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

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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
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  10. Dr. K. Selvakumar
  11. Dr. Ghanshyam S. Bopche
  12. Dr. Jitendra Kumar
  13. Dr. B. Balaji

MCA - Syllabus – Core Subjects

Semester	Subject Code	Subject Name	L	T	P	C
I	CA711	Problem Solving and Programming	3	0	0	3
	CA713	Mathematical Foundations of Computer Applications	3	0	0	3
	CA715	Digital Logic and Computer Organization	3	0	0	3
	CA717	Data Structures and Applications	3	0	0	3
	CA719	Operating Systems	3	0	2	4
	CA701	Problem Solving Lab using Python	0	0	4	2
	CA703	Data Structures Lab using C	0	0	4	2
II	CA710	Design and Analysis of Algorithms	3	0	0	3
	CA712	Database Management Systems	3	0	0	3
	CA714	Probability and Statistical Methods	3	0	2	4
	CA716	Object Oriented Programming	3	0	0	3
	CA718	Computer Networks	3	0	0	3
	CA702	DBMS Lab	0	0	4	2
	CA704	Computer Networks Lab	0	0	4	2
III	CA721	Data Mining and Warehousing	3	0	0	3
	CA723	Computational Intelligence	3	0	0	3
	CA725	Software Engineering	3	0	2	4
	CA727	Accounting and Financial Management	3	0	0	3
	CA7A_	Elective-I	3	0	0	3
	CA705	Data Mining Lab	0	0	4	2
	CA707	Business Communication	0	0	4	2
IV	CA720	Machine Learning and Deep Learning	3	0	0	3
	CA722	Web Technology and Its Applications	3	0	2	4
	CA724	Parallel and Distributed Computing	3	0	0	3
	CA7A_	Elective-II	3	0	0	3
	CA7B_	Elective-III	3	0	0	3
	CA706	Machine Learning and Deep Learning Lab	0	0	4	2
	CA749	Project Work - Phase I	0	0	4	2
V	CA731	Information Security	3	0	0	3
	CA733	Cloud Computing	3	0	0	3
	CA735	Organizational Behaviour	3	0	0	3
	CA7C_	Elective-IV	3	0	0	3
	CA7D_	Elective-V	3	0	0	3
	CA708	Information Security Lab	0	0	4	2
	CA709	Cloud Computing Lab	0	0	4	2
VI	CA750	Project Work				10

Total Credits – **109**

L: LECTURE | T: TUTORIAL | P: PRACTICAL | C: CREDITS

List of Electives

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

L: LECTURE | T: TUTORIAL | P: PRACTICAL | C: CREDITS

Semester-I

CA711 PROBLEM SOLVING AND PROGRAMMING

Objective(s):

To learn problem solving methodologies and aspects of Python programming.

Programming paradigms- Program Development Cycle- Evolution of Programming languages - Computational Problem Solving - Principles of Structured programming: Sequential, selective and repetitive structures- Modular Programming: Functions and Procedures-Algorithms.

Introduction to Python Programming: Python interpreter- Garbage collection- Python working Environment-Mutable and Immutable objects- Variables- Dynamic typing- expressions- Operators: precedence and Associativity- comments- Conditionals: conditional - alternative - chained conditional - Short Circuits; Iteration: while- for-range- break- continue- pass; Strings: string slices- immutability- string methods- Regular Expression: Patterns- Matching- Search and replace.

Lists: Traversing a List- list operations- list slices- list methods- list loop- mutability- aliasing-cloning lists- list parameters; Tuples: tuple assignment- tuple as return value. Dictionary: operations and methods- Tuples as key; Set: Creation- Methods. Comprehension: List comprehension and Dictionary comprehensions; Map- Filter and Reduce.

Functions: Definitions- parameters and arguments: Keyword arguments- Positional arguments- Parameter unpacking- Scope: Local, Global and Enclosed. Recursion- Lambda functions- Higher order Functions; Object orientation in Python: Classes- Objects.

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:

1. John V. Guttag, Introduction to Computation and Programming Using Python: with Application to Computational Modelling and Understanding Data- Third Edition- MIT press- 2021.
2. Paul J. Deitel- Harvey Deitel- Python for Programmers- First Edition- Pearson- 2020.
3. Martin C. Brown- Python: The Complete Reference-Fourth Edition-Mc-Graw Hill- 2018.
4. Robert Sedgewick- Kevin Wayne- Robert Dondero- —Introduction to Programming in Python: An Inter-disciplinary Approach- First Edition-Pearson India- 2016.
5. Allen B. Downey- Think Python: How to Think like a Computer Scientist- 2nd edition- Updated for Python 3- O‘Reilly- 2015.

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

Set Theory - Basic concepts –Algebra of sets – The power sets –Cartesian products – Relation and its types – Properties – Relational Matrix and the graph of relation – Partitions –Equivalence relations – Poset – Hasse diagram – Lattices and their properties – Sublattice – Boolean Algebra - Algebraic manipulation of Boolean expressions - Simplification of Boolean expressions - Karnaugh maps - Logic gates - Digital circuits and Boolean algebra.

Functions - Definitions of functions and its Classification – Types – Examples – Composition of functions – Inverse functions – Binary and n-ary operations – Characteristic function of a set – Hashing functions – Recursive functions – Permutation functions – Fuzzy set – fuzzy set operations - membership function - Triangular, Trapezoidal, Gaussian.

Logic Propositions – Logical Connectives - Compound statements – Conditional and Biconditional Propositions – Truth tables – Tautologies and Contradictions – Logical equivalence and implications – Demorgan's Law – Normal forms – PDNF and PCNF – Predicate Calculus – Free and bound variables – Quantifiers – Universe of discourse – Theory of inference – Rules of universal specification and generalization – Arguments – Validity of Arguments. Fuzzy Logic - Linguistic Truth Table - Approximate and Plausible Reasoning.

Graph Theory - Graphs - Basic concepts - Isomorphism – complements - Matrix representation of graphs - Trees, Spanning trees, Minimal Spanning tree Algorithms - Euler graphs - Hamiltonian graphs.

Finite State Automata - Finite Automata – Context-Free Grammars – Chomsky‟s Normal form - Griebach Normal Form - Push-down Automata - Equivalence of CFL‟s and PDA‟s - Non-context free languages.

REFERENCES:

1. Trembley J.P and Manohar.R, "Discrete Mathematical Structures with Applications to Computer Science", First Edition, Tata McGraw-Hill Pub. Co. Ltd, New Delhi, 2017.
2. Ralph. P.Grimmaldi, "Discrete and Combinatorial Mathematics An applied Introduction", Fourth Edition, Pearson Education, Asia, Delhi, 2002.
3. Hopgaff and Ullman, "Introduction to Automata Theory, Languages and Computation", Third Edition, Pearson Education, 2008, Asia, Delhi.
4. Doerr Alan and Levasseur Kenneth, "Applied Discrete Structures for Computer Sciences", Galgotia Publications Pvt. Ltd., 2002.
5. George J Klir and Bo Yuan, "Fuzzy Sets and Fuzzy Logic: Theory and Applications", First Edition, Pearson India, 2015.

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

Number Systems - Binary Arithmetic - Boolean algebra - Map Simplifications - Gates - Combinational Circuits - Sequential Circuits - Different Computer & Structure – Functional Units – Basic Operational Concepts - Memory: Internal - External - Speed Size and Cost - Memory Organization - Memory Management Requirements - Associative - Cache – Virtual memory - Performance Considerations.

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.

External Devices: I/O modules - Programmed I/O – Interrupts - Interrupt Driven I/O - Direct Memory Access – Buses - Interface Circuits - I/O Channels - Asynchronous Data Transfer.

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

1. M. Morris Mano, Michael D. Ciletti, "Digital Design", 6th Edition, Pearson Education, 2018.
2. William Stallings, "Computer Organization and Architecture", 11th Edition, PHI, 2019.
3. Hennessy J. and Patterson D., "Computer Architecture: A Quantitative Approach", 6th Edition, Morgan Kaufmann, 2019.
4. John P. Hayes, "Computer Architecture and Organization", McGraw Hill Education; 3rd edition, 2017.

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.

Introduction – Human analogy, Informal Definition, Formal Definition, examples – Differences among ADTs, data structures and data types- classifications of data structures- primitive data types – Non-primitive data types: Arrays and Records, Applications: sorting and searching.

Linear data Structures –Linked Lists: Singly, Doubly, Circular linked lists, operations on them and applications - Stacks: operations and applications, representing Stacks - Queues: operations and applications, representing Queues, types: priority queue, Deque, IRD, ORD - Hashing.

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.

Advanced Data Structures (Part I) - Top-Down Splay Trees, Red-Black Trees - Bottom-Up Insertion, Top-Down Deletion, Treaps, Suffix Arrays and Suffix Trees - Linear-Time Construction of Suffix Arrays and Suffix Trees, Trie structures - The *k*-d Trees.

Advanced Data Structures (Part II) - B-trees: Definition, operations – Fibonacci heaps: Definition, operations - van Emde Boas Trees: Preliminary approaches, A recursive structure, The van Emde Boas tree - Data Structures for Disjoint Sets: Disjoint-set operations, Linked-list representation of disjoint sets, Disjoint-set forests.

REFERENCES:

1. T.H. Cormen, C.E. Leiserson, R.L. Rivest and C.Stein, "Introduction to Algorithms", 4th Edition, MIT Press, 2022.
2. Goodrich, Tamassia and Goldwasser, "Data Structures & Algorithms in Java", 6th Edition, Wiley, 2014.
3. D. Samanta, "Classic Data Structures", 2nd Edition, PHI, 2013.
4. M.A.Weiss, "Data Structures and Problem Solving using Java", 4th Edition, Pearson Education, 2012.

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

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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.

Processes and Threads: Process Concept, Process Scheduling, Operations on Processes, Cooperating Processes, Interprocess Communication, Communication in Client Server Systems, Multithreading Models, Thread Libraries, Threading Issues, P-threads Basic Concepts.

Process Synchronization: Synchronization Background, Critical-Section Problem, Synchronization Hardware, Semaphores, Classic Problems of Synchronization, Critical Regions, Monitors, OS Synchronization, Atomic Transactions. Deadlocks: System Model, Deadlock Characterization, Methods for Handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock.

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.

File System: File Concept, Access Methods, Directory Structure, File-System Mounting, File Sharing, Protection File-System Structure, File-System Implementation, Directory Implementation, Allocation Methods, Free-Space Management, Efficiency and Performance, Recovery, Log-Structured File System, NFS.

I/O Systems: Hardware, Application I/O Interface, Kernel I/O Subsystem, Transforming I/O to Hardware Operations, STREAMS, Performance, Disk Structure , Disk Scheduling , Disk Management, Swap-Space Management, RAID Structure , Disk Attachment, Stable-Storage Implementation, Tertiary-Storage Structure. RAID Structure.

Protection: Goals of Protection, Domain of Protection, Access Matrix, Implementation of Access Matrix, Revocation of Access Rights, Language-Based Protection, Capability-Based Systems, The Security Problem , User Authentication , Program Threats, System Threats, Securing Systems and Facilities, Intrusion Detection, Cryptography, Computer-Security Classifications. Case studies: Linux, Windows, Mac OS and Mobile OS.

REFERENCES

1. Silberschatz, Galvin and Gagne, "Operating System Concepts", 10th Edition, John Wiley & Sons Inc, 2018.
2. Sibsankar Haldar, Alex A.Aravind, "Operating systems", 2nd Edition, Pearson Education, 2014.
3. Andrew S. Tanenbaum, "Modern Operating Systems", 4th Edition, Prentice-Hall of India, 2015.
4. William Stallings, "Operating Systems –Internals and Design Principles", 9/E, Pearson Publications, 2018.

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

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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

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CA703 DATA STRUCTURES LAB USING C

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.

Algorithms – Definition and Algorithms as a technology – Design and Analysis of Insertion sort and merge sort - Recurrences and Solving recurrences - Asymptotic notations - Examples- heap sort and quick sort – Sorting in linear time - order statistics.

Divide-and-Conquer - The maximum-subarray problem, Multiplication of two large integers, Strassen's algorithm for matrix multiplication - Dynamic Programming – Elements - Matrix-chain multiplication, Longest common subsequence, Optimal binary search trees.

Greedy Algorithms – Elements - An activity-selection problem, Huffman codes and Minimum Spanning tree algorithms – Graph Algorithms - Single source shortest paths problem – All-pairs shortest paths problem – Flow Networks.

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

NP concepts – introduction - NP-hard and NP-complete problems – Definitions and Properties – Satisfiability problem - Reducibility – Cook's Theorem (without proof) - Approximation algorithms - examples.

REFERENCES:

1. T.H. Cormen, C.E. Leiserson, R.L. Rivest and C.Stein, "Introduction to Algorithms", 4th Edition, MIT Press, 2022.
2. Robert Sedgewick and Kevin Wayne, "Algorithms", 4th Edition, Addison Wesely, 2011.
3. Steve S. Skiena, "The Algorithm Design Manual", 3rd Edition, Springer, 2020.
4. George T. Heineman, Gary Pollice and Stanley Selkow, "Algorithms in a Nutshell", 2nd Edition, O'Reilley, 2016.
5. Kleinberg and Tardos, "Algorithm Design", First Edition,Pearson, 2013.
6. Udi Manber, "Introduction to Algorithms: A Creative Approach", First Edition, Addison Wesley, 1989.
7. Anany Levitin, "The Design and Analysis of Algorithms", 3rd Edition, Pearson, 2012.
8. Aditya Y. Bhargava, "Grokking Algorithms", First Edition, Manning Publications, 2016.

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.

Relational database design: Dependencies – Axioms - Normal forms – Normalization – Decomposition - Dependency preservation - Lossless design.

Query processing and optimization: Evaluation of relational algebra expressions - Query equivalence - Join strategies - Query optimization algorithms. Storage and File Structures: Indices - B + Trees - hashing.

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

REFERENCES:

1. Silberschatz, Korth and Sudarshan, “Data Base System Concepts”, McGraw-Hill, 7th Edition, 2019.
2. C. J. Date, “An Introduction to Database Systems”, 8th Edition, Addison-Wesley, 2003.
3. R. Elmasri, S.B. Navathe, “Fundamentals of Database Systems”, 7th Edition, Pearson Education/Addison Wesley, 2015.
4. Raghu Ramakrishnan and Johannes Gehrke, “Data Base Management Systems”, 4th Edition, McGraw-Hill, 2018.

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

CA 714 PROBABILITY AND STATISTICAL METHODS

Objective(s):

To introduce the fundamentals of probability and statistical methods.

Probability Spaces- Elementary Theorem – Conditional Probability – Independent events – Random variables – Probabilistic modeling

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:

1. John.E..Freund, Irwin Miller, Marylees Miller "Mathematical Statistics with Applications ", 8th Edition, Prentice Hall of India, 2012
2. Yannis viniotis, " Probability and Random Processes for electrical engineers", McGraw-Hill International Edition, 1998.
3. Ross, Sheldon. M, "Introduction to Probability and Statistics for Engineers and Scientists", 5th Edition, Academic Press, 2014.

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.

CA 716 OBJECT ORIENTED PROGRAMMING

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.

GUI Programming with Swing: Introduction, limitations of AWT, MVC architecture, components, containers. Understanding Layout Managers, Flow Layout, Border Layout, Grid Layout, Card Layout, Grid Bag Layout. Event Handling- The Delegation event model- Events, Event sources, Event Listeners, Event classes, Handling mouse and keyboard events, Adapter classes, Inner classes, Anonymous Inner classes.

A Simple Swing Application, Applets – Applets and HTML, Security Issues, Applets and Applications, passing parameters to applets. Creating a Swing Applet, Painting in Swing, A Paint example. Exploring Swing Controls- JLabel and Image Icon, JText Field, The Swing Buttons- JButton, JToggle Button, JCheck Box, JRadio Button, JTabbed Pane, JScroll Pane, JList, JCombo Box, Swing Menus, Dialogs.

REFERENCES:

1. Herbert Schildt, "Java The complete reference", 12th edition, McGraw Hill Education (India) Pvt. Ltd,2021.
2. J. Nino and F.A. Hosch, "An Introduction to programming and OO design using Java" 3rd Edition, John Wiley & sons,2008.
3. Y. Daniel Liang, "Introduction to Java programming", 11th Edition, Pearson Education, 2017.
4. P. Radha Krishna, "Object Oriented Programming through Java",First Edition, Universities Press,2007.

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.

Introduction to Computer Networks: Basics of Computer Networks - Problems associated with computer networks: Communication problems, Identification problems, and Connection problems – Network protocol basics – Service identification – MAC Address - IPv4 Addressing System, Subnetting and Super netting, IPv6 Addressing System - Network requirements: Network interface card (NIC), Media, and Networking devices – Hub, Switch, and Routers.

Network Topologies and Network Architectures: Network Topologies – Bus, Star, Ring, Mesh – Network Architectures – Client/Server Architecture, Peer-To-Peer Architecture - Open System Interconnect (OSI) Reference Model - TCP/IP Model - TCP Operation - UDP Operation – Flow Control – Congestion Control.

Local Area Networks: LAN components – Packet Switching and Forwarding – LAN Technologies - Ethernet, Token Bus, Token Ring, Wireless LAN – Multiple Access Protocols – Error-Detection and Correction Techniques.

Wide Area Networks: WAN Components – WAN Technologies - WAN Encapsulation - Routing: Static Routing and Dynamic Routing - Routed Protocols (IP and IPX) - Routing Protocols.

Protocols: Address Resolution Protocol (ARP) Protocol - Dynamic Host Configuration Protocol (DHCP)- Domain Name System (DNS) – Internet Protocol (IP) – Internet Control Message Protocol (ICMP) - Hypertext Transfer Protocol (HTTP) - File Transfer Protocol (FTP) - Simple Mail Transfer Protocol (SMTP), Remote Administration Protocols: Telnet and Secure Shell (SSH).

REFERENCES:

1. Behrouz A. Forouzan, "Data Communications and Networking", 5th Edition, McGraw-Hill, July 2017.
2. James F. Kurose and Keith W. Ross, "Computer Networking - A Top-Down Approach", 8th Edition, Pearson, 2020.
3. William Stallings, "Data and Computer Communications" 10th Edition, Pearson, 2013.
4. Andrew S. Tanenbaum, David J. Wetherall, "Computer Networks", 6th Edition, Pearson, 2020.
5. Chwan-Hwa Wu, J. David Irwin, "Introduction to Computer Networks and Cybersecurity", 1st Edition, CRC Press, 2013.

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

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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:

1. Jiawei Han & Micheline Kamber, Data Mining – Concepts and Techniques, 3rd Edition, Morgan Kaufmann Publishers, Elsevier, 2012.
2. Margaret H Dunham, Data Mining Introductory and Advanced Topics, 2nd edition, Pearson Education, New Delhi, India,2006.
3. Arun K Pujari, Data Mining Techniques, 3rd edition, Universities Press, 2013.
4. Amitesh Sinha, Data Warehousing, First Edition, Thomson Learning, India, 2007.
5. Xingdong Wu, Vipin Kumar, The Top Ten Algorithms in Data Mining, CRC Press, UK, 2009.

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

Introduction: Applications, Agents, Types pf Agents, Intelligent Agent, Agent Environment, Problem Solving by Searching Techniques, Uninformed Search, Informed Search, hill climbing, simulated annealing, genetic algorithm search, heuristic search, A* algorithm, Adversarial Search, AO* algorithm, Minimax and game trees, Alpha – Beta pruning.

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.

Evolutionary Algorithms: Genetic programming - Evolution strategies - Evolutionary neural network - Metaheuristics - Swarm Intelligence - Ant colony systems – case studies.

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

REFERENCES:

1. Eberhart and Shi, "Computational Intelligence - Concepts to Implementations", Morgan Kaufmann, 2007.
2. A.P. Engelbrecht, "Computational Intelligence: An Introduction", 2nd Edition, John Wiley & Sons, 2012.
3. H.K. Lam, S.S.H. Ling, and H.T. Nguyen, "Computational Intelligence and Its Applications: Evolutionary Computation, Fuzzy Logic, Neural Network and Support Vector Machine", Imperial College Press, 2012.
4. S. Russell and P. Norvig, Artificial Intelligence: A Modern Approach, 3rd Edition, Pearson Education, 2010.
5. Elaine Rich and Kelvin Knight, Artificial Intelligence, 3rd Edition, Tata McGraw Hill, 2017.
6. Dan W. Patterson, Introduction to Artificial Intelligence and Expert Systems, Prentice Hall of India, 2006.
7. Saroj Kaushik, Logic and Prolog Programming, 2nd Edition, New Age International Publisher, 2006.

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.

Introduction to Software Engineering, Software Life Cycle Models, Requirements Analysis and Specification: formal requirements specification and verification - axiomatic and algebraic specifications.

Software Design Issues, Function Oriented Software Design, Object Modeling using UML: use case model, class and interaction diagrams, activity and state chart Diagrams, Object Oriented Software Development: design patterns, domain modeling, User Interface Design.

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

Software Project Planning: Project planning and estimation, cost and staffing level estimation, Software Project Monitoring and Control, Software Reliability and Quality Management, Risk Management and Software Quality Assurance.

Agile Software Development - Agile Manifesto and Principles – Agile Project Management (Lean Software Management and DevOps) – Agile and Lean Frameworks: SCRUM, Crystal, Kanban, Feature Driven Development, Adaptive Software Development, and Extreme Programming: Method overview – lifecycle – roles, practices and Applicability.

REFERENCES:

1. Ian Sommerville, Software Engineering, 10th Edition, Pearson, 2017
2. Roger Pressman, Software Engineering: A Practitioner's Approach, 8th Edition, McGraw Hill, 2014.
3. Rajib Mall, Fundamentals of Software Engineering, 5th Edition, PHI Learning, 2018.
4. Craig Larman, Agile and Iterative Development: A Manager's Guide, 1st Edition, Addison-Wesley, 2003
5. David J. Anderson, Agile Management for Software Engineering: Applying the Theory of Constraints for Business Results, Prentice Hall, 2003.

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.

Assets – Liabilities – Types - Trading account – Accounting records and Systems – Limitations - Income statement – Preparation and Interpretation.

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

Ratio analysis - Use of ratios in interpreting Trading Accounts and Financial Statements, Limitations – Management Accounting.

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:

1. S.N. Maheswari and S.K. Maheswari, "An Introduction to Accountancy", 12th Edition, Vikas Publishing, 2018.
2. Manmohan and Goyal, "Principles of Management and Accounting", 5th Edition, Sahitya Bhawan, 1994.

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.

Communication in the Business World: Communication: Concepts and Goals – Theories of communication – Organizational and personal goals. Psychology of communication – Channels and Networks – Barriers to and cost of communication.

Listening and Speaking Practice: Message Planning – Purposive Listening – – Familiarizing to different accents and tones – Listening Practice - Oral Communication – Extempore speech practice – Presentation skills – Group Discussion Practice - Interview skills. Telephone strategies.

Writing practice: Business Correspondence – Different kinds of written communication in business Organizations - Marketing Language – Creativity and Appeal – Report writing practice.

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

REFERENCES:

1. Simon Sweeney, “English for Communication”, 2nd Edition, CUP, 2003.
2. Leo Jones and Richard Alexander, “New International Business English”, CUP, 2000.

Course Outcome:

Students will be able to

- Communicate in the business world using different communication tools

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SEMESTER IV

CA720 MACHINE LEARNING AND DEEP LEARNING

Prerequisite : CA713

Objective(s):

To introduce the advanced techniques of machine learning and deep learning

Introduction: Learning, Designing a Learning System, Supervised Learning, Unsupervised Learning, Reinforcement Learning, Machine Learning workflow, Machine Learning issues and challenges, Introduction to Deep Learning, Machine Learning and Deep Learning Applications.

Supervised Learning: Predictive Models: Regression, Multivariate Regression, Types of Regression Models, Estimation of Regression coefficients, issues and challenges, applications. Classification Models: Introduction, Different types of classifiers, issues and challenges of single classifiers, applications. Unsupervised Learning – Clustering, Mixture Models and EM Algorithm, Fuzzy k-Means Algorithm, applications.

Ensemble Learning: Boosting, AdaBoost Algorithm, Bagging, Random Forest, No-Free-Lunch Theorem, XGBoost Algorithm, Ensemble Diversity, Error Decomposition, Diversity Measures, Evaluating Ensembles of Classifiers.

Reinforcement Learning: Introduction to Reinforcement Learning, Learning Task, Example of Reinforcement Learning in Practice, Learning Models for Reinforcement – (Markov Decision process, Q Learning - Q Learning function, Q Learning Algorithm, SARSA algorithm), Nondeterministic Rewards and Actions, Application of Reinforcement 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:

1. Ethem Alpaydin, Introduction to Machine Learning, 4th Edition, MIT Press 2020.
2. Tom M. Mitchell, Machine Learning, 1st Edition,McGraw-Hill Education (India) Private Limited, 2017.
3. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, MIT Press 2016.
4. Stephen Marsland, Machine Learning: An Algorithmic Perspective, 2nd Edition, CRC Press, 2014.
5. Bishop, C., Pattern Recognition and Machine Learning. Berlin: Springer-Verlag, 2013.

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

Web essentials – W3C – client-server communication – markup languages – XHTML – simple XHTML pages style sheets – CSS – CSS Frameworks.

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

Separating programming and presentation - Middleware Technologies - MVC Architecture - Java servlets – basics – simple programs - cookies and sessions - data base connectivity – JDBC – XML – DTD – XML schema – DOM – SAX – XQuery – JSON – Web services.

Server side programming – ASP/JSP - JSP basics ASP/JSP objects – simple ASP/JSP pages – scripting, directive and active elements – CRUD operations – ADO.NET - Building Web applications - PHP – MYSQL – Web applications with advanced databases.

Advanced Web Technologies and Tools – AJAX – Ajax Frameworks - Jquery – Web Socket - Web 3.0 –E-Commerce applications development.

REFERENCES:

1. Jeffrey C Jackson, “Web Technology – A computer Science perspective”, 1st Edition, Pearson Education, 2012.
2. Chris Bates, “Web Programming – Building Internet Applications “, 3rd Edition, Wiley India, 2006.
3. Deitel, Deitel and Nieto, “Internet and Worldwide Web - How to Program”, 5th Edition, PHI, 2018.
4. Akshi Kumar, “Web Technology: Theory and Practice”,1st Edition, Chapman and Hall/CRC, 2018.

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

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CA 724 PARALLEL AND DISTRIBUTED COMPUTING

Pre-requisite: CA710

Objective(s):

To introduce parallel and distributed concepts and programming

Introduction to Parallel Computers: Multi-core processors – Interconnection Networks – Distributed and Shared Memory Systems – Cache Coherence – Parallel Computer Architectures – Synchronization Primitives – Performance and Scalability.

Parallel Programming: Parallel Programming Paradigm – MPI: Datatypes - SLURM Scheduler – Point to Point and Collective Communication – Routines & Errors – OpenMP: Variables – Pre-process directives – Constructs – Subroutines –API – Schedulers.

Distributed Computing: Distributed System Models – Synchronization Algorithms –Shared Memory Space - Consistency Models - Replacement Strategy - Thrashing - Replication and Fault Tolerance - Resource and Process Management.

Distributed File Systems: Introduction to DFS - File models - Accessing models - Caching Schemes – Replication - Network File System (NFS) - Andrew File System (AFS) - Hadoop Distributed File System and Map Reduce.

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

REFERENCES:

1. Peter Pacheco, An Introduction to Parallel Programming ,1st Edition, Margan Kauffmann, 2011
2. William Gropp, Ewing Lusk, and Anthony Skjellum,Using MPI: Portable Parallel Programming with the Message-Passing Interface, MIT Press, 3rd Edition, 2015.
3. Timothy G. Mattson, The OpenMP Common Core - Making OpenMP Simple Again, MIT Press, 2019
4. George Coulouris, Jean Dollimore, Tim Kindberg, Gordon Blair, Distributed Systems: Concepts and Design, 5th Edition, Pearson, 2011
5. Andrew S.Tanenbaum, Maarten Van Steen, Distributed Systems: Principles and Paradigms, 2nd Edition, Pearson, 2015.

Course Outcomes:

Students will be able to

- Develop parallel programming skills
- Understand distributed concepts and develop distributed programs

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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, CA718

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

1. William Stallings, “Cryptography and Network Security Principles and Practices”, 7th Edition, Pearson Education, 2017.
2. Deven N. Shah, Mark Stamp’s “Information Security Principles and Practices”, 3rd Edition, Wiley India 2021.
3. Matt Bishop, “Computer Security Art and Science”, Second Edition, Pearson Education, 2019.
4. Nina Godbole, “Information Systems Security”, 2nd Edition, Wiley, 2017.

5. Whitman, Thomson, “Principles of Information Security”, 6th Edition, GEX Publishing Services,2017.
6. Douglas R. Stinson, “Cryptography: theory and practice”, 3rd Edition, CRC Press, 2021.
7. Merkov, Breithaupt, “Information Security”, 2nd Edition, Pearson Education, 2014.
8. Nina Godbole, Sumit Belapure, “Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives”,1st Edition, Wiley, April 2011.

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

Overview of Computing Paradigms- Distributed Systems Models and Enabling Technologies - Cloud Computing Properties and Characteristics - Business Drivers for Adopting Cloud Computing

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

Service Level Agreements (SLAs) – Pricing Models of Cloud - Migrating to Cloud – Cloud Simulators - Task Scheduling - Resource Management – Mobile Cloud Computing - Cloud Security Risks - Data Privacy and Security Issues - Identity and Access Management, Access Control, Authentication in Cloud Computing - Emerging Trends in Cloud Computing

REFERENCES:

1. Kai Hwang, Jack Dongarra, Geoffrey C. Fox: Distributed and Cloud Computing: From Parallel Processing to the Internet of Things, Morgan Kaufmann, 2013
2. Gustavo Alonso, Fabio Casati, Harumi Kuno, Vijay Machiraju: Web Services: Concepts, Architectures and Applications, 1st Edition, Springer, 2010
3. Rajkumar Buyya, Christian Vecchiola, and Thamarai Selvi: Mastering Cloud Computing, 1st Edition, McGraw Hill, 2017.

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

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CA735 ORGANIZATIONAL BEHAVIOR

Objective(s):

To learn the leadership skills and group behavior.

History of Management - The human relations movement - The Hawthorne studies - Models for organizational behavior – Management concepts.

Foundations of Individual Behavior - Personality – Meaning and development - Major determinants of Personality and Values -Theories of Personality – Perception and Individual Decision Making – sensation versus perception - Stress – Causes and effect of job stress - coping strategies for stress.

Foundations of Group Behavior - Understanding Work Teams - Communication - Basic Approaches to Leadership - Contemporary Issues in Leadership – Motivation Concepts - Motivation From Concepts to Applications –Work motivation – Attitude and Job Satisfaction - Power and Politics - Job design - Goal setting

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

Foundations of Organization Structure - Organizational Culture – Organizational Dynamics

REFERENCES:

1. Stephen P. Robbins, Timothy A. Judge, “Organizational Behavior”, 18th Edition, Pearson Education, 2018.
2. Robert Kreitner, Angelo Kinicki, “Organizational Behavior”, 10th Edition, McGraw-Hill,2012.
3. Fred Luthans, "Organizational Behavior", 12th Edition, McGraw Hill, 2017.

4. Keith Davis, "Human behavior at work: Human relations and Organizational Behavior", Tata McGraw Hill, 1982.
5. Rudrabasavaraj M.N. “Dynamic personnel Administration”, 3rdEdition, Himalaya Publishing House, 2015.

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

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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.

Introduction to Data Science – Data Science Process – Exploratory Data analysis –Collection of Data – Graphical Presentation of Data – Classification of Data – Storage and Retrieval of Data, Big data: Definition, Risks of Big Data, Structure of Big Data – Web Data: The Original Big Data – Evolution Of Analytic Scalability – Analytic Processes and Tools –Analysis versus Reporting – Core Analytics versus Advanced Analytics– Modern Data Analytic Tools – Statistical Concepts: Sampling Distributions – Re-Sampling – Statistical Inference – Introduction to Data Visualization.

Univariate Analysis: Frequency, Mean, Median, Mode, Variance, Standard Deviation, Skewness and Kurtosis – Bivariate Analysis: Correlation – Regression Modeling: Linear and Logistic Regression – Multivariate Analysis – Graphical representation of Univariate, Bivariate and Multivariate Analysis in R: Bar Plot, Histogram, Box Plot, Line Plot, Scatter Plot, Lattice Plot, Regression Line, Two-Way cross Tabulation.

DATA MODELING - Bayesian Modeling – Support Vector and Kernel Methods – Neuro – Fuzzy Modeling – Principal Component Analysis – Introduction to NoSQL: CAP Theorem, MongoDB: RDBMS Vs MongoDB, Mongo DB Database Model, Data Types and Sharding – Data Modeling in HBase: Defining Schema – CRUD Operations.

DATA ANALYTICAL FRAMEWORKS - Introduction to Hadoop: Hadoop Overview – RDBMS versus Hadoop – HDFS (Hadoop Distributed File System): Components and Block Replication – Introduction to MapReduce – Running Algorithms Using MapReduce – Introduction to HBase: HBase Architecture, HLog and HFile, Data Replication – Introduction to Hive, Spark and Apache Sqoop.

STREAM ANALYTICS - Introduction to Streams Concepts – Stream Data Model and Architecture – Stream Computing – Sampling Data in a Stream – Filtering Streams – Counting Distinct Elements in a Stream – Estimating Moments – Counting Oneness in a Window – Decaying Window.

REFERENCES:

1. Anand Rajaraman, Jeffrey David Ullman, “Mining of Massive Datasets”, 3rd Edition, Cambridge University Press, 2020.
2. Bill Franks, “Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics”, 1st Edition, John Wiley & sons, 2012.

3. Umesh R Hodeghatta, Umesha Nayak, "Business Analytics Using R – A Practical Approach", 1st Edition, Apress, 2017.
4. Rachel Schutt, Cathy O'Neil, "Doing Data Science", 1st Edition, O'Reilly, 2013.
5. Foster Provost, Tom Fawcet, "Data Science for Business",1st Edition, O'Reilly, 2013.
6. Bart Baesens, "Analytics in a Big Data World: The Essential Guide to Data Science and its Applications", 1st Edition, Wiley, 2014.

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
3. Christina Prell, Social Network Analysis: History, Theory and Methodology, 1st Edition, SAGE Publications Ltd, Publication Year, 2011.

4. David Easley and Jon Kleinberg, “Networks, Crowds, and Markets: Reasoning About a Highly Connected World”, Cambridge University Press, 2010.
5. Carrington and Scott, The SAGE Handbook on Social Network Analysis, First Edition, SAGE, 2011.

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.

Active and Deductive Databases: Syntax and Semantics - Applications – rule generation - Design Principles of active databases – IDEA - Datalog - fixpoint - Least Fixpoint Semantics for Datalog - Stratification - Fixpoint Semantics for Stratified Programs - Magic Sets Algorithm - Adorned Rules.

Temporal and Object Databases: Data types - Associating Facts - Temporal Query Languages – TSQL2 - Time Ontology - Data Model – Language constructs – System architecture – Adding temporal support - Object Database and Change Management – Change of Schema – Implementing Database Updates in O2 – Benchmark Database Updates – Performance Evaluation.

Complex Queries and Reasoning: Relational Algebra - From Safe Datalog to Relational Algebra - The Logic of Query Languages – Recursive rules - Syntax and Semantics of Datalog Languages - Implementation of Rules and Recursion – Bottom-Up and Top-Down Execution - Rule-Rewriting Methods - Compilation and Optimization - Recursive Queries in SQL.

Spatial, Text, and Multimedia Databases: Indexing methods – Inverted files – k-D trees – Spatial Access Methods – R-trees – Text retrieval – multimedia indexing – 1-D time series – DFT – 2-D color images – Sub pattern matching.

REFERENCES:

1. Carlo Zaniolo, Stefano Ceri "Advanced Database Systems", Morgan Kauffmann Publishers. 1997.
2. Raghu Ramakrishnan "Database Management System", 3rd Edition, McGraw Hill Publications, 2014.
3. R. Elmasri, S.B. Navathe, "Fundamentals of Database Systems", 7th Edition, Pearson Education/Addison Wesley, 2017.

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.

Concepts and secondary structure prediction –Probabilistic models: Markov chain, Hidden Markov Models -Gene identification and other applications.

REFERENCES:

1. Andreqas D. Baxevanis, B. F. Francis Ouellette, "Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins", 4th Edition, John Wiley and Sons, 2020.
2. Shanmughavel, P., "Principles of Bioinformatics", Pointer Publishers, 2008.
3. Richard Durbin, Sean Eddy, Anders Krogh, and Graeme Mitchison, "Biological Sequence Analysis: Probabilistic Models of Proteins and Nucleic Acids", Cambridge University Press,1998.

4. Bishop M.J., Rawlings C.J. (Eds.), "DNA and protein sequence analysis: A Practical Approach", IRL Press, Oxford, 1997.
5. Doolittle R.F. (Ed.), "Computer methods for macromolecular sequence analysis Methods in Enzymology", Academic Press, 1996.

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

Linear programming problems: Formulation – Simplex method – Big M method – Two Phase method – Revised Simplex method-Primal Dual problems- Dual Simplex method.

Network Programming models: Transportation problem – Assignment problem -Dynamic programming: Multi-stage graph formulation– Stage coach problem- Resource allocation problem- Inventory problem.

Non-linear Programming: One dimensional unconstrained optimization – Fibonacci method – Golden section method – Quadratic approximation method – constrained optimization with Lagrangian multipliers.

Integer Programming: All integer programming problem –- Mixed integer programming- Gomory Cutting plane method- Branch and Bound method- Zero-one integer programming problem- Balas-additive algorithm.

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:

1. H.A. Taha, "Operations Research: An Introduction", 10th Edition, Pearson Education, 2019.
2. Swarup.K, Gupta and P.K Man Mohan, "Operations Research", 20th Edition, Sultan Chand &Sons, 2019.
3. S.R.Yadav, A.K.Malik, "Operations Research", Oxford University Press, First Edition, 2014.

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

Fundamentals of Image Processing: Introduction to Digital Image Processing - Characteristics of Digital Image - Basic relationship between pixels - Image sampling and quantization - Color models - Basic Geometric Transformations - Fourier Transform - Cosine-Sine and Hartley Transform - Hadamard-Haar-Slant Transform - Discrete Fourier Transform.

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 Restoration: A model of the image Degradation/Restoration process, Noise models, mean filters, inverse filtering, Wiener filtering, Geometric Mean Filter.

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.

Image Segmentation: Fundamentals, Basics of Point, Line, Edge detection, Thresholding, Iterative thresholding, Otsu's method, Multivariable thresholding, Region based segmentation, Segmentation using Morphological Watershed algorithm, The use of motion in segmentation.

REFERENCES:

1. Rafael C Gonzalez, Richard E Woods, “Digital Image Processing”, Fourth Edition, Pearson Education, 2018.
2. William K Pratt, “Digital Image Processing”, Fourth Edition, John Wiley, 2010.
3. S E Umbaugh, “Digital Image Processing and Analysis: Application with MATLAB and CVIP Tools”, Third Edition, Taylor & Francis, CRC Press, 2018.
4. Frank Y. Shih, “Image Processing and Pattern Recognition”, Wiley – IEEE Press, 2010.

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.

Software components - COTS and infrastructure - Software variability management-Software architecture design methods - Architecture evaluation and assessment methods - architectural styles.

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

Product, Process and Project – Definition – Product Life Cycle – Project Life Cycle Models.

Format Process Models and Their Use -Definition and Format model for a process – The ISO 9001 and CMM Models and their relevance to Project Management –Emerging Models - People CMM-Metrics – Configuration Management – Software Quality Assurance – Risk Analysis.

Engineering and People Issues in Project Management-Phases (Requirements, Design, Development, Testing, Maintenance, Deployment) –Engineering Activities and Management Issues in Each Phase – Special Considerations in Project Management for India and Geographical Distribution Issues.

REFERENCES:

1. Len Bass, Paul Clements, and Rick Kazman, "Software Architecture in Practice", 4th Edition, Addison-Wesley Longman, Inc., Reading, MA, 2021.
2. Richard N.Taylor, NenadMedvidovic, and Eric M.Dashofy, “Software Architecture: Foundations, Theory and Practice”, Wiley India Edition, 2012.
3. Mary Shaw, and David Garlan ,” Software Architecture in Practice: Perspectives on an Emerging Discipline", PHI Learning Private Limited,2010.
4. Ramesh and Gopalaswamy, "Managing Global Projects", Tata McGraw Hill,2001.

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

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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

Introduction: Concepts of Distributed Computing, XML, Fundamental of SOA, Evolution of SOA, Principles of Service-Oriented Architecture- Service-orientation and object- orientation, SOA Standards Stack, SOA with Web Services, Key Principles of SOA.

Web Services Fundamentals: Web Services: Definition, Architectures and Standards. Directory services, SOAP message structure - SOAP encoding - Message exchange models - Communications and Messaging - Limitations of SOAP - Fundamentals of RESTFUL web services - Development and deployment of RESTFUL services - Web service life cycle - Anatomy of WSDL document - Describing web services - WSDL bindings, tools - Limitations - Discovering web services using UDDI.

Web Services Security and Transaction: Meta Data Management - Advanced Messaging - Addressing - Reliable Messaging - Policies - WS Policy - Security - WS Security - Transaction Management.

Business Process Management and Multi-channel Access: Basic Business process management concepts - Examples - Business modelling - Options - Basis of workflow - Atomic services and composite services - Service Orchestration and Choreography - Business Process Execution Language - Business process modelling Notations - Business process re-engineering and management - Combining BPM, SOA and Web Services - SOA for Multi-Channel Access.

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:

1. Thomas Erl, "Service Oriented Architecture (SOA): Concepts, Technology and Design ", Prentice Hall, USA, 2016.
2. Eric Newcomer, Greg Lomow, "Understanding SOA with Web Services", Pearson Education India, New Delhi, 2016.
3. Dirk Krafzig, Karl Banke, Dirk Slama , "Enterprise SOA, Service Oriented Architectures Best Practices", Prentice Hall, 2016.
4. Mark D. Hansen , “SOA Using Java™ Web Services “,Illustrated edition, Prentice Hall; 2009.
5. James McGovern, Sameer Tyagi, Michael E Stevens, Sunil Mathew, “Java Web Services Architecture”, Elsevier, 2003.
6. Shankar Kambhampaty, “Service - Oriented Architecture & Micro services Architecture: for Enterprise, Cloud, Big Data and Mobile”, 3rd Edition, Wiley, 2018.

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.

AGILE METHODOLOGY**:** Theories for Agile Management – Agile Software Development – Traditional Model vs. Agile Model - Classification of Agile Methods – Agile Manifesto and Principles – Agile Project Management – Agile Team Interactions – Ethics in Agile Teams - Agility in Design, Testing – Agile Documentations – Agile Drivers, Capabilities and Values.

AGILE PROCESSES**:** Lean Production - SCRUM, Crystal, Feature Driven Development- Adaptive Software Development - Extreme Programming: Method Overview – Lifecycle – Work Products, Roles and Practices.

AGILITY AND KNOWLEDGE MANAGEMENT**:** Agile Information Systems – Agile Decision Making - Earl_S Schools of KM – Institutional Knowledge Evolution Cycle – Development, Acquisition, Refinement, Distribution, Deployment, leveraging – KM in Software Engineering – Managing Software Knowledge – Challenges of Migrating to Agile Methodologies – Agile Knowledge Sharing – Role of Story-Cards – Story-Card Maturity Model (SMM).

AGILITY AND REQUIREMENTS ENGINEERING**:** Impact of Agile Processes in RE–Current Agile Practices – Variance – Overview of RE Using Agile – Managing Unstable Requirements – Requirements Elicitation – Agile Requirements Abstraction Model – Requirements Management in Agile Environment, Agile Requirements Prioritization – Agile Requirements Modeling and Generation – Concurrency in Agile Requirements Generation.

AGILITY AND QUALITY ASSURANCE**:** Agile Product Development – Agile Metrics – Feature Driven Development (FDD) – Financial and Production Metrics in FDD – Agile Approach to Quality Assurance - Test Driven Development – Agile Approach in Global Software Development.

REFERENCES:

1. David J. Anderson and Eli Schragenheim, Agile Management for Software Engineering: Applying the Theory of Constraints for Business Result, Prentice Hall, 2003.
2. Craig Larman, —Agile and Iterative Development: A Managers Guide, 1st Edition, Addison-Wesley, 2004.
3. Kevin C. Desouza, —Agile Information Systems: Conceptualization, Construction, and Management, Butterworth-Heinemann, Penguin Books Ltd 2007.

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. Bases for Segmenting: Consumer, Business Markets, Market Targeting, Positioning.

Product : Levels , hierarchy , Classification of products, Major product decisions, Product line and product mix; Branding, brand equity, Product life cycle – strategic implications, New product development and consumer adoption process. Pricing: Objective of pricing decision, factors affecting price determination, pricing policies, developing pricing strategies, strategies for new products and existing products.

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:

1. Philip Kotler,"Marketing Management", 16th Edition, Pearson Prentice Hall,2022.
2. Ramaswamy V.S and Namakumari .S," Marketing Management: Planning, implementation and control", 5th Edition, Macmillan, New Delhi,2009
3. Michael J. Etzel, Bruce J. Walker, William J. Stanton, Ajay Pandit, "Marketing – concepts and cases", 8th Edition, McGraw Hill, 2004.
4. Zikmund d Amico, "The power of Marketing", 7th edition, Sowth Western , Thomson Learning Publications, 2006.

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.

Soft Computing and its Techniques, Soft Computing verses Hard Computing. Need for Soft Computing, Applications of Soft Computing in the current industry. Neural Network (NN), Biological foundation of Neural Network, Neural Model and Network Architectures, Perceptron Learning, Supervised Hebbian Learning, Back-propagation, Associative Learning, Competitive Networks, Hopfield Network, Computing with Neural Nets, and applications of Neural Network.

Genetic Algorithm, Concepts, Operators, Function Optimization, Dominance, Swarm Intelligence, Modeling Collective Behavior in Social Insects, Division of Labor and Task Allocation.

Fuzzy Sets, Operations on Fuzzy sets, Fuzzy Relations, Fuzzy Measures, Defuzzification, Fuzzy Systems, Fuzzy Clustering, Fuzzy Decision Making, Applications of Fuzzy Set Theory to different branches of Science and Engineering.

Neuro Fuzzy and Soft Computing, Adaptive Neuro-Fuzzy Inference System Architecture, Hybrid Learning Algorithm, Learning Methods that Cross-fertilize ANFIS and RBFN, Coactive Neuro Fuzzy Modeling, Framework, Neuron Functions for Adaptive Networks, Neuro Fuzzy Spectrum. Hybridization of other techniques.

REFERENCES:

1. J. S. R. Jang, C. T. Sun, and E. Mizutani, Neuro-Fuzzy and Soft Computing, First Edition, PHI, 2015.
2. G. J. Klir, and B. Yuan, Fuzzy Sets and Fuzzy Logic: Theory and Applications, First Edition, Prentice- Hall, 1995.
3. S. Rajasekaran and G. A. V. Pai, Neural Networks, Fuzzy Logic and Genetic Algorithms, PHI, 2017 .
4. D. Goldberg, Genetic Algorithm in Search, Optimization and Machine Learning, 13th Edition, Pearson Education,1989.
5. E. Bonabeau, M. Dorigo, G. Theraulaz, Swarm Intelligence: From Natural to Artificial Systems, Oxford Press, 1999
6. K. L. Du, M. N. S. Swamy, Neural Networks in a Soft computing Framework, Springer, 2006.
7. R. A. Aliev, R. R. Aliev, Soft Computing and Its Applications, World Scientific, 2001.

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.

Genetic Algorithms (GA): Biological foundation of GA, General steps in GA, Genetic Operations: cloning, crossover and mutation, Encoding and Selection techniques, Mathematical foundation and Schemata, Holland Schemata theorem, design and implementation of GA, issues in implementation of GA, applications of GA, Classifier systems, Genetic programming, new trends in GA. Applications of GA.

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,
2. D. E. Goldberg, "Genetic Algorithms in Search, Optimization, and Machine Learning," Addison Wesley,1989.
3. R.Eberhart, P.Simpson and R.Dobbins, Computational Intelligence - PC Tools, AP Professional, 1996.

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.

Useful Statistical Models – Discrete Distribution – Continuous Distributions – Poisson – Empirical Distribution – Manufacturing and Material Handling System – Models – Goals and Performances Measure – Issues – Queuing System – Characteristics – Transient and Steady-State Behaviour of Queues – Long-Run Measures – Infinite – Population Markovian Models.

Random Numbers - Generation of Pseudo Random Numbers – Mid-Square Method – Linear Congruential Generators – Generating Random Variates from Continuous and Discrete Probability Distributions. System dynamics and object-oriented approach in simulation.

Generalization of Growth Models – System Dynamics Diagram – Decision Function – Multi Segment Model – Representation of Time Delays – Inventory and Flow Distribution Systems.

World Model – Object Oriented Approach – Rule Based Approaches– Casual Loops – Flow Diagrams – Levels and Rates – Simple examples of Animation.

Analysis – Input – Output – Verification and Validation of Simulation Models – Comparison and Evaluation of Alternative System Design - Development of simulation models using simulation language.

REFERENCES:

1. Jerry Banks, John S. Carson II, Barry L. Nelson, David M. Nicol, "Discrete-Event System Simulation", 5th Edition, Pearson Education, 2009.
2. Lawrence M. Leemis, Stephen K. Park, "Discrete-Event Simulation: A First Course", First Edition, Pearson Education, 2006.

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

Natural Language Processing– Applications of NLP- Linguistic Background - NLP tasks - Ambiguities in NLP tasks - Finite state automata –Regular Expressions - Corpus - Text Normalization - Edit Distance - Boundary Determination – Tokenization -Stemming- Lemmatization.

Morphological Analysis - Part of speech tagging - Shallow parsing – Dependency parsing - WordNet- Sematic similarity measures -Semantic representation - Co-reference Resolution. Tools–Natural Language Toolkit, Stanford CoreNLP.

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

Machine Learning for NLP: Language Features – Classifier. Deep Learning for NLP: Neural Networks, Vector Representations, Word Embeddings.

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

REFERENCES:

1. Daniel Jurfsky, James H. Martin , Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition, Second Edition, Pearson 2013.
2. Jacob Eisenstein, Introduction to Natural Language Processing (Adaptive Computation and Machine Learning series), Kindle Edition, MIT Press, 2019.
3. Anders Sogaard, Ivan Vulic, Sebastian Ruder, Manaal Faruqui , Cross-Lingual Word Embeddings (Synthesis Lectures on Human Language Technologies), Morgan & Claypool Publishers , 2019.
4. Christopher D. Manning and Hinrich Schutze, "Foundations of Statistical Natural Language Processing", First Edition,MIT Press, 1999.

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.

DevOps : DevOps and Software - Development Life Cycle - Waterfall Model - Agile Model - Continuous Integration & Deployment – Jenkins Containers and Virtual Development –Docker – Vagrant - Configuration Management Tools – Ansible – Puppet – Chef..

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 -

Securing Jenkins – Authentication –Authorization –Confidentiality -Creating Users - Jenkins Plugins - Installing Jenkins Plugins - SCM plugin - Build and test.

Version Control-GIT : GIT Features - 3-Tree Architecture - GIT – Clone /Commit / Push - GIT Hub Projects - GIT Hub Management - GIT Rebase & Merge - GIT Stash, Reset, Checkout - GIT Clone, Fetch, Pull.

Build tool- Maven: Maven Installation - Maven Build requirements -Maven POM Builds (pom.xml) -Maven Build Life Cycle- Maven Local Repository (.m2) - Maven Global Repository - Group ID, Artifact ID, Snapshot -Maven Dependencies - Maven Plugins.

ANSIBLE : Introduction to Ansible - Ansible Server Configuration - Infrastructure Management - SSH Connection in Ansible Master - YAML Scripts -Host Inventory -Hosts and Groups - Host Variables - Group Variables - Host and Group Specific Data - Ad-hoc Commands – Playbooks – Variables – Conditionals – Loops – Blocks – Handlers – Templates – Modules - Core Modules - Extra Modules - Ansible Roles.

Docker : How to get Docker Image - What is Docker Image - Docker Installation - Working with Docker Containers -What is Container - Docker Engine - Crating Containers with an Image - Working with Images - Docker Command Line Interphase - Docker Compose - Docker Hub - Docker Trusted Registry - Docker swarm - Docker attach - Docker File & Commands.

REFERENCES

1. Emily Freeman, DevOps For Dummies, First Edition, John Wiley & Sons, 2019
2. Barrie Sosinsky ,Cloud Computing Bible, First Edition, Wiley-India, 2010
3. Sonatype Company ,Maven The Definitive Guide, Second Edition, O'Reilly Media, 2015.
4. Lorin Hochstein , Rene Moser , Ansible: Up and Running: Automating Configuration Management and Deployment the Easy Way, 2nd Edition, O'Reilly Media, Inc,2017.
5. Adrian Mouat, Using Docker: Developing and Deploying Software with Containers ,1st Edition , O'Reilly Media,2016.

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

Introduction to Wireless Networks - Applications - History - Simplified Reference Model - Wireless transmission - Frequencies - Signals - Antennas - Signal propagation - Multiplexing - Modulation - Spread spectrum - Cellular Systems: Frequency Management and Channel Assignment - types of hand-off and their characteristics.

MAC - Motivation - SDMA - FDMA - TDMA - CDMA - Telecommunication Systems – GSM: Architecture Location tracking and call setup - Mobility management - Handover - Security - GSM - SMS - International roaming for GSM - call recording functions - subscriber and service data management - DECT - TETRA - UMTS - IMT-2000.

Wireless LAN - Infrared vs. Radio transmission - Infrastructure - Adhoc Network - IEEE 802.11WLAN Standards - Architecture - Services - HIPERLAN - Bluetooth Architecture & protocols.

Mobile Network Layer - Mobile IP - Dynamic Host Configuration Protocol - Mobile Transport Layer - Traditional TCP - Indirect TCP - Snooping TCP - Mobile TCP - Fast retransmit/Fast recovery - Transmission/Time-out freezing - Selective retransmission - Transaction Oriented TCP.

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

1. Jochen Schiller, “Mobile Communication”, Second Edition, Pearson Education, 2008.
2. Theodore, S. Rappaport, “Wireless Communications, Principles, Practice”, Second Edition, PHI, 2010.
3. C. Siva Ram Murthy, B. S. Manoj, “Adhoc Wireless Networks: Architectures and Protocols”, Second Edition, Pearson Education, 2008.
4. Vijay. K. Garg, “Wireless Communication and Networking”, First Edition, Morgan Kaufmann Publishers, 2008.

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.

History of Blockchain – Types of Blockchain – Consensus – Decentralization using Blockchain – Blockchain and Full Ecosystem Decentralization – Platforms for Decentralization.

Bitcoin – Digital Keys and Addresses – Transactions – Mining – Bitcoin Networks and Payments – Wallets – Alternative Coins – Theoretical Limitations – Bitcoin limitations – Name coin – Prime coin – Zcash – Smart Contracts – Ricardian Contracts.

The Ethereum Network – Components of Ethereum Ecosystem – Ethereum Programming Languages: Runtime Byte Code, Blocks and Blockchain, Fee Schedule – Supporting Protocols – Solidity Language.

Introduction to Web3 – Contract Deployment – POST Requests – Development Frameworks – Hyperledger as a Protocol – The Reference Architecture – Hyperledger Fabric – Distributed Ledger – Corda.

Kadena – Ripple – Rootstock – Quorum – Tendermint – Scalability – Privacy – Other Challenges – Blockchain Research – Notable Projects – Miscellaneous Tools.

REFERENCES:

1. Joseph J. Bambara, Paul R. Allen, Block Chain : A Practical Guide To Developing Business, Law And Technology Solutions, McGrawHill, 2020
2. Andreas Antonopoulos, Satoshi Nakamoto, "Mastering Bitcoin", Second Edition,O'Reilly, 2017.
3. A. Narayanan, J. Bonneau, E. Felten, A. Miller, S. Goldfeder, "Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction", Illustrated Edition, Princeton University Press, 2016.

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

Introduction to Business Ethics, Ethics, Morals and Values, Concepts of Utilitarianism and Universalism – Theory of rights, theory of Justice – Virtue ethics – ethics of care– Law and Ethics – The Nature of Ethics in management – Business Standards and Values – Value Orientation of the Firm.

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.

Personal Integrity and self-development – wisdom based leadership - History of Corporate form and models - Corporate Objective and goals, Ownership pattern – Issues in managing public limited firms – Agency problems.

REFERENCES:

1. M. G. Velasquez, “Business Ethics: Concepts and Cases”, 8th Edition,Prentice Hall of India,2017.
2. N. Minow and R. Monks, “Corporate Governance”, 5th Edition,Wiley-Blackwell, 2011.
3. E. Banks, “Corporate Governance: Financial Responsibility, Ethics and Controls”, Palgrave Macmillan, 2004.
4. Laura P. Hartman & Joe DesJardins, Business Ethics: Decision-Making for Personal Integrity and Social Responsibility, 5th Edition, NY: McGraw-Hill/Irwin, 2020.

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.

Introduction to Big Data: Types of Digital Data - Characteristics of Data – Evolution of Big Data - Definition of Big Data - Challenges with Big Data - Dimensions of Big Data - Types of Big Data Analytics - Big Data Analytics Generic Flow and Big Data Stack.

Hadoop & Spark: Overview of Hadoop Ecosystems - Hadoop Architecture – HDFS - Map Reduce – Spark – Programming Examples.

Mining Data Streams: Stream Data Model – Sampling Data in the Stream – Filtering Streams – Counting Distance Elements in a Stream – Estimating Moments – Counting Ones in Window – Decaying Windows.

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

Big Data Management: Big Data Visualization - Managing and Optimizing the Analytics Value Chain - Selecting the Right Business Processes - Data Governance - Organizational Dynamics - Change Management - Security and Privacy for Big Data Applications - Case Studies.

REFERENCES:

1. Tom White. Hadoop: The Definitive Guide. O'Reilly Publications. 2015.
2. Kyle Banker. Mongo DB in Action, 2nd Edition, Manning Publications. 2016.
3. Russell Bradberry, Eric Blow. Practical Cassandra A developers Approach, 1st Edition, Pearson Education. 2014.
4. Jure Leskovec, Anand Rajaraman, Jeffrey Ullman. Mining of Massive Datasets, 3rd Edition, Cambridge University Press. 2020.

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.

Magic of Incentive, The Role of Electric Utilities, A most Significant Step – "Virtualizing IT Systems, Consolidation and Virtualization, Data Storage.

Need for Standard IT Energy-Use Metrics: SPEC – EPA – LEED, Green Grid Data Center Power Efficiency Metrics: PUE and DciE, Data Center: Strategies for Increasing Data Center- Cooling Efficiency, Fuel Cells for Data Center Electricity, Emerging Technologies for Data Centers.

IT Case Studies for Energy Utilities, Green IT Case Studies for Universities and a Large Company, Worldwide Green IT Case Studies, Future of Green IT for Corporations.

REFERENCES:

1. John Lamb, "The Greening of IT-How Companies Can Make a Difference for the Environment", First Edition, IBM Press 2009
2. Frederic P. Miller, Agnes F. Vandome, John McBrewster, "Green Computing", Alpha script publishing, 2011.

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

Introduction to IoT - Physical and Logical Design- Enabling Technologies - Levels and Deployment Templates - Domain Specific IoTs – IoT system management using NETCONF & YANG - IoT Platforms Design Methodology, IoT Sensors – Temperature, Moisture, Light, Acoustic & Noise, Water level, Presence & Proximity, Motion, Gyroscope, Chemical, Image; IoT actuators.

IoT Architecture: ETSI, IETF, and OGC architectures - IoT reference model - Domain model - information model - functional model - communication model - IoT reference architecture.

IoT Protocols - Protocol Standardization – Efforts – M2M and WSN Protocols – SCADA and RFID Protocols – Unified Data Standards – Protocols – IEEE 802.15.4 – BACNet Protocol – Modbus– Zigbee Architecture – Network layer –LowPAN - CoAP – Security.

Building IoT - RASPERRY PI- IoT Systems - Logical Design using Python – IoT Physical Devices & Endpoints - IoT Device -Building blocks -Raspberry Pi-Board - Linux on Raspberry Pi - Raspberry Pi Interfaces -Programming Raspberry Pi with Python - Other IoT Platforms -Arduino.

Case Studies and Real-World Applications – Real-world design constraints - Applications - Asset management, Industrial automation, smart grid, Commercial building automation, Smart cities - participatory sensing - Data Analytics for IoT – Software & Management Tools - Cloud Storage Models & Communication APIs - Cloud for IoT - Amazon Web Services for IoT.

REFERENCES:

1. Adrian McEwen and Hakim Cassimally, “Designing the Internet of Things”, First Edition, John Wiley & Sons, 2013.
2. Cuno Pfister, “Getting Started with the Internet of Things: Connecting Sensors and Microcontrollers to the Cloud”, First Edition, Maker Media, 2011.

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

Introduction to fundamentals of HCI - The Human: I/O Channels – Memory - Reasoning and Problem Solving - The Computer: Devices- Memory - Processing and Networks - Interaction: Models-Frameworks – Ergonomics – Styles – Elements – Interactivity – Paradigms - User centric design - History - Issues and challenges.

User-Centric: An Engineering Perspective - Engineering a Software System – Usability - User Centric Design - Case Studies - User-Centric: A Computational Perspective - A Framework for User-Centric Computing - User-Centric Models - Models for User-Centric Computing – Taxonomy.

Computational Models of Users: Classical Models - The GOMS Models - Models of Specific User Behaviour - The Models and the Computational Framework - Contemporary Interfaces and Interactions: WIMP Interactions - 2D Pointing and Scrolling - Constrained Navigation on Interfaces - Mobile Typing - Touch Interaction - Design Implications and Present State: Design Case Study - Virtual Keyboard - Models for Non-Traditional Interactions - Learning-based Models - Emerging Trend in Interactive Systems.

Formal Models in User-Centric Computing: User-Centric Computing with Matrix Algebra - Use of Formal Models and Issues - Formal Modelling of Dialog - Other Formal Models and Trends - User-Centric Computing for Evaluation: Evaluation with Experts - Evaluation with Users - Model-Based Evaluation - A Framework for Usability Evaluation and Design - User-Centric Computing Beyond GUI: Ubiquitous Systems - Recent Trends: GUI and Beyond - User- Centric Issues and Challenges - Enabling Technologies.

Assistive Technologies – Case Studies – HCI using Mechanical Sensors – Brain Computer Interface and Applications – Gestures recognition – Video based eye tracking – Speech interfaces.

REFERENCES:

1. Samit Bhattacharya, "Human-Computer Interaction User-Centric Computing for Design", McGraw-Hill Education. 2019.
2. Alan Dix, Janet Finlay, Gregory Abowd& Russell Beale, "Human-Computer Interaction", 3rd Edition, Prentice Hall, 2004.
3. Julie A. Jacko (Ed), "The Human-Computer Interaction Handbook", 3rd edition, CRC Press, 2012.
4. Jonathan Lazar, Jinjuan Heidi Feng, & Harry Hochheiser, "Research Methods in Human Computer Interaction", Wiley, 2010

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.

Process – Definition – Process creation – working with process Environment Variables – killing a process – process- resources- synchronous and asynchronous processes – Multithreading – Comparing threads to processes – Architecture of a thread- creation and management of threads – CUDA programming.

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:

1. M. Herlihy and N. Shavit, "The Art of Multiprocessor Programming",2nd Edition, Morgan Kaufmann,2020.
2. D.B.Kirk and W.W.Hwu, "Programming Massively Parallel Processors: A Hands-on Approach",3rd Edition, Morgan Kaufmann,2016.
3. C.Huges and T.Huges, "Professional Multi-core Programming: Design and Implementation for C++ Developers", First Edition, Wrox, 2008.

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 – Post Controller – Base Router – Testing Controllers – npm test – JSHint.

Karma – Bower – Heroku –Working of Heroku – MongoDB and Redis on Heroku – Single Server vs Multiserver – Fedora 2.0 – Multiserver migration.

REFERENCES:

1. Jeff Dickey, "Write Modern Web Apps with the MEAN Stack: Mongo, Express, AngularJS, and Node.js", First Edition, Peachpit Press, 2015.
2. Brad Dayley, Brendan Dayley, "Node.js, MongoDB and Angular Web Development", 2nd Edition, Addison Wesley, 2017.
3. Amos Q. Haviv, Adrian Mejia,"Web Application Development with MEAN ", First Edition, Packt Publishing, 2016.
4. Nicholas McClay. MEAN Cookbook: The Meanest Set of MEAN Stack Solutions Around, First Edition, Packt Publishing Limited. 2017.
5. Chris Sevilleja, Holly Lloyd. MEAN Machine: A beginner's practical guide to the JavaScript stack, First Edition,Leanpub Publishing Limited,2016.

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

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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.

Fundamentals of Image Formation, Transformation, Image Transforms: DFT-DCT-WHT-Applications: filtering-compression, Image Enhancement-Histogram Processing.

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:

1. Richard Szeliski, Computer Vision: Algorithms and Applications, 2nd Edition, Springer-Verlag London Limited 2022.
2. D. A. Forsyth, J. Ponce, Computer Vision: A Modern Approach, 2nd Edition, Pearson Education, 2011.
3. Mohamed Elgendy, Deep Leaning for Vision Systems, Manning Publications, 2020.

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

Foundations and Technologies for Decision Making - Decision Making: Introduction and Definitions; Phases of Decision-Making Process: Intelligence, Design, Choice and Implementation – DSS: Characteristics and Capabilities – DSS Classifications - Components of DSS.

Business Intelligence: Information support for Decision Making – Decision Support System - Introduction to Business Intelligence BI concept, BI architecture, BI in today's perspective, BI Process, Applications of BI like Financial analysis, statistical analysis, sales analysis, CRM, result pattern and ranking analysis, Balanced Scorecard, BI in Decision Modelling: Optimization, Decision making under uncertainty. Ethics and business intelligence.

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.

Applications and Future of BI: Marketing models – Logistic and Production models – Case studies.; Future of business intelligence – Emerging Technologies: Machine Learning, Predicting the Future with Data Analysis, BI Search & Text Analytics – Advanced Visualization – Rich Report, Future beyond Technology.

REFERENCES:

1. Efraim Turban, Ramesh Sharda, Dursun Delen, "Decision Support and Business Intelligence Systems", 10th Edition, Pearson 2015.
2. Larissa T. Moss, S. Atre, "Business Intelligence Roadmap: The Complete Project Lifecycle for Decision Support Applications", First Edition, Addison Wesley, 2003.
3. Carlo Vercellis, "Business Intelligence: Data Mining and Optimization for Decision Making", First Edition,Wiley Publications, 2011.
4. David Loshin, "Business Intelligence: The Savvy Manager‟s Guide", Second Edition, Morgan Kaufman Publishers, 2012.
5. Cindi Howson, "Successful Business Intelligence: Secrets to Making BI a Killer App", First Edition, McGraw-Hill, 2008.

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.