Master of Computer Applications

SYLLABUS
FOR
CREDIT-BASED CURRICULUM
(Applicable from 2022-2023 onwards)

Department of Computer Applications
National Institute of Technology
Tiruchirappalli
MASTER OF COMPUTER APPLICATIONS

SYLLABUS
FOR

CREDIT-BASED CURRICULUM
(Applicable for 2022-2023 onwards)

DEPARTMENT OF COMPUTER APPLICATIONS
NATIONAL INSTITUTE OF TECHNOLOGY
TIRUCHIRAPPALLI-620 015
TAMIL NADU - INDIA
About us:

The Department of Computer Applications is one of the pioneering departments of the institution that offers Information Technology courses such as MCA, M.Sc., Computer Science and M.Tech. Data Analytics and one among the top five institute offering MCA courses in the country. It is committed to impart quality education in the sub-fields of IT, a field growing in leaps and bounds.

Vision:

Towards building a school of Information Science and Technology conforming to international standards to provide valuable resources to the society

Mission:

- To offer state-of-art education in Information Science and Technology
- To provide strong theoretical foundation complemented with extensive practical training
- To inculcate value-based, socially committed professionalism to the cause of holistic development of students and society

Objectives of the Programme:

1. Prepare graduates to become computer professionals with comprehensive knowledge and skills to produce software for emerging requirement
2. Prepare graduates to become continuous learner with aptitude for teaching and research with societal focus
3. Prepare graduates to become Consultant / Entrepreneurs in the IT and ITES industries with confidence in self-employment
The board of studies for Computer Applications Department includes the following members:

- **Chairman:**
  Dr. P.J.A. Alphonse, Head of the Department

- **External Experts:**
  1. Dr. A. Valarmathi, Dept. of Computer Applications, Anna University, Trichy.
  2. Dr. K. Rajbabu, Manager/IT Solutions, BHEL, Trichy.
  3. Mr. Prashanth/Associate Consultant/ATOS Global IT Solutions and Services/Chennai.

- **Members:**
  1. Dr. S.R. Balasundaram
  2. Dr. S. Nickolas
  3. Dr. Michael Arock
  4. Dr. S. Domnic
  5. Dr. G.R. Gangadharan
  6. Dr. (Mrs) B. Janet
  7. Dr. (Mrs) S. Sangeetha
  8. Dr. (Mrs). R. Eswari
  9. Dr. U. Srinivasulu Reddy
  10. Dr. K. Selvakumar
  11. Dr. Ghanshyam S. Bopche
  12. Dr. Jitendra Kumar
  13. Dr. B. Balaji
<table>
<thead>
<tr>
<th>Semester</th>
<th>Subject Code</th>
<th>Subject Name</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
<th>Total Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>CA711</td>
<td>Problem Solving and Programming</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CA713</td>
<td>Mathematical Foundations of Computer Applications</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CA715</td>
<td>Digital Logic and Computer Organization</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CA717</td>
<td>Data Structures and Applications</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CA719</td>
<td>Operating Systems</td>
<td>3</td>
<td>0</td>
<td>2</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CA701</td>
<td>Problem Solving Lab using Python</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CA703</td>
<td>Data Structures Lab using C</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>CA710</td>
<td>Design and Analysis of Algorithms</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CA712</td>
<td>Database Management Systems</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CA714</td>
<td>Probability and Statistical Methods</td>
<td>3</td>
<td>0</td>
<td>2</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CA716</td>
<td>Object Oriented Programming</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CA718</td>
<td>Computer Networks</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CA702</td>
<td>DBMS Lab</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CA704</td>
<td>Computer Networks Lab</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>III</td>
<td>CA721</td>
<td>Data Mining and Warehousing</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CA723</td>
<td>Computational Intelligence</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CA725</td>
<td>Software Engineering</td>
<td>3</td>
<td>0</td>
<td>2</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CA727</td>
<td>Accounting and Financial Management</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CA7A_</td>
<td>Elective-I</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CA705</td>
<td>Data Mining Lab</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CA707</td>
<td>Business Communication</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>IV</td>
<td>CA720</td>
<td>Machine Learning and Deep Learning</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CA722</td>
<td>Web Technology and Its Applications</td>
<td>3</td>
<td>0</td>
<td>2</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CA724</td>
<td>Parallel and Distributed Computing</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CA7A_</td>
<td>Elective-II</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CA7B_</td>
<td>Elective-III</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CA706</td>
<td>Machine Learning and Deep Learning Lab</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CA749</td>
<td>Project Work - Phase I</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>V</td>
<td>CA731</td>
<td>Information Security</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CA733</td>
<td>Cloud Computing</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CA735</td>
<td>Organizational Behaviour</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CA7C_</td>
<td>Elective-IV</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CA7D_</td>
<td>Elective-V</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CA708</td>
<td>Information Security Lab</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CA709</td>
<td>Cloud Computing Lab</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>VI</td>
<td>CA750</td>
<td>Project Work</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

Total Credits – **109**

*L*: LECTURE  |  *T*: TUTORIAL  |  *P*: PRACTICAL  |  *C*: CREDITS
List of Electives

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subject Name</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>CA7A1</td>
<td>Data Science</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CA7A2</td>
<td>Social Network Analysis</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CA7A3</td>
<td>Advanced Database Technology</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CA7A4</td>
<td>Bioinformatics</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CA7A5</td>
<td>Resource Management Techniques</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CA7A6</td>
<td>Image Processing</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CA7B1</td>
<td>Software Architecture and Project Management</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CA7B2</td>
<td>Service Oriented Architecture</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CA7B3</td>
<td>Agile Technology</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CA7B4</td>
<td>Marketing Management</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CA7C1</td>
<td>Soft Computing</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CA7C2</td>
<td>Evolutionary Computing</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CA7C3</td>
<td>Modelling and Computer Simulation</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CA7C4</td>
<td>Natural Language Processing</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CA7C5</td>
<td>DevOps</td>
<td>3</td>
<td>0</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>CA7C6</td>
<td>Mobile Computing</td>
<td>3</td>
<td>0</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>CA7C7</td>
<td>Block Chain Technology</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CA7C8</td>
<td>Business Ethics</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CA7D1</td>
<td>Big Data Management</td>
<td>3</td>
<td>0</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>CA7D2</td>
<td>Green Computing</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CA7D3</td>
<td>Internet of Things</td>
<td>3</td>
<td>0</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>CA7D4</td>
<td>Human Computer Interaction</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CA7D5</td>
<td>Multi-core Programming</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CA7D6</td>
<td>MEAN Stack Development</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CA7D7</td>
<td>Computer Vision</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CA7D8</td>
<td>Business Intelligence</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

L: LECTURE | T: TUTORIAL | P: PRACTICAL | C: CREDITS
Objective(s):

To learn problem solving methodologies and aspects of Python programming.


Files and exception: text and binary files- CSV files- JSON Files- reading and writing files- Object serialization; Exception Handling: Errors and exceptions- handling exceptions- modules-packages: Creating modules and packages- Python standard Library: OS- Sys- Collections- Random- Library for Data science: PANDAS- NUMPY.

REFERENCES:
Course Outcome:
Students will be able to:

- To write structured pseudo codes for a given problem.
- To develop Python programs with conditionals - loops and data structures
- To design and create Python applications using functions and files
- To build and package Python modules for reusability

CA713 MATHEMATICAL FOUNDATIONS OF COMPUTER APPLICATIONS

Objectives:

- To introduce the mathematical aspects in computer applications.
- To familiarize students with the concepts of Sets, Function, Logic Propositions
- To make the students to describe the concepts of Graph Theory and Automata


REFERENCES:

Course Outcome:
Students will be able to:
• To explain the mathematical principles for computer applications.
• To describe about the concept of logical propositions
• To explain about Graph Theory and its Applications
• To summarize the ideas of Automata Theory

CA715 DIGITAL LOGIC AND COMPUTER ORGANIZATION

Objectives:
• To introduce the basic operational characteristics of digital systems.
• To familiarize students about the working principles of CPU and Memory
• To make the students to understand the Multi-core Architecture and Pipelining


CPU: Arithmetic and Logic Unit - Instruction Sets - RISC - CISC - Instruction pipeline - Addressing modes and formats - Register organization – Booth’s Algorithm, Robertson Multiplication Algorithms. Control Unit Operation – Processor organization.


Processors: Parallel – Multi-core – Mobile – Embedded – GPU and TPU.
Pipelining: Basic Concepts - Instruction Hazards - Data Hazards - Influence on Instruction Sets - Data Path and Control Considerations - Arithmetic Pipeline - Instruction Pipeline - RISC Pipeline.

REFERENCES

Course Outcome:
Students will be able to:
- Explain the principles of Digital systems and its design
- Describe the functional units of the CPU and Memory
- Brief the concepts of Pipelining
- Summarize about advanced computer architectures

CA717 DATA STRUCTURES AND APPLICATIONS

Objective(s):
To make students to learn different data structures and their applications.


Non-Linear data Structures - Binary Trees – Binary Tree Representations – Binary tree Traversals – Binary search trees: Definition, operations - Graphs – Matrix and list Representations – Graph Traversals – Applications: Diameter finding and topological sort.


REFERENCES:

Course Outcomes:
Students will be able to
- Use linear and nonlinear data structures to solve real-time problems
- Apply advanced data structures in different application domains

CA719 OPERATING SYSTEMS

Objectives:
- To introduce the generic structure of an Operating System
- To detail the concepts of Processes, Threads and Synchronization principles
- To explain the students about the Memory Management, Protection
- To provide an idea of different File Systems and I/O

Introduction: Operating system structures: Computer system structure, Network structure, I/O Structure, Storage Structure, Dual mode operation, System Boot, System components, Operating-System Services, System Calls, Types of System Calls, System Programs, System structure, Virtual Machines, System Design and Implementation, System Generation.


Memory Management: Memory Management Background, Swapping, Contiguous Memory Allocation, Paging, Segmentation, Segmentation with Paging, Virtual Memory, Demand Paging, Process Creation, Page Replacement, Allocation of Frames, Thrashing, Operating- System Examples, Other Considerations.


REFERENCES

Course Outcomes:
Students will be able to
- Understand functional architecture of an operating system
- Design device drivers and multi-threading libraries for a tiny OS
- Design and solve synchronization problems
- Understand standard UNIX and FAT file systems, Protection and Security

CA701 PROBLEM SOLVING LAB USING PYTHON

Objective(s):
To make the students to experiment the problem-solving techniques using Python.

Exercises for learning basic features of Python and exercises to implement various applications in Python.

Course Outcomes:
Students will be able to
- Demonstrate the different programming paradigms in python for problem solving
Objective(s):
To make the students to problems in Data Structures using C.

Exercises for learning basic features of C and exercises to implement various data structures for real world applications.

Course Outcomes:
Students will be able to
- Write C programs for solving any problems.
- Implement linear and nonlinear data structures to solve real time problem.
- Perform searching and sorting techniques to different application domains.
- Implement different design strategies to solve complex problems.
Semester-II

CA710 DESIGN AND ANALYSIS OF ALGORITHMS

Pre-requisite: CA 717

Objective(s):

To introduce various design strategies in algorithm analysis and their applications.


Backtracking and Branch-and-Bound strategies with applications – Randomized algorithms – Examples.


REFERENCES:

Course Outcomes:
Students will be able to
• Design algorithms using different strategies, Compute time-and space complexities of algorithms.

CA 712 DATABASE MANAGEMENT SYSTEMS
Pre-requisites: CA713

Objectives:
• To make the students to learn different database models
• To provide knowledge of design of databases
• To explain the concepts of query languages and transaction management

Database system architecture: Data Abstraction - Data Independence - Database Languages - Data models - Entity-relationship model - integrity constraints - Conceptual Design with ER Model.

Relational Model – Keys – Constraints – Querying - Relational query languages: Relational algebra - Relational Calculus – SQL.


Transaction processing: Serializability – Concurrency control mechanisms – Protocols - Recovery systems.

REFERENCES:

Course Outcomes:
Students will be able to:
• Get practical knowledge on designing and creating relational database systems
• Describe the nuances of Data retrieval methods
• Apply normalization techniques in DB design
• Perform concurrency and Transaction Management operations
Objective(s):
To introduce the fundamentals of probability and statistical methods.


Binomial, Poison and Normal Distributions – Fitting of Probability distributions – Correlation and Regression – Linear regression – Correlation coefficient – Multiple linear regression

Sampling Distributions & Descriptive Statistics: The Central Limit Theorem, distributions of the sample mean and the sample variance for a normal population, Sampling distributions, problems. Graphical representation, measures of locations and variability

Estimation: Unbiasedness, consistency, the method of moments and the method of maximum likelihood estimation, confidence intervals for parameters in one sample and two sample problems of normal populations, confidence intervals for proportions, problems.

Test of Hypothesis- Testing for Attributes – Mean of Normal Population – One-tailed and two-tailed tests, F-test and Chi-Square test - ANOVA – One way and two way classifications

REFERENCES:

Course Outcomes:
Students will be able to
• Explain basic probabilistic and statistical models and illustrate their related applications
• Estimate the likelihood of events from population
• Propose, test and evaluate hypothesis.
Objectives:

- To introduce the object-oriented programming concepts.
- To understand object-oriented programming concepts, and apply them in solving problems.
- To introduce the principles of inheritance and polymorphism; and demonstrate how they relate to the design of abstract classes.
- To introduce the implementation of packages and interfaces.
- To introduce the concepts of exception handling and multithreading.
- To introduce the design of Graphical User Interface using applets and swing controls.

Introduction: OOP Principles, Data types, Variables, Scope and life time of variables, Operators, Control statements, Type conversion and casting, Arrays. Concepts of classes and objects, Introducing methods, Method overloading, Constructors, Constructor overloading, Usage of static with data and methods, Access control, This key word, Garbage collection, String class.

Inheritance, Packages and Interfaces: Inheritance basics, Types of inheritance, Member access rules, Usage of super key word, Method overriding, Usage of final, Abstract classes, defining an interface, Differences between abstract classes and interfaces, implementing interface, applying interfaces, Variables in interface and extending interfaces; Defining, creating and accessing a Package, Importing packages, Access control in packages, Collections in Java.

Exception Handling & Multithreading: Concepts of exception handling, Types of exceptions, Usage of Try, Catch, Throw, Throws and Finally Keywords, Built-in exceptions, creating user defined exception; Concepts of multithreading, Differences between process and thread, Thread life cycle, creating multiple threads using thread class and runnable interface, Synchronization, Thread priorities, Inter thread communication.


REFERENCES:


Course Outcomes:
Students will be able to
- Describe object-oriented programming principles
- Write, compile and execute java programs
- Comprehend the java architecture and use the java APIs
- Understand and use of inheritance and polymorphism as implemented in java
- Apply exception handling mechanism
- Perform standard input-output operations
- Understand and use GUI components

CA718 COMPUTER NETWORKS

Pre-requisites: CA719

Objective(s):

To learn various network architectures, protocols, and the functions of different networking layers in line with IEEE standards.


REFERENCES:

Course Outcomes:
Students will be able to
- List the functionalities of networking layers available in both OSI reference model and TCP/IP model.
- Describe available LAN and WAN Technologies.
- Describe the principles of packet switching, forwarding, and routing.
- Distinguish between TCP and UDP packet formats.
- Describe the available application protocols and networking services.

CA702 DBMS LAB

Pre-requisite: CA712

Objectives:
- To make the students to experiment Queries for Database Design and Manipulation
- To provide basic understanding of Front-End Tools to integrate with Databases

Suggested list of Exercises:
1. Data Definition, Table Creation, Constraints
2. Insert, Select Commands, Update & Delete Commands
3. Inbuilt functions in RDBMS
4. Nested Queries & Join Queries
5. Set operators & Views
6. Control structures
7. Procedures and Functions
8. Triggers
9. Front End Tool, Forms, Menu Design, Reports
Course Outcomes:
Students will be able to
• Design Databases for querying and manipulation in real time
• Develop use case-based databases for Integration with front end tools

---

CA704 COMPUTER NETWORKS LAB

Pre-requisite: CA727

Objectives:
• To practice installation and configuration of different network architecture.
• To practice and configure different routing protocols.

Suggested list of Exercises:
1. Introduction to Components for building Network Topologies
2. Switch Configuration, Addressing, Port and terminal Security, VLAN and Trunk link configuration
3. Router Configuration – Static, Default routing, Dynamic Routing
4. IP Subnetting
5. Implementation of TCP and UDP
6. Implementation of OSI Layers

Course Outcomes:
Students will be able to:
• Configure different network topologies.
• Build the network according to the requirement.
• Configure different routing protocols.
• Implement different networking principles.
Semester-III

CA 721 DATA MINING AND WAREHOUSING

Pre-requisite: CA712

Objectives:

- To explain the architecture of Data Mining and Warehousing
- To describe the various techniques in Data mining for knowledge discovery

Fundamentals of data mining and Data Pre-processing: Motivation, Importance, Definition of Data Mining - Data Mining Functionalities - Classification of Data Mining systems - Data Mining Task Primitives - Integration of a Data Mining System with a Database or a Data Warehouse System - Major issues in Data Mining. Types of Data Sets and Attribute Values - Basic Statistical Descriptions of Data - Data Visualization - Measuring Data Similarity Data. Pre-processing: Need for Pre-processing the Data - Data Cleaning - Data Integration and Transformation - Data Reduction - Discretization and Concept Hierarchy Generation.

Data Warehouse and OLAP Technology for Data Mining: Data Warehouse - Multidimensional Data Model - Data Warehouse Architecture - Data Warehouse Implementation - Further Development of Data Cube Technology - From Data Warehousing to Data Mining Data Cube Computation and Data Generalization: Efficient Methods for Data Cube Computation, Further Development of Data Cube and OLAP Technology.

Mining Frequent Patterns, Associations and Correlations: Basic Concepts on Frequent Item sets - Efficient and Scalable Frequent Item set Mining Methods - Mining various kinds of Association Rules – Apriori Algorithm – FP-tree algorithm - From Association Mining to Correlation Analysis, Constraint-Based Association Mining.

Classification and Prediction: Issues Regarding Classification and Prediction - Classification by Decision Tree Induction - Bayesian Classification - Rule-Based Classification - Classification by Back propagation - Support Vector Machines – Prediction - Accuracy and Error measures - Evaluating the accuracy of a Classifier or a Predictor - Ensemble Methods.

Clustering Methods: Cluster Analysis Introduction - Types of Data in Cluster Analysis - A Categorization of Major Clustering Methods- Partitioning Methods, Hierarchical Methods, Density-Based Methods, Grid Based Methods, Model-Based Clustering Methods - Clustering High-Dimensional Data – Constraint Based Cluster Analysis; Outlier Analysis; Fundamentals of Web Data Mining.
REFERENCES:

Course Outcomes:
Students will be able to
- Explain the Data warehouse and its implementation
- Design applications for implementation of Data mining tasks
- Implement Classification and Prediction algorithms
- Experiment the Clustering methods

CA723 COMPUTATIONAL INTELLIGENCE

Prerequisite: CA713

Objectives:
- To know basic concepts of Computational Intelligence and Problem-solving through various searching techniques
- To study about building knowledge base, representation and reasoning and Bayesian networks
- To know about Bayesian network and fuzzy logic controller
- To study various evolutionary algorithms


Knowledge Representation and Reasoning: Knowledge representation, Propositional Logic, Rules of inference, First order logic, Inference in First order logic, resolution, unification, deduction system, Forward chaining, Backward chaining, refutation, PROLOG, semantic networks, frame system, Ontologies, Planning: Partial order planning.

Handling uncertainty: Bayes Theorem, Bayesian Belief Network, Inference in Bayesian Networks, Fuzzy rules, Fuzzy inference, Fuzzy logic controller.

Applications: Optimization, Control Systems, Expert Systems, Natural Language Processing and Decision making.

REFERENCES:

Course Outcomes:
Students will be able to
• Know how to build simple knowledge-based systems
• Apply knowledge representation and fuzzy logic to solve real-world problems
• Apply computational intelligence techniques to solve real-world problems
CA725 SOFTWARE ENGINEERING

Objective(s):
To impart concepts of a comprehensive study on the theories, processes, methods, and techniques of building high-quality software in cost-effective ways.


Coding and Testing: code review, black box testing, white box testing, debugging, integration and system testing, Automation testing tools - Software Maintenance, Software Reuse.


REFERENCES:

Course Outcomes:
Students will be able to
• Demonstrate a basic understanding of software engineering practices from vision to analysis, design, development, validation, deployment and maintenance.
• Develop skills to create and use various software Engineering based techniques and tools to solve real world problems
• Estimate cost, effort and risk involved in a software project development.
CA727 ACCOUNTING AND FINANCIAL MANAGEMENT

Objective(s):
To learn the fundamentals of accounting and financial management.


Depreciation – Methods - Inventory methods, Sources of working capital, Fund flows, Cash flows – Financial Statement analysis.


Variable costs – Fixed costs – Cost Volume Profit Analysis – Break even marginal and full costing contribution, Standard costing - Analysis of variance - Computer accounting and algorithms.

Characteristics of Budgets - Forecasting – Long term, Short term – Methods of capital investment decision making, Sensitivity Analysis, Cost of capital.

REFERENCES:

Course Outcomes:
Students will be able to
• Prepare and analyse the final accounts of the firm
• Prepare and analyse the funds & cash flow statements of the firm
• Perform basic analysis of financial statements and write a report on the financial performance, conditions and effectiveness of the firm
• Analyse and evaluate costing systems
• Prepare different types of budgets and policies

ELECTIVE – I
One Elective to be chosen from CA7A group.
CA705 DATA MINING LAB

Pre-requisite: CA 721

Exercises to
- Understand the datasets and data preprocessing using ETL tools.
- Demonstrate the working of algorithms for data mining tasks such as association rule mining, classification, regression and, clustering.

Course Outcomes:
Students will be able to
- Work with ETL Tools
- Demonstrate the classification, clustering and other mining techniques in large datasets
- Ability to add mining algorithms as a component to the existing tools
- Ability to apply mining techniques for real time data

CA707 BUSINESS COMMUNICATION

Objectives:
- Introduce the dynamics of Communication in the Business world.
- Help to familiarize and practice the different kinds of communication tools.
- Give practice in the nuances of spoken communication.
- Expose to the different forms of Business communication.


Technology and Communication: Practice in telephone etiquette – Limitations & possibilities of E mail - Use of Power point- Role of mass media in business communication.

REFERENCES:

Course Outcome:
Students will be able to
- Communicate in the business world using different communication tools
**SEMESTER IV**

**CA720 MACHINE LEARNING AND DEEP LEARNING**

**Prerequisite:** CA713

**Objective(s):**

To introduce the advanced techniques of machine learning and deep learning


Deep Learning: Introduction, Deep Feedforward Networks, Architecture Design; Convolutional Networks – Introduction, Convolution (1D and 2D), Pooling, Training of network, Case study of CNN (Healthcare, Agriculture, Stock Market, Weather Forecasting, etc.).

Sequence Modeling: Recurrent Neural Network (RNN) Model, Types of RNNs, Vanishing Gradients with RNN, Gated Recurrent Unit, Long Short-Term Memory (LSTM), Deep Recurrent Neural Networks, RNN for Time Series, Transformer Network Models. Case studies on recent real-world problems.

**REFERENCES:**

Course Outcomes:
Students will be able to
• Explain the different Machine Learning Techniques and its Applications
• Design Deep learning models for different use cases.

CA722 WEB TECHNOLOGIES AND ITS APPLICATIONS

Pre-requisite: CA716

Objectives:
• To learn about essential of web-based application development
• To develop websites using markup languages, style sheets and multimedia tools
• To know about client-server application technologies and development
• To develop rich internet and web applications


Client side programming – Java script language – java script objects – Browsers and the DOM - native objects and host objects: wrappers and parsers – Java script frameworks.


REFERENCES:
Course Outcomes:
Students will be able to
• Develop client-server side applications.
• Design and develop enterprise applications.
• Develop rich internet applications using AJAX, jQuery, Web-sockets

CA 724 PARALLEL AND DISTRIBUTED COMPUTING

Pre-requisite: CA710

Objective(s):
To introduce parallel and distributed concepts and programming


Recent Advancements: Micro-services and Applications - Load balancing and caching - Containers - Distributed databases- Scientific computing – Case Study: PARAM 10000.

REFERENCES:
Course Outcomes:
Students will be able to
• Develop parallel programming skills
• Understand distributed concepts and develop distributed programs

Elective - II
To be chosen from CA7A group

Elective – III
To be chosen from CA7B group

CA706 Machine Learning and Deep Learning Lab
Exercises to implement and apply Machine Learning and Deep Learning algorithms for problem solving.

CA749 Project Work Phase 1
Case Study/ Mini Project using the concepts and techniques covered in the syllabus.
Semester V

CA731 INFORMATION SECURITY

Pre-requisite: CA 713, CA 718

Objectives:
- To introduce the basic concepts of Information Security and Cryptography
- To explain Access control and Authentication Mechanisms
- To know about the principles of Network and Operating System security

History of information systems and its importance, changing nature of information systems, need of distributed information systems, critical characteristics and components of information system, digital assets, security controls, security threats and attacks - ransomware, advanced persistent threats (APTs), distributed denial of service attacks (DDoS), insider threats; threat agents, principles of information security.

Cryptography basics, symmetric key cryptography, public key cryptography, cryptanalysis, hash functions, authentication applications, digital certificates and public key infrastructure (PKI), key distribution, information hiding: digital watermarking and steganography.

Security principles, authentication vs authorization, authentication methods, authentication protocols, authorization mechanisms: access control policies, access control matrix; CAPTCHA, firewall, intrusion detection and prevention system (IDPS), unified threat modeling (UTM).

Network security basics, network security principles, demilitarized zone (DMZ), proxy services, the Cyber kill chain, software vulnerabilities, software supply chain vulnerabilities, vulnerability assessment and penetration testing (VAPT), wireless security, virtual LAN, virtual private networks (VPN), domain name system (DNS) protection.

Software security, software reverse engineering (SRE), digital rights management (DRM), reproducible builds, data security, data loss prevention (DLP), database security, operating system security: trusted operating system, next generation secure computing base (NGSCB); application security: email Security (PGP, S/MIME); web application security (OWASP), cloud security, Internet of things (IoT) security.

REFERENCES

Course Outcomes:
Students will be able to
- Explain the concepts of Cryptography and Access control mechanisms.
- Brief about the Networking protocols and Software Security essentials.

---

**CA 733 CLOUD COMPUTING**

**Objectives:**
- To understand Cloud Computing concepts, technologies, architecture, and applications
- To understand different cloud programming platforms and tools to develop and deploy applications on cloud


Introduction to virtualization - Different Approaches to Virtualization - Server, Storage, Network Virtualization - Virtual Machine Provisioning and Manageability - VM Placement- VM Migration - Hypervisors - Case studies: VMware, KVM, Xen - Containers

Service Science - Service oriented Architecture - Web Services: SOAP, WSDL, UDDI - Web Services Discovery and Composition - REST based Web Services

Cloud Computing Architecture - Cloud Computing Service Delivery Models: Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Software as a Service(SaaS) Deployment Models: Public cloud, Private cloud, Hybrid cloud - Data Center Design and Management - Case Studies: Amazon AWS, Microsoft Azure, Amazon EC2, Google Cloud

REFERENCES:

Course Outcomes:
Students will be able to
- Acquire Knowledge on the concepts and technologies of Cloud Computing.
- Define the principles of virtualization
- Identify the Service Oriented Architecture for Distributed Computing workflow.
- Use various performance criteria to evaluate the quality of the cloud architecture

CA735 ORGANIZATIONAL BEHAVIOR

Objective(s):
To learn the leadership skills and group behavior.


Conflicts - Individual conflict, Interpersonal conflict, Inter-group conflict– Conflict Resolution - Negotiation

Foundations of Organization Structure - Organizational Culture – Organizational Dynamics

REFERENCES:

Course Outcome:
Students will be able to
• Practice ethical behavior and community responsibilities in organizations and society.

Industrial Component:
A series of tutorials on Organization development

Elective – IV
To be chosen from CA7C group

Elective – V
To be chosen from CA7D group

CA708 Information Security Lab
Exercises from information security related programming using Tools.

Course Outcomes:
Students will be able to:
• Implement Cryptography techniques to data
• Simulate the various network security issues
• Experiment with application security
• Explore the nature and logic behind the various security threats on the web.

CA709 Cloud Computing Lab
Pre-requisite: CA 731

Exercises:
Problems to
• Deploy different types of virtualizations, Host and bare metal hypervisors and implement horizontal scalability.
• Create and access VM instances and demonstrate various components
• Implement Infrastructure as a Service
• Simulate identity management in your private cloud
• Deploy web applications on cloud
Course Outcomes:
Students will be able to:
  • Acquire Knowledge on the concepts and technologies of Cloud Computing.
  • Develop cloud-based applications and evaluate the quality of the cloud architecture

Semester VI

CA750 Project Work
MCA Course – Electives

CA7A1 DATA SCIENCE

Objectives:
- To know the fundamental concepts of data science and analytics.
- To learn fundamental data analysis using R.
- To understand various data modeling techniques.
- To learn the basic and advanced features of open source big data tools and frameworks.
- To study various analytics on stream data.


REFERENCES:

Course Outcomes:
Students will be able to:
• Convert real world problems to hypothesis and perform statistical testing
• Perform data analysis using R.
• Work with big data platform and its analysis techniques.
• Identify and design efficient modeling of very large data.
• Implement suitable data analysis for stream data.
• Write efficient MapReduce programs for small problem-solving methods.

CA7A2 SOCIAL NETWORK ANALYSIS

Prerequisite: CA713

Objectives:
• To introduce the concepts and methods of Social Network Analysis
• To apply various tools for Social Network Analysis

Social network concepts – Development of social network and analysis - Online social networks–Social Network Data - Issues and challenges.

Linked-based and structural analysis - Content-based analysis - Static and dynamic analysis Mathematical Representation of social networks.

Social networking systems and API - Statistical Analysis of Social Networks- Community Detection in Social Networks - Node Classification in Social Networks -Evolution in Dynamic Social Networks.

Social Influence Analysis -Link Prediction in Social Networks -Data Mining in Social Media Text Mining in Social Networks - Social Tagging -Building social services.

Tools for Social network analysis: UCINET – PAJEK– NETDRAW – StOCNET - SPlus - R – NodeXL- SIENA and RSIENA - Real-world networks (Facebook graph, Twitter networks, etc.)

REFERENCES:
1. Xiaoming Fu, Jar-Der Luo, Margarete Boos, Social Network Analysis Interdisciplinary Approaches and Case Studies, Taylor and Francis,2017
2. Tanmoy Chakraborty, Social Network Analysis, Wiley, 2021


**Course Outcomes:**

Students will be able to:

- Describe the issues and challenges in social network functions
- Mathematically represent social networks for analysis
- Use various tools for social network analysis
- Concepts and methods of social network analysis.

---

**CA7A3 ADVANCED DATABASE TECHNOLOGY**

**Prerequisite:** CA712

**Objectives:**

- To learn different types of databases
- To study various indexing techniques
- To study query languages

Parallel and Distributed Databases: Architectures for Parallel Databases - Parallel Query Evaluation - Parallelizing Individual Operations - Parallel Query Optimization - Distributed DBMS Architectures – Storing data - Distributed Catalog Management - Distributed Query Processing - Updating Distributed Data - Distributed Transactions - Distributed Concurrency Control - Distributed Recovery.


REFERENCES:

Course Outcomes:
Students will be able to:
- Design various databases
- Apply indexing techniques
- Use query languages

CA7A4 BIO-INFORMATICS

Objective(s):
To understand Genomic data acquisition and analysis, comparative and predictive analysis of DNA and protein sequence, Phylogenetic inference etc.

Introduction to bioinformatics, classification of biological databases, Biological data formats, application of bioinformatics in various fields. Introduction to single letter code of amino acids, symbols used in nucleotides, data retrieval – Entrez and SRS.

Introduction to sequence alignment, substitution matrices, scoring matrices – PAM and BLOSUM. Local and Global alignment concepts, dot plot, dynamic programming methodology, Multiple sequence alignment – Progressive alignment. Database searches for homologous sequences – FASTA AND BLAST versions.

Evolutionary analysis: distances - clustering methods – rooted and unrooted tree representation – Bootstrapping strategies.

Fragment assembly-Genome sequence assembly - Gene finding method, Gene prediction - Analysis and prediction of regulatory regions.


REFERENCES:

Course Outcomes:
Students will be able to:
- Describe user-oriented aspects of product design
- Analyze the screen designing principles
- Apply HCI principles in product designs

CA7A5- RESOURCE MANAGEMENT TECHNIQUES

Objective(s):
To learn different resource management techniques


Queuing theory - notation and assumptions – characteristics of queue – Poisson input process – exponential service times – Queuing models – M/M/1 – M/M/C – M/M/1/N – M/M/C/N

REFERENCES:

Course Outcomes:
Students will be able to:
- Formulate and solve LP/NLP/DP Problems
- Identify appropriate model for given inventory problems and solve the problems
- Solve queuing problems using queuing models
CA7A6 IMAGE PROCESSING

Objectives:

- To become familiar with digital image fundamentals
- To get exposed to simple image enhancement techniques in Spatial and Frequency domain.
- To learn concepts of degradation function and restoration techniques
- To study the image segmentation and representation techniques
- To become familiar with image compression and recognition methods


Image Enhancement in the Spatial and Frequency Domain Filtering: Basic Intensity Transformation Functions, Histogram Processing, Basics of spatial filtering, Smoothing and Sharpening Spatial filters, the basics of filtering in the Frequency Domain, Image smoothing and sharpening using Frequency Domain Filters- Ideal, Butterworth and Gaussian Filters, Homomorphic filtering, Color image enhancement.


Image Compression: Fundamentals, Types of redundancies, Lossy and Lossless compression, Entropy of an information source, Shannon Fano Coding, Huffman Coding, Golomb Coding, Arithmetic Coding, LZW coding, Run length coding.

Morphological Image Processing: Basics, Erosion and Dilation, Opening and Closing, The Hit-or-Miss Transform, Morphological Algorithms-Boundary extraction, Hole filling, convex hull, thinning, skeletons.


REFERENCES:

Course Outcomes:
Students will be able to:
- Know and understand the basics and fundamentals of digital image processing, such as digitization, sampling, quantization, and 2D-transforms.
- Operate on images using the techniques of smoothing, sharpening and enhancement.
- Understand the restoration concepts and filtering techniques.
- Learn the basics of segmentation, features extraction, compression and recognition methods for color models.

CA7B1 SOFTWARE ARCHITECTURE AND PROJECT MANAGEMENT

Objective(s):
To know the issues related to the design of complex software and to learn the project management concepts and the use of tools.


Design Patterns - Evolution patterns - Software artifact evolution processes - Case studies - Java Beans.


REFERENCES:
Course Outcomes:
Students will be able to:
• Explain various design and evaluation methods
• Employ design patterns in the software architecture
• Apply various phases of life cycle models
• List various process models and describe issues related with quality assurance
• Apply engineering activities involved in various project management phases

Industrial Component
Presentation of Case studies on the design & development of complex software and current practices of successful project management activities by professionals from leading industries

CA7B2 SERVICE ORIENTED ARCHITECTURE

Prerequisites: CA716

Objectives:
• To understand the basic principles of service orientation
• To learn concepts such as web services, WS* specification standards, service composition, orchestration, and choreography
• To develop and deploy Web Services
• To understand and apply the principles of Micro services


SOA Platforms: Design and implementation of Inter-Enterprise applications using services and micro services - SOA support in J2EE – Java API for XML- based web services (JAX-WS) - Java architecture for XML binding (JAXB) – Java API for XML Registries (JAXR) - Java API for XML based RPC (JAX-RPC)- SOA support in .NET-Web services and micro services in .NET - Software stacks-Cloud Platforms.

REFERENCES:

Course Outcomes:
Students will be able to:
- Explain the principles of service-oriented architecture.
- Use the concepts of SOA in developing Web Services based applications.
- Develop enterprise applications using Web Services.
- Understand the Microservices architectures and apply in application development.
CA7B3  AGILE TECHNOLOGY

**Prerequisite:** CA725

**Objectives:**

- To provide students with a theoretical as well as practical understanding of agile software development practices and how small teams can apply them to create high-quality software.
- To provide a good understanding of software design and a set of software technologies and APIs.
- To do a detailed examination and demonstration of Agile development and testing techniques.
- To understand the benefits and pitfalls of working in an Agile team.
- To understand Agile development and testing.


**REFERENCES:**

Course outcomes:  
Students will be able to:  
• Realize the importance of interacting with business stakeholders in determining the requirements for a software system  
• Perform iterative software development processes: how to plan them, how to execute them.  
• Point out the impact of social aspects on software development success.  
• Develop techniques and tools for improving team collaboration and software quality.  
• Perform Software process improvement as an ongoing task for development teams.  
• Show how agile approaches can be scaled up to the enterprise level.

CA7B4 MARKETING MANAGEMENT

Prerequisites: CA727, CA722

Objective(s):

To facilitate understanding of the conceptual framework of marketing and its applications in decision making under various environmental constraints.

Introduction to marketing, scope of marketing, core marketing concepts, new marketing realities, production concept, product concept, selling concept, marketing concept, Relationship Marketing, Integrated Marketing, Performance Marketing, new 4P’s.

Buying Behaviour: key psychological process, buying decision process, stages in buying process.  


Promotion: Communication Process; Promotion mix – advertising, personal selling, sales promotion, publicity and public relations, direct marketing; Determining advertising budget; Copy designing and testing; Media selection; Advertising effectiveness; Sales promotion – tools and techniques.

Market control: Annual plan control, sales analysis market share analysis, profitability control, marketing profitability analysis, efficiency control and strategic control. Trends in marketing, socially responsible marketing, internal marketing, green marketing, cause marketing, cause related marketing.
REFERENCES:

Course Outcomes:
Students will be able to:
• Define the fundamentals of marketing
• List the issues related to buying and target marketing
• Apply the new product development strategies
• Use product promotional techniques
• Familiar with trends in analysis & control in marketing

CA7C1 SOFT COMPUTING

Prerequisites: CA713, CA717

Objective(s):
• To introduce the techniques of soft computing
• To explain the hybridization of soft computing systems which differ from conventional AI and computing in terms of its tolerance to imprecision and uncertainty.


REFERENCES:

Course Outcome:
Students will be able to:
- Explain the basics of soft computing and their suitable industry related applications
- Apply neural network principles and algorithms for given problems
- Apply the principles of fuzzy algorithms for real time applications

Industrial Component:
A series of tutorials on MATLAB.

CA7C2 EVOLUTIONARY COMPUTING

Objective(s):
To introduce evolutionary Computation and global optimization techniques

Evolutionary computing: Biological foundation of Evolutionary computing, introduces evolutionary algorithms, a class of stochastic, population-based algorithms inspired by natural evolution theory, capable of solving complex problems for which other techniques fail.


Swarm Intelligence (SI): Biological foundation of SI, SI Techniques: Ant Colony Optimization (ACO) and Particle Swarm optimization (PSO). General steps in ACO, the "Invisible Manager"
(Stigmergy), the Pheromone, Ant Colonies and Optimization, Ant Colonies and Clustering, Applications of Ant Colony Optimization. Applications of ACO.

PSO: Social Network Structure: The Neighborhood Principle, PSO Algorithm, Fitness Calculation, Convergence, PSO System Parameters, Particle Swarm Optimization versus Evolutionary Computing and Applications of PSO.

Mimetic algorithm, Firefly Algorithm, multi objective algorithms.

REFERENCES:
1. A.E. Eiben, J.E. Smith, Introduction to Evolutionary Computing (Natural Computing Series) Springer, 2016,

Course Outcomes:
Students will be able to:
- Describe the Evolutionary algorithms and solve complex problem using evolutionary algorithms.
- Identify the issues in design and implementation of genetic algorithm.
- Explain the concepts of Swarm Intelligence techniques.
- Describe the social network structure.

CA7C3 MODELING AND COMPUTER SIMULATION

Prerequisites: CA713

Objectives:
- To understand the techniques of random number generations and testing randomness.
- To design simulation models for various case studies like inventory, traffic flow networks, etc.
- To practice on simulation tools and impart knowledge on building simulation systems.

Simulation and Simulation Software - Systems – Models – Types, Components, Steps in Modeling – Simulation of statistical queuing, manufacturing and material handling.


REFERENCES:

Course Outcomes:
Students will be able to:
• Practice simulation tools and build simulation systems
• Assess the techniques of random number generations and testing its randomness
• Design various simulation models for real time situation.

CA7C4 NATURAL LANGUAGE PROCESSING

Objectives:
• To introduce the basic NLP tasks
• To comprehend the statistical and machine learning models for text processing


Language model- n-gram language models- Hidden Markov Model– Conditional random Fields- Topic models - Graph Models for Text.

Applications and Case Studies- Question Answering, Machine Translation, Information retrieval - Information Extraction

**REFERENCES:**


**Course Outcomes:**

Students will be able to:

- Identify the patterns in text and pre-process the large text corpus
- Describe and work with basic NLP tasks
- Use statistical and machine learning models for text
- Adopt embeddings and Deep learning models for NLP
- Apply the NLP concepts for solving Applications

---

**CA7C5 DEVOPS**

Prerequisite: CA719, CA733

**Objectives**

- To provide in-depth knowledge on various DevOps tools including Git, Jenkins, Docker, Ansible
- To acquire knowledge on best practices in Continuous Development, Configuration Management and Continuous Integration, and finally, Continuous Monitoring of software throughout its development life cycle.


Jenkins - Continuous Integration with Jenkins - Configure Jenkins - Jenkins Management- Scheduling build Jobs - POLL SCM - Maven Build Scripts - Support for the GIT version control System - Types of Jenkins Jobs - Jenkins Build Pipe Line - Parent and Child Builds - Sequential Builds - Jenkins Master & Slave Node Configuration - Jenkins Workspace Management -


REFERENCES
1. Emily Freeman, DevOps For Dummies, First Edition, John Wiley & Sons, 2019

Course outcome
Students will be able to
Apply various DevOps tools including Git, Jenkins, Docker, Ansible during problem solving.
CA7C6 MOBILE COMPUTING

Objectives:
• To understand the fundamentals of mobile communication
• To understand the architecture of various Wireless Communication Networks
• To understand the significance of different layers in mobile system


WAP Model - Mobile Location based services - WAP Gateway - WAP protocols - WAP user agent profile caching model - wireless bearers for WAP - WML - WML Scripts – WTA – iMode – SyncML

REFERENCES

Course Outcomes
Students will be able to:
• Develop a strong grounding in the fundamentals of mobile Networks
• Apply knowledge in MAC, Network, and Transport Layer protocols of Wireless Network
• Comprehend, design, and develop a lightweight network stack
CA7C7 BLOCK CHAIN TECHNOLOGY

Objectives:
- To decompose a blockchain system’s fundamental components, how they fit together and examine a decentralization using blockchain.
- To explain how Cryptocurrency works, from when a transaction is created to when it is considered part of the blockchain.
- To explain the components of Ethereum and programming languages for Ethereum.
- To study the basics Hyperledger and Web3.
- To provide details of alternative blockchain and blockchain projects in different perspective.


REFERENCES:

Course Outcomes:
Students will be able to:
- Understand the technology components of Blockchain and how it works behind – the scenes.
- Be aware of different approaches to developing decentralized applications.
- Understand the Bitcoin and its limitations by comparing with other alternative coins.
• Establish deep understanding of the Ethereum model, its consensus model and code execution.
• Understand the architectural components of a Hyperledger and its development framework.
• Aware of the Alternative blockchains and emerging trends in blockchain.

---

**CA7C8 BUSINESS ETHICS**

**Prerequisite:** CA722

**Objective(s):**

To introduce business ethics and its practices


Environmental Pollution and Society - Marketing Ethics (in Products, Pricing, Promotion and Place) and Consumer protection – Ethics in Human Resources management (Recruitment and promotion policies, Working Conditions, Down Sizing Workforce), Ethical issues at the top management, Ethics in financial markets and investor protection – Ethical responsibility towards competitors and business partners.

A Historical Perspective from Industrial Revolution to Social Activism – Current CSR practices of the firms in India and abroad. Conflicts in decision making from ethical and economic point of view - Ethical Dilemma - Solving ethical dilemma -Managerial integrity and decision making.


**REFERENCES:**


**Course Outcomes:**

Students will be able to:

• Define the principles of ethics and morals of business
• Convey ethical response with respect to Competitors & Business Partners
• Enhance the leadership skills with respect to decision making & business management
CA7D1 BIG DATA MANAGEMENT

Objectives:
- To explore the fundamental concepts of big data analytics.
- To learn to analyze the big data using intelligent techniques.
- To design a complete data analytics solution using big data frameworks.


Next Generation Databases: CAP Theorem – SQL vs. NOSQL vs NewSQL - Mongo DB – Cassandra -Neo4J.


REFERENCES:

Course Outcomes:
Students will be able to:
- Understand the fundamentals of various big data analytics techniques.
- Design efficient algorithms for mining the data from large volumes.
- Analyze the HADOOP and Map Reduce technologies associated with big data analytics.
- Build a complete business data analytics solution.
CA7D2 GREEN COMPUTING

Objective(s):
To introduce Green Computing in the ICT environments

Importance of Green IT, The Growing Significance of Green IT and Green Data Centers, All Basic steps towards Green IT, The Basics of Green IT.

Collaboration is Key for Green IT, The Government’s Role, Regulation and EPA Activity, Regulating Greenhouse Gases, Role of EPA, IT Company support of Government Regulation, Educational Institutions and Government Regulation.


REFERENCES:

Course Outcomes:
Students will be able to:
• Deduce the need and basics of Green IT.
• Compare the collaborative effort of various agencies for the effectiveness of the Green IT.
• State the need for virtualization and its impact.
• List and categorize various IT energy-use metrics.
• Use Green IT in various areas and the future needs and trends.
CA7D3 INTERNET OF THINGS

Objectives:
• To understand the fundamentals of Internet of Things
• To learn about the basics of IOT protocols
• To build a small low-cost embedded system using Raspberry Pi.
• To apply the concept of Internet of Things in the real-world scenario


REFERENCES:

Course Outcomes:
Students will be able to:
• Analyze various protocols for IoT
• Develop web services to access/control IoT devices.
• Design a portable IoT using Raspberry Pi
• Deploy an IoT application and connect to the cloud.
• Analyze applications of IoT in real time scenario
CA7D4 HUMAN COMPUTER INTERACTION

Prerequisites: CA725

Objectives:
- To learn the fundamentals and components of HCI
- To understand the user centric parameters associated with HCI
- To know about various computational models and Formal models of HCI
- To understand the design requirements of various assistive technologies


REFERENCES:

Course Outcome:
Students will be able to:
• To understand HCI principles and apply them in product designs.
• To develop user-centric applications.

Industrial Component:
Providing exposure to HCI based software development products.

CA7D5 MULTI-CORE PROGRAMMING

Prerequisites: CA715

Objective(s):
To learn different multi-core programming techniques.

Multi-core – Definition and hybrid architectures – The software developer’s viewpoint – the bus connection – from single core to multi-core – Four effective multi-core designs.

Challenges of multi-core programming – Sequential model – definition – Concurrency – Definition – challenges pertaining to software development – Processor architecture challenges – Operating system’s role.


Communication and synchronization – synchronizing concurrency – Thread strategy approaches – Decomposition and encapsulation of work- Approaches to application design – PADL and PBS.

UML and concurrent behavior – Basic testing types – Defect removal for parallel programs – Standard software engineering tests.
REFERENCES:

Course Outcomes:
Students will be able to:
- List the features of multi core systems and assess the challenges of multi core programming
- Apply process techniques
- Identify the approaches to application design
- Describe the communication and fine issues

CA7D6 MEAN Stack Web Development

Prerequisites: CA735

Objectives:
- To understand the features of MEAN (Mongo, Express, AngularJS, and Node.js) set of technologies.
- To develop robust, fast and maintainable web and mobile applications.

Modern Web Architecture - Static App - Thick Client - Angular. Js, Node.Js- Express- MongoDB-
Social Networking Project - Creating A Static Mockup of The Recent Posts Page - Angularizing
The Page - Adding New Posts.

Building A Node.Js API - The Stock Endpoint - Creating Posts Via The API - MongoDB Models
With Mongoose - Using Mongoose Models With The Post Endpoint - Integrating Node With
Angular - $Http - Reading Posts From The Api With $Http - Serving Posts.Html Through Node
- Saving Posts To The API With $Http - Fixing The Post Ordering - Cleaning Up Server.Js -
Cleaning Up Angular.

Grunt and Gulp - Gulp Hello World - Building JavaScript With Gulp – Building CSS With Gulp -
Gulp Dev Task - Other Gulp Plug-Ins - Building Authentication in Node.Js - Introducing Token
Authentication – JSON-Web Token (Jwt) - Using BCrypt – Authentication With MongoDB.

Adding Routing and Client Authentication - Web Sockets - Pushing Notifications With
WebSocket – Web Sockets In Angular.Js – Architecture Testing - Protractor - Mocha For Node

REFERENCES:

Course Outcome:
Students will be able to:
Understand the principles of MEAN Stack Web development and practice them in product design and development.

Industrial Component:
Providing exposure to MEAN Stack based web development products

CA7D7 COMPUTER VISION

Prerequisite: CA713

Objectives:
To understand the fundamental concepts related to image processing, feature extraction, pattern analysis etc.
To apply the concepts to solve computer vision problems of different fields.


Edges - Canny, LOG, DOG; Line detectors (Hough Transform), Corners - Harris and Hessian Affine, Orientation Histogram, SIFT, SURF, HOG, GLOH.

Image Segmentation: Graph-Cut, Mean-Shift, Texture Segmentation; Object detection: traditional methods-deep learning methods.

Motion analysis: Background Subtraction and Modeling, Optical Flow, KLT, Spatio-Temporal Analysis, Dynamic Stereo; Motion parameter estimation.
Object tracking, Mean shift tacking, Object categorization, content based image retrieval, action recognition.

REFERENCES:

Course Outcome:
Students will be able to:
- Apply fundamental algorithms in Image Processing and analyse their applicability for real time problems.

CA7D8 BUSINESS INTELLIGENCE

Prerequisite: CA707

Objectives:
- To Know the process of Decision making and Evolution of BI from Decision Support System
- Be exposed with the basic rudiments of business intelligence system
- To understand the modeling aspects behind Business Intelligence
- To understand the business intelligence life cycle and the techniques used in it


Knowledge Delivery: Business intelligence user types, Standard reports, Interactive Analysis and Ad Hoc Querying, Parameterized Reports and Self-Service Reporting, dimensional analysis, Alerts/Notifications, Visualization: Charts, Graphs, Widgets, Scorecards and Dashboards, Geographic Visualization, Integrated Analytics, Considerations: Optimizing the Presentation for the Right Message.
Data Visualization and Dashboard Design: Importance of data visualization and different types of data that can be visually represented - characteristics of a dashboard, the types of dashboards, and the list attributes of metrics usually included in dashboards - guidelines for designing dashboard and the common pitfalls of dashboard design.


REFERENCES:

Course Outcome:
Students will be able to:
• Understand the concepts and techniques of business intelligence.
• Link data mining with business intelligence.
• Apply various modelling techniques.
• Understand data analysis and knowledge delivery stages.
• Apply business intelligence methods to various situations.