libraries like Plotly and Streamlit.
3.Design dashboards and manage user interactions using Dash, Streamlit, and Bokeh.
4.Apply specialized visualizations such as geospatial, time series, and network graphs.
5.Develop capstone projects that showcase data storytelling using real-world datasets.

List of experiments

1. Create basic visualizations (bar, line, scatter) using Plotly and Plotly Express.
    a. Apply appropriate color theory and chart selection principles.
2. Build interactive visualizations with Plotly:
    a. Add sliders, dropdowns, hover effects, and tooltips.
3. Create sunburst and treemap visualizations using Plotly Express for hierarchical data.
4. Animate data over time using Plotly (e.g., COVID-19 cases, GDP, population growth).
5. Develop a Streamlit application with interactive widgets (slider, selectbox, button).
6. Design a dashboard layout in Streamlit with multiple charts and user interactions.
7. Build a simple dashboard using Dash with callback functions and layout components.
8. Use Bokeh to create interactive plots with hover tools, linked plots, and custom styling.
9. Perform time series visualization using Plotly (stock prices, weather trends, etc.).
10. Visualize geospatial data using Folium or Geopandas (e.g., map of crime, sales by region).
11. Create specialized visualizations: word clouds, heatmaps, and network graphs using NetworkX.
12. Design a mini-capstone project using a public dataset (Kaggle/UCI):
    - Present key insights through a multi-chart dashboard
    - Use effective visual storytelling techniques