MASTER OF COMPUTER APPLICATIONS
Department of Computer Science and Engineering

MASTER OF COMPUTER APPLICATIONS- 2020

Bridge Courses

1. Problem Solving and Programming
2. Fundamentals of Database Management Systems

	Course Code	Course Title	L T P	Cr	ES		Course Code	Course Title	L T P	Cr	ES	
	SEMESTER 1						**SEMESTER 2**					
	20CSA501	Object Oriented Programming Using Java	3 0 1	4			20CSA511	Data structures and Algorithms	3 1 0	4		
	20MAT504	Mathematical Foundations for Computer Applications I	3 1 0	4			20CSA512	Advanced Web Technologies and Mean Stack	3 0 1	4		
	20CSA502	Advanced Operating Systems	3 0 0	3			20MAT514	Mathematical Foundations for computer Applications II	3 0 0	3		
	20CSA503	Advanced Computer Networks	3 0 1	4			20CSA513	Data mining and Applications	3 0 1	4		
	20CSA504	Python Programming	2 0 1	3				Elective-I	3 0 0	3		
	20CSA505	Advanced DBMS	3 0 1	4				Elective-II	3 0 0	3		
							20CSA514	Research Methodologies and Case Study	1 1 0	2		
	18CUL501	Cultural Education		P/F			20CSA581	Data Structures and Algorithms Lab	0 0 1	1		
				22				**TOTAL**		**24**		

SEMESTER 3						SEMESTER 4					
20CSA601	Machine Learning	3 0 1	4			20CSA699	Dissertation Phase II		12		
20CSA602	Software Engineering and Design Patterns	3 0 0	3								
	Elective III	3 0 0	3								
	Elective IV	3 0 0	3								
	Elective V	2 0 1	3								
20CSA681	IoT and Cloud Lab	0 0 1	1								
	Open Lab	0 0 1	1								
20CSA698	Dissertation Phase I		4								
	TOTAL		**22**				TOTAL		**12**		
						TOTAL credits = 80					
Electives						**Management Elective**					
20CSA531	Artificial Intelligence	3 0 0	3			20HU531	Principles of Economics and Management	3 0 0	**3**		
20CSA532	Mobile Application Development	3 0 0	3			20HU532	Software Project Management	3 0 0	3		
20CSA533	Cryptography	3 0 0	3			20HU533	Management Information Systems	3 0 0	3		
20CSA534	Compiler Design	3 0 0	3			20HU534	Management and Organizational Behavior	3 0 0	3		
20CSA535	Big data Analytics and Visualization	3 0 0	3			20HU535	Business Intelligence	3 0 0	3		
20CSA536	C# and .NET	3 0 0	3			**Open Lab (1 Practical session= 3 lab hours)**					
20CSA537	Parallel and Distributed Computing	3 0 0	3			20CSA682	R Programming	0 0 1	**1**		

	20CSA538	Advanced Algorithms	3 0 0	3			20CSA683	MATLAB Programming	0 0 1	**1**		
	20CSA539	Deep Learning	3 0 0	3			20CSA684	High Performance Computing Lab	0 0 1	**1**		
	20CSA540	Software Testing	3 0 0	3			20CSA685	Natural Language Processing Lab	0 0 1	**1**		
	20CSA541	Natural Language Processing	3 0 0	3			20CSA686	Cyber Security Lab	0 0 1	**1**		
	20CSA542	Wireless Networks	3 0 0	3			20CSA687	Deep Learning Lab	0 0 1	**1**		
	20CSA543	Bio-informatics	3 0 0	3								
	20CSA544	Network Management and System Administration	3 0 0	3								
	20CSA545	Digital Image Processing	3 0 0	3								
	20CSA546	Information Retrieval	3 0 0	3								
	20CSA547	Semantic Web	3 0 0	3								
	20CSA548	Software Defined Networks	3 0 0	3								
	20CSA549	Open Source Systems	3 0 0	3								
	20CSA550	Network Security	3 0 0	3								
	20CSA551	Database Administration	3 0 0	3								
	20CSA552	Pattern Recognition	3 0 0	3								
	20CSA553	Block Chain Technologies	3 0 0	3								
	20CSA554	Operations Research And Optimization Techniques	3 0 0	3								

Stream Based Electives

Data Science	Cyber Security	Next Generation Networks
Artificial Intelligence	Cryptography	Parallel and Distributed Computing
Big data Analytics and Visualization	Network Management and System Administration	Wireless Networks
Deep Learning	Open Source Systems	Software Defined Networks
Natural Language Processing	Network Security	
Digital Image Processing	Database Administration	
Pattern Recognition	Block Chain Technologies	

Semester 1

20CSA501 OBJECT ORIENTED PROGRAMMING USING JAVA 3 0 1 4

Course Objectives:

1. To understand Object Oriented Programming concepts and familiarize the relationship between classes and objects in a Java program.
2. To know the principles of packages, inheritance and interfaces
3. To introduce the concepts of exception handling, multithreading and I/O streams
4. To introduce the design of Graphical User Interface using applets and swing controls.
5. To understand how database connectivity is achieved using JDBC.

Course Outcomes:

CO1 :Able to understand object-oriented programming principles.
CO2: Develop Java programs with the concepts of inheritance and interfaces.
CO3: Build Java applications using exceptions, threads and I/O streams.
CO4: Able to create applets and develop interactive Java programs using swings.
CO5: Develop java applications that interact with database.

Syllabus:

UNIT I

Object Oriented Programming – Abstraction – objects and classes – Encapsulation- Inheritance – Polymorphism- OOP in Java – Characteristics of Java – The Java Environment – Java Source File Structure – Compilation. Fundamental Programming Structures in Java – Defining classes in Java – constructors, methods -access specifiers – static members -Comments, Data Types, Variables, Operators, Control Flow, Arrays - Strings

UNIT II

Packages- Inheritance – Super classes- sub classes –Protected members – constructors in sub classes- the Object class – abstract classes and methods- final methods and classes – Interfaces – defining an interface, implementing interface, differences between classes and interfaces and extending interfaces

UNIT III

Exceptions – exception hierarchy – throwing and catching exceptions – built-in exceptions, creating own exceptions. Input / Output Basics – Streams – Byte streams and Character streams – Reading and Writing Console – Reading and Writing Files. Multithreading- Differences between thread-based multitasking and process-based multitasking, Java thread model, creating threads, thread priorities, synchronizing threads, inter thread communication.

UNIT IV

GUI Programming with Java: The AWT class hierarchy, introduction to Swing, Swing Vs AWT, hierarchy for swing components. Containers: JFrame, JApplet, JDialog, JPanel, overview of some swing components: JButton, JLabel, JTextField, JTextArea, simple applications. Layout management: Layout manager types, border, grid and flow. Applets: Inheritance hierarchy for applets, differences between applets and applications, life cycle of an applet, passing parameters to applets.

Unit V

Introduction to JDBC, JDBC Drivers & Architecture, CRUD operation Using JDBC.

TEXTBOOK:

Herbert Schildt*, "Java: The Complete Reference, Eleventh Edition", Oracle 2018*

CO – PO Affinity Map

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2	PSO3
CO1	3	1	1	-	-	-	-	-	-	-	-	-	-	-	-
CO2	1	1	2	-	-	-	-	-	-	-	-	-	-	-	-
CO3	1	1	3	-	-	-	-	-	-	-	-	-	-	-	-
CO4	2	1	3	-	-	-	-	-	-	-	-	-	-	-	-
CO5	1	2	2	-	2	-	-	-	-	-	-	-	-	-	-

20MAT504 MATHEMATICAL FOUNDATIONS FOR COMPUTER APPLICATIONS- I 3 1 0 4

OBJECTIVE

This course provides mathematical background and sufficient experience on various topics like matrix algebra, logic and proofs, combinatorics and algebraic structures. This knowledge improves student's Logical and Mathematical thinking and ability to deal with abstract concepts in computer science and to solve practical problems.

Course Outcomes

1. To construct mathematical arguments using logical connectives and quantifiers.
2. Understand the basic concepts of Mathematical reasoning, set and functions.
3. Acquires knowledge of matrix, set theory, functions and relations concepts needed for designing and solving problems
4. Apply the concepts of generating functions to solve the recurrence relations.
5. To familiarise concepts like Groups and Rings .

UNIT I

Mathematical logic: Introduction, Statements and Notation, Connectives, Arguments, Normal Forms, Theory of Inference for the Statement Calculus, The Predicate Calculus, Inference Theory of the Predicate Calculus.

Unit II

Sets-Basic definitions - Laws of set theory - Principle of inclusion and exclusion – Partitions - Permutation and combination – Relations - Properties of relations –Equivalence relation-Matrices of relations - Closure operations on relations -n-ary relations- Functions .

Unit III

Groups – Axiom of a group – Examples and basic algebra in groups – Order of an element of a group – Isomorphism of groups – Cyclic groups – Subgroups – Cosets and Lagrange's theorem – Rings-Field

Unit IV

Matrices - Rank of a matrix - Solving system of equations – Echelon form of a matrix and Row reduced echelon form of matrix.- Eigen values and Eigenvectors - Cayley - Hamilton theorem .

Unit V

COMBINATORICS -Review of Permutation and Combination - Mathematical Induction - Pigeon hole principle - Principle of Inclusion and Exclusion - generating function - Recurrence relations, Homogeneous and nonhomogeneous recurrences and their solutions - solving recurrences using generating functions.

TEXT BOOKS/ REFERENCES:

1. Rosen K. H., "Discrete Mathematics and its Applications", Seventh Edition, Tata McGraw-Hill, New Delhi, 2007.
2. R. P. Grimaldi, "Discrete and Combinatorial Mathematics", Pearson Education, Fifth Edition, 2007.
3. David Makinson, "Sets, Logic and Maths for Computing", Springer Indian Reprint, 2011.
4. Trembley, J.P. and Manohar, R, "Discrete Mathematical Structures with Applications to Computer Science", Tata McGraw Hill, New Delhi, 2007.

20CSA502 ADVANCED OPERATING SYSTEMS 3 0 0 3

Course Outcomes

CO1: Understand the architecture and functionalities of modern OS and virtual machines

CO2: Understand and apply the algorithms for resource management and scheduling

CO3: Apply semaphores and monitors for classical and real world synchronization scenarios.

CO4: Understand how a distributed OS system works.
CO5: Ability to engage in independent learning as a team to study characteristic features of modern operating systems

syllabus

UNIT 1

Introduction to Operating System and its functions: Types of Operating Systems; Computer hardware review – Instruction execution cycle, Interrupts; System calls – How to implement a new system call in Linux; Difference between system calls and library routines.
Process concept - Process Creation and termination, PCB, Process States, Inter-process Communication, Classic synchronization problems and their solutions; Deadlocks, Concept of Threads

UNIT 2

Memory Management & I/O: Address space abstraction, Address binding. Dynamic linking and shared libraries. Basic memory management, swapping, Paging, Segmentation, Virtual memory, Page replacement algorithms, DMA & Cache memory Creation of shared memory. Overview of I/O Hardware; Application I/O Interface; Kernel I/O Subsystem; Transforming I/O Requests to Hardware Operations; Performance.

UNIT 3

Unix Internals: Introduction and architecture of Unix OS – Basics & Commands- Architecture of Unix OS- Kernel Data structures, File subsystem and process subsystem – Process states and transitions – sleep and wakeup – buffer cache. File system – Internal representation of files – system calls for the file system. Inter-process communication – System V IPC, Network Communications.

UNIT 4

Memory management in Unix- swapping, demand paging, a hybrid system with swapping and demand paging. I/O subsystem- driver interfaces, disk drivers, terminal drivers, streams Protection and Security Domain of Protection, Access Matrix, Implementation of Access Matrix, Access Control, Revocation of Access Rights, Capability-Based Systems. User and group creation in Windows and Linux, directory and file permissions for Linux.

UNIT 5

Distributed Operating Systems – Fundamentals of Distributed systems, Message Passing, RPC, Distributed Shared Memory, Synchronization; Distributed File System, Distributed Coordination – Mutual Exclusion; Time Stamping.

TEXT BOOKS

1. Silberschatz, Galvin, Gagne, Operating System Concepts, Tenth Edition, John Wiley & Sons, Inc.
2. Distributed Operating Systems Concepts and Design – Pradeep K Sinha - Prentice-Hall India
3. The Design of the Unix Operating System - Maurice J Bach – Prentice-Hall India

REFERENCES:

1.Godbole - Operating Systems - Tata McGraw Hill Publications
2. H.M Deitel - Operating Systems - Second Edition - Pearson Edition Asia
3. Modern Operating Systems – Andrew S Tanenbaum, Prentice Hall, fourth Edition, 2015
4. Unix System Programming - Kay A Robbins, Steven Robbins – Pearson Education, Second Edition.

CO – PO Affinity Map

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CO1	2	1	1	-	-	-	-	-	-	-	-	-	-	-	-
CO2	2	3	2	3	-	-	-	-	-	-	-	-	-	-	-
CO3	2	3	1	3	-	-	-	-	-	-	-	-	-	-	-
CO4	2	1	2	2	-	-	-	-	-	-	-	-	-	-	-
CO5	1	2	2	2	-	-	-	-	2	2	-	-	-	-	-

20CSA503 ADVANCED COMPUTER NETWORKS 3 0 1 4

COURSE OUTCOMES

CO1: To master the terminology and concepts of the core network and layered approach.
CO2: To determine proper usage of the IP address, subnet mask and default gateway in a routed network and designing of Network Models using Simulation tools

CO3: Understand and analyze (Using Wireshark tool) the concepts of TCP/IP layers and their working in local area networks and wide area networks.

CO4: Mastering basic concepts of Routing protocols and services and their design/performance issues in local area networks and wide area networks.

CO5: To design or simulate a real time network and study its QoS parameters

SYLLABUS

Computer Networks -Protocol layers -The Network Edge- The Network Core– Delay– Loss and Throughput in Packet Switched Networks - IP, Routing algorithm – Interior and Exterior routing. ICMP, Classless and Subnet Address Extensions (CIDR), Internet Multicasting. NAT Routing protocol design and architectures for RIP, OSPF, BGP, RIP. Application layer protocols – HTTP- DNS – PPP file sharing Introduction to Transport Layer Services - Connectionless Transport- UDP - Principles of Reliable Data Transfer- Connection Oriented Transport- TCP Traffic Control: Packet Scheduling, TCP Congestion Control, - Leaky Bucket, Token Bucket-Internet protocol – Internet Layer-Class full Addressing – Class less addressing – Private Addresses – Subnets – Subnet masks –ARP – ICMP-Routing & Forwarding - Global Internet– RIP – OSPF – BGP – Broadcast & Multicast routing-Multimedia Networking – Multimedia networking applications – Streaming stored video and audio – Protocols for real time interactive applications

Common network services and tools - ifconfig, nw.js - netcat - netstat - DNS - dhcp and monitoring tool Wireshark

Network simulator –NS2/NS3 basic routing protocols, congestion control, flow monitoring and case studies

TEXT BOOKS/ REFERENCES:

1. James F. Kurose and Keith W. Ross, “Computer Networking: A Top-Down Approach”, 6th Edition, Addison Wesley, 2008.
2. Larry Peterson and Bruce Davie, “Computer Networks: A Systems Approach”, Fourth Edition, Morgan Kaufmann, 2007.
3. Richard Stevens, Bill Fenner and Andrew M. Rudoff, “UNIX Network Programming”, Volume 1: “The Sockets Networking API”, Third Edition, Addison Wesley, 2004.
4. Andrew S.Tanenbaum, “Computer Networks”, Fifth Edition, Prentice Hall of India, 2011.

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CO2	3	2	1	2	-	-	-	-	-	-	-	-	-	-	-
CO3	2	2	1	2	2	-	-	1	-	-	-	-	-	-	-
CO4	2	2	3	2	1	-	-	1	-	-	1	-	-	-	-
CO5	2	2	3	1	2	1	-	2	-	1	1	-	-	-	-

20CSA504 PYTHON PROGRAMMING 2013

COURSE OUTCOMES

CO1: Must be able to learn basics—including data types, control structures, algorithm development, and program design with functions—via the Python programming language.
CO2: To apply the fundamental principles of Object-Oriented Programming, as well as in-depth data and information processing techniques.
CO3: Students will be equipped with knowledge to solve problems, explore real-world software development challenges, and create practical and contemporary applications.
CO4: To understand the role of python programming with respect to current industry requirements and become job ready.
CO5: To learn how to develop algorithms for resolving huge data processing problems.

SYLLABUS

Why Python- Python Installation- Python 2.7 vs 3.x- Introduction to Essential Python Libraries- Introduction to iPython and Jupyter - Python Language Basics-Indentation, Comments, Function Calls, Variables and Argument Passing- Python Language Basics -Types, Duck-Typing, Import, Binary operator, Comparisons, Mutable objects -Standard Data Types in Python, Command Line Arguments, Control Flow, Input/Output in Python-Input, Output, Eval, Print, Repr() and Str(), -Zfill-File IO.

Lists, tuples, and dictionaries; basic list operators, replacing, inserting, removing an element; searching and sorting lists; dictionary literals, adding and removing keys, accessing and replacing values; traversing dictionaries.

Design with functions: hiding redundancy, complexity; arguments and return values; formal vs actual arguments, named arguments, Program structure and design, Recursive functions. Classes and OOP: classes, objects, attributes and methods; defining classes; design with classes, data modeling; persistent storage of objects. inheritance, polymorphism, operator overloading (_eq_, _str_, etc); abstract classes; exception handling, try block.

Graphical user interfaces; event-driven programming paradigm; tkinter module, creating simple GUI; buttons, labels, entry fields, dialogs; widget attributes - sizes, fonts, colors layouts, nested frames.

TEXT BOOKS/ REFERENCES:

1. Kenneth A. Lambert, The Fundamentals of Python: First Programs, 2011, Cengage Learning, ISBN: 978-1111822705.
2. Let Us Python: Python Is Future, Embrace It Fast. YashavantKanetkar,Kindle Edition

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CO2	2	2	1	3	-	-	-	-	-	-	-	-	-	-	-
CO3	2	1	2	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	2	3	-	-	-	-	-	-	-	-	-	-	-	-
CO5	3	1	2	1	3	1	-	1	-	-	1	-	-	-	-

Lab

SYLLABUS

1. Write a Python program to print all the Disarium numbers between 1 and 100.
2. Write a Python program to encrypt the text using Caesar Cipher technique. Display the encrypted text. Prompt the user for input and the shift pattern.
3. Write a Python program to construct a linked list. Prompt the user for input. Remove any duplicate numbers from the linked list.
4. Traverse a path and display all the files and subdirectories in each level till the deepest level for a given path. Also, display the total number of files and subdirectories.
5. Read a file content and copy only the contents at odd lines into a new file.
6. Write a function ball_collide that takes two balls as parameters and computes if they are colliding. Your function should return a Boolean representing whether or not the balls are colliding.
7. Write a function nearly_equal to test whether two strings are nearly equal. Two strings a and b are nearly equal when a can be generated by a single mutation on b.
8. Write a function cumulative product to compute cumulative product of a list of numbers.
9. Write a function reverse to reverse a list. Without using the reverse function.

10. Using Regular Expressions, develop a Python program to
    a) Identify a word with a sequence of one upper case letter followed by lower case letters.
    b) Find all the patterns of "1(0+)1" in a given string.
    c) Match a word containing 'z' followed by one or more o's.
    d) Prompt the user for input.
11. Write a Python program to plot the Line chart in MS Excel Sheet using Xlsx Writer module to display the annual net income of the companies mentioned below.
12. Python Program to Make a Simple Calculator
13. Python program using packages and libraries.
14. Python Program to Shuffle Deck of Cards
15. Python Program to Display Calendar.
16. Python | Sort Python Dictionaries by Key or Value
17. Handling missing keys in Python dictionaries
18. Python dictionary with keys having multiple inputs
19. Python program to find the sum of all items in a dictionary
20. Python | Ways to remove a key from dictionary
21. Ways to sort list of dictionaries by values in Python – Using itemgetter
22. Ways to sort list of dictionaries by values in Python – Using lambda function
23. Python | Merging two Dictionaries
24. Program to create grade calculator in Python
25. Python | Check order of character in string using OrderedDict( )
26. Python | Find common elements in three sorted arrays by dictionary intersection
27. Dictionary and counter in Python to find winner of election
28. Find all duplicate characters in string
29. Print anagrams together in Python using List and Dictionary
30. K'th Non-repeating Character in Python using List Comprehension and OrderedDict
31. Check if binary representations of two numbers are anagram
32. Python Counter to find the size of largest subset of anagram words
33. Python | Remove all duplicates words from a given sentence
34. Python Dictionary to find mirror characters in a string
35. Counting the frequencies in a list using dictionary in Python
36. Python | Convert a list of Tuples into Dictionary
37. Python counter and dictionary intersection example (Make a string using deletion and rearrangement)

38. Python dictionary, set and counter to check if frequencies can become same
39. Scraping And Finding Ordered Words In A Dictionary using Python
40. Possible Words using given characters in Python

20CSA505 **ADVANCED DBMS** **3 0 1 4**

COURSE OUTCOMES

1. Familiarize the students to OPPS Database concepts and its features
2. Exemplify the complex data types, all level inheritance, and DBS architecture
3. Be Familiar with Client server and parallel Databases, Explain Interquery and Intraquery Parallelism
4. Exemplify XML data model and how-to retrieval information in Databases.
5. Understand the concepts of Intelligent database and Temporal database

Introduction to object-oriented database & syllabus discussion Abstraction, encapsulation, and information hiding. Inheritance Overloading Polymorphism Dynamic binding, Object-Oriented Data Model. Complex Data Types, Structured Types and Inheritance in SQL Table Inheritance, Array and Multiset. Types in SQL Object, Identity and Reference Types in SQL.

Introduction to Parallel database and I/O Parallelism, Interquery Parallelism, Intraquery Parallelism. Intraoperation Parallelism, Interoperation Parallelism, Transaction model and properties, Transaction structure, Transaction serialization and recovery

XML Databases: XML Data Model – DTD – XML Schema – XML Querying – Web Databases – JDBC – Information Retrieval – Data Warehousing.

INTELLIGENT DATABASES
Active Databases: Syntax and Semantics (Starburst, Oracle, DB2)- Taxonomy- Applications- Design Principles for Active Rules- Temporal Databases: Overview of Temporal Databases TSQL2- Deductive Databases-Recursive

REFERENCE BOOKS:

1. Database Systems Concepts; Silberschatz, Abraham, Henry F. Korth, and S.Sudarshan.
2. Principles of Distributed Database Systems; Ozsu, M. Tamer and Patrick Valduriez.
3. C. S. R. Prabhu, “Object Oriented Database Systems : Approaches and Architectures”, Third Edition, PHI Learning Pvt. Ltd.

4. RamezElmasri and ShamkantNavathe, "*Fundamentals of Database Systems*", Sixth Edition, Addison Wesley, 2010
5. Hector Garcia-Molina, Jeffrey Ullman and Jennifer Widom, "*Database Systems: The Complete Book*", Second Edition, Prentice Hall, 2008
6. Carlo Zaniolo, Stefano Ceri, Christos Faloutsos, Richard T.Snodgrass, V.S.Subrahmanian, Roberto Zicari, ―Advanced Database Systems‖, Morgan Kaufmann publishers,2006.
7. Henry F Korth, Abraham Silberschatz, S. Sudharshan, ―Database System Concepts‖, Sixth Edition, McGraw Hill, 201

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CO2	2	2	1	1	-	-	-	-	-	-	-	-	-	-	-
CO3	1	1	2	1	-	-	-	-	-	-	-	-	-	-	-
CO4	2	1	2	-	-	-	-	-	-	-	-	-	-	-	-
CO5	2	1	1	1	1	-	-	-	-	-	-	-	-	-	-

Semester 2

20CSA511 DATA STRUCTURES AND ALGORITHMS 3 014

COURSE OUTCOMES

CO1: To understand how data are stored and organised.
CO2: Ability to describe stack, queue and linked list operation. Understand basic data structures such as arrays, linked lists, stacks and queues.
CO3: Ability to analyze algorithms and algorithm correctness. To summarize the searching and sorting techniques. Apply Algorithm for solving problems like sorting, searching, insertion and deletion of data
CO4: Understand the concept of Dynamic memory management, data types, algorithms, Big O notation.

CO5: Solve problem involving graphs, trees and heaps. To solve real world problems efficiently. Represent and manipulate data using nonlinear data structures like trees and graphs to design algorithms for various applications.

SYLLABUS

Abstract Data Types, Linear Data Structures: Arrays (single and multi-dimensional), Stack ADT, Multi Stack ADT, Queue ADT, Circular Queue, Singly Linked List, Doubly Linked List, Circular Linked List.
Nonlinear Data Structures: Trees - Array and List Representations: Binary Tree, Binary Search Tree and Threaded Binary Tree. Balanced Trees: Weight Balanced Trees, Applications of WBTs, Height Balanced Trees -AVL Trees, Red-Black Trees. Binary Heaps: applications
Introduction– Asymptotic Notations- Monotonicity vs. Nonmonotonicity - Examples.Analysis of iterative programs, Analysis of recursive programs: Recurrence Relation: Substitution method, Recursion Tree Methods, Master Method. Sorting: Bubble – Insertion Sort- Selection Sort. Divide and Conquer: Quick Sort- Merge Sort- Bucket Sort-Lower Bounds- Heap Sort – Comparisons of Sorting. Greedy Algorithm: Fractional Knap-sack Problem- Task Scheduling Problem.
Dynamic Programming: Longest common subsequence problem, Matrix Multiplication Problem- 0/1 Knap-sack Problem. Branch and Bound - backtracking
Graphs: Matrix and List Representation of Graphs, Breadth First Search, Depth First Search, Shortest Path Algorithms (with Analysis) – Dijkstra - Bellman Ford- Floyd Warshall's all Pair shortest path Algorithm-Minimum spanning Tree (with Analysis) – Kruskal– Prims - Applications of BFS and DFS.

TEXT BOOKS/ REFERENCES:

1. Ellis Horowitz, SartajSahni and Susan Anderson-Freed, "*Fundamentals of Data Strucures in C*", Second Edition, Silicon Press, 2008.
2. Jean-Paul Tremblay and G. Sorenson, "*An introduction to Data Structures with Applications*", Second Edition, Tata McGraw-Hill, 2008.
3. Robert L.Kruse, Bruce P. Leung, Clovis.L. Tondo and ShasshiMogalla, "*Data Structure and Program Design in C*", Pearson Education, Second Edition, 1997.
4. CormenT.H ,Leiserson C.E, Rivest R.L and Stein C, "*Introduction to Algorithms*", Third Edition, Prentice Hall of India, 2009.
5. Baase.S and Gelder A.V., *"Computer Algorithms- Introduction to Design and Analysis*", Third edition, Pearson Education Asia, 2003.

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CO1	1	1	1	1	-	-	1	-	-	-	-	-	-	-	-

CO2	1	1	-	1	-	-	-	-	-	-	-	-	-	-	-
CO3	1	1	1	1	-	-	1	-	-	-	-	-	-	-	-
CO4	1	1	1	1	-	-	1	-	-	-	-	-	-	-	-
CO5	1	1	-	1	-	-	1	1	-	-	-	-	-	-	-

20CSA512 ADVANCED WEBTECHNOLOGIES AND MEAN STACK 3 0 1 4

Objectives: This course helps the students to proficient in Javascript and use HTML, CSS and Javascript to handle front-end operations and back-end server scripting. MEAN is a full-stack development toolkit used to develop a fast and robust web application.

COURSE OUTCOMES

CO1: Let the students acquainted with the latest web application development trends in the IT industry.
CO2:Equip students with principles, knowledge and skills for the design and construction of web-enabled internet applications.
CO3:Design, Implement and deploy an inhouse project using MongoDB, Express.js,AngularJS and Node.js.
CO4: Evaluate different web application development alternatives and choose the appropriate one for a specific scenario.

SYLLABUS

Basics of HTML, CSS, and Javascript HTML, CSS, Bootstrap, Javascript basics – Variables, functions, and scopes, Logic flow and loops, Events and Document object model, Handling JSON data, Understanding Json callbacks.
Introduction to Node JS Installation, Callbacks, Installing dependencies with npm, Concurrency and event loop fundamentals, Node JS callbacks, Building HTTP server, Importing and exporting modules,
Building REST services using Node JS REST services, Installing Express JS, Express Node project structure, Building REST services with Express framework, Routes, filters, template engines - Jade, ejs.

MongoDB Basics and Communication with Node JS Installation, CRUD operations, Sorting, Projection, Aggregation framework, MongoDB indexes, Connecting to MongoDB with Node JS, Introduction to Mongoose, Connecting to MongoDB using mongoose, Defining mongoose schemas, CRUD operations using mongoose.

Building Single Page Applications with AngularJS Single Page Application – Introduction, Two-way data binding(Dependency Injection), MVC in Angular JS, Controllers, Getting user input, Loops, Client side routing – Accessing URL data, Various ways to provide data in Angular JS – Services and Factories, Working with filters, Directives and Cookies, The digest loop and use of $apply.

TEXT BOOKS/ REFERENCES:

1. Simon Holmes , "Getting MEAN with Mongo, Express, Angular, and Node, Second Edition, Manning Publications; 1 edition (31 October 2015)
2. Jeff Dickey, "Write Modern Web Apps with Mean Stack , Peachpit press, 2015
3. Ken Williamson, "Learning Angular JS", O′Reilly; 1 edition (24 March 2015)
4. Mithun Satheesh, "Web development with MongoDB and Node JS", Packt Publishing Limited; 2nd Revised edition (30 October 2015).

CO – PO Affinity Map

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2	PSO3
CO1	1	-	2	-	1	-	1	-	-	-	-	-	-	-	-
CO2	2	1	2	-	2	-	-	-	-	-	-	-	-	-	-
CO3	-	1	3	-	3	-	-	-	-	-	-	-	-	-	-
CO4	-	-	1	-	1	-	-	-	-	-	-	-	-	-	-

20MAT514 MATHEMATICAL FOUNDATIONS OF COMPUTER APPLICATIONS-II 3 0 0 3

Objective

This course will discuss the application of probability in the computer science field and how it is used in the design and analysis of algorithms. This helps to familiar with the graph theory basics in solving computer science problems.

CourseOutcomes

1.Gain in depth knowledge about statistical distributions, properties and real time applications.
2. Acquires knowledge of finite automata theory and to design discrete problems to solve using computers.
3. Apply algorithms and use definitions to solve problems to prove statements in elementary number theory.
4. It enables students to model and solve real world problems using graphs and trees.

Unit 1

Probability and Random Variables-Random experiment, sample space and events. Definitions of probability, addition and multiplication rules of probability, conditional probability and some numerical examples(optional); Random variables: Definition, types of random variables, Probability Mass Function and Probability Distribution Function of random variables; Mathematical expectation: mean, variance, covariance, Moment generating function and Cumulative generating function of random variables; Probability distributions: Binomial, Poisson and Normal distributions with their important characteristics.

Unit II

Finite state automata - Deterministic finite state automata (DFA) - Non deterministic finite state automata (NFA) - Equivalence of DFA and NFA - Equivalence of NFA and Regular Languages

Unit III

Divisibility theory in integers: Division algorithm,GCD,Primes,Euclidean algorithm. Modular Arithmetic – exponentiation and inversion. Fermat's Little Theorem, Euler's Theorem. Solution to congruences, Chinese Remainder Theorem.

Unit IV

Graphs- Basic Concepts, Isomorphisms and Subgraphs, Trees and their Properties, Spanning Trees, Directed Trees, Binary Trees, Planar Graphs, Kruskal's and Prim's algorithms for minimal spanningtrees - Dijkstra's shortest path algorithm.

UNIT - V

Euler's Formula, Euler Circuits, chinese postman problem , applications of kuratowski's theorem, Hamiltonian Graphs,Coloring of graphs,Chromatic Numbers, chromatic polynomials, map colouring,The Four-Color Problem, Max-Flow Min-Cut theorem, maximum bipartite matching.

TEXT BOOKS/ REFERENCES:

1. Ravichandran. J, "Probability and Statistics for Engineers", First Edition, Wiley India, 2012.
2. B.R.Bhatt :Modern Probability Theory , An Introductory text book, Third edition, New Age International,2009.
3. D. B. West, Introduction to Graph Theory, P.H.I. 2010.
4. Hopcroft J.E and Ullman,J.D, "Introduction to Automata Theory, Languages and Computation", Narosa Publishing House, Delhi, 2002.
5. Rosen K. H., "Discrete Mathematics and its Applications", Seventh Edition, Tata McGraw-Hill, New Delhi, 2007.

20CSA513 DATA MINING AND APPLICATIONS3 0 1 4

COURSE OUTCOMES

CO1	Recall important Knowledge discovery concepts, methods, and applications, in particular, thebasic concepts data preprocessing to prepare the data for mining.
CO2	Recall importance of warehouse and identify efficient pattern mining association methods and rules, such as Apriori, and FP-growth.
CO3	Learn pattern-based classifications and prediction, including all classifiers.
CO4	Recall basic concepts, methods, and applications of cluster analysis, including the concept of clustering, the requirements and challenges of cluster analysis, a multi-dimensional categorization of cluster analysis, and an overview of typical clustering methodologies..
CO5	Overview about advanced data types and visualization and applications in various fields.

Introduction: Evolution and Importance of Data Mining-Types of Data and Patterns Mined-Technologies-Applications-Major Issues in Data Mining. Knowing about Data-Data Preprocessing: attribute type, Basic statistical descriptions of data, measuring data similarity and dissimilarity, Cleaning– Integration–Reduction–PCA, Data Transformation and Discretization.

Data warehousing-basic concepts: data warehouse, Difference, Comparison, architecture-data warehouse modeling: datacube, star, snowflakes and fact constellations schemas, typical OLAP operations. Mining Frequent Patterns: Basic Concept – Frequent Item Set Mining Methods – Mining Association Rules – Association to Correlation Analysis.

Classification and Prediction: Issues - Decision Tree Induction - Bayesian Classification – Rule Based Classification – k-Nearest-Neighbor Classification - Linear SVM - Regression – Linear, Logistic - Accuracy and Error measures –Introduction to Ensemble methods

Clustering: Overview of Clustering – Types of Data in Cluster Analysis – Major Clustering Methods-Partitioning Methods- k-Means, k-Medoids. Hierarchical Methods-Agglomerative and Divisive hierarchical clustering-single linkage, complete linkage, average linkage. Density-Based Methods-DBSCAN, Graph-based clustering (CHAMELEON), Grid-based Clustering: CLIQUE, probabilistic Model-Based Clustering-EM algorithm

Datamining trends and research frontiers- Mining complex Data types- Mining other kinds of data-data mining applications.

Lab :Implementation of Data mining algorithms using Latest Open Source Data mining Tools.Tensorflow, python, R

TEXT BOOKS/ REFERENCES:

1. Jiawei Han, Micheline Kamber and Jian Pei, “Data mining concepts and Techniques”, Third Edition, Elsevier Publisher, 2006.
2. K.P.Soman, Shyam Diwakar and V.Ajay, “Insight into data mining Theory and Practice”, Prentice Hall of India, 2006.
3. Yanchang Zhao, “R and Data Mining”, Elsevier, 2013 4. AurélienGéron, Hands-On Machine Learning with Scikit-Learn and TensorFlow, O'Reilly Media, 2017 5. Itay Lieder, YehezkelResheff, Tom Hope, Learning TensorFlow, O'Reilly Media, 2017

20CSA514 RESEARCH METHODOLOGIES AND CASE STUDY 110 2

COURSE OUTCOME

CO1: To develop understanding of the basic framework of research process

CO2: identify various sources of information for literature review and data collection.

CO3: Gain a practical understanding of the various methodological tools used for conducting research

CO4: Able to conduct a research study from its inception to its report and study on Ethical issues in research

CO5: To formulate a problem based on a case study and design a proper research design with supporting literature survey

Research: Meaning, Purpose, Types of Research, Steps in Research, Identification, Selection and Formulation of Research Problem, Research Questions, Research Design, Formulation of Hypothesis, Review of Literature. Internet as a source in identifying gap areas from literature reviews and emerging trends. Sampling Technique: Types of Sampling, Steps in Sampling, Sample Size, Advantages and Limitations of Sampling.

Data for Research: Primary Data, Collection Methods, Observation, Interview, Questionnaire, Pre-test-Pilot test, Experimental and Case Studies, Secondary Data, Relevance, Limitations and Cautions. Processing Data: Checking, Editing, Coding, Transcriptions and Tabulation. Data Analysis- Meaning and Methods- Quantitative and Qualitative Analysis. Statistical Tables, Diagrams and Graphs, Measures of Averages, Measures of Dispersion, Correlation Analysis and Regression Analysis.

Familiarization of Spreadsheet Tools, Presentation Tools and Writing Tools, Structuring the Report, Pagination, Identification, Presenting Footnotes, Abbreviations, Presentation of Tables and Figures- Referencing- Use and Format of Appendices, Indexing.

Research Report: Types of Reports- Styles of Reporting- Steps in Drafting Reports-Editing and Evaluating the Final Draft. Developing a Proposal and Working in a Research Team.

Ethical Issues, Copyright, Royalty, Intellectual Property Rights and Patent Law, Reproduction of Published Material, Citation and Acknowledgement.

Case study – choosing a computational problem, problem definition, scope, objective, literature survey, data collection, sampling, research design and report

TEXT BOOKS/ REFERENCES:

1. *CR Kothari: "Research Methodology-Methods and Techniques", New Age International Publishers,* 2004
2. *Jacques Barzun, Henry F. Graff: "The Modern Researcher" Edition 6, Wadsworth Inc Fulfillment,* 2003
3. *Carlo Lastrucci, The Scientific Approach: Basic Principles of the Scientific Method (Cambridge, Mass.: Schenkman, 1967)*

CO – PO Affinity Map

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO 2	PSO 3
CO1	3	2	2	2	-		1	-	-	-	-	-	-	-	-
CO2	2	3	1	2	1	1	1	-	-	-	-	-	-	-	-
CO3	1	2	1	2	3	-	-	1	-	-	-	-	-	-	-
CO4	2	2	3	2	1	2	1	1	1	1	1	-	-	-	-
CO5	2	3	2	1	2	1	1	2	-	2	1	1	-	-	-

Semester 3

20CSA601 MACHINE LEARNING 3 0 1 4

COURSE OUTCOMES:

CO1: Ability to select and implement machine learning techniques and computing environment that are suitable for the applications under consideration.
CO2: Ability to understand and apply scaling up machine learning techniques and associated computing techniques and technologies.
CO3: Ability to recognize and implement various ways of selecting suitable model parameters for different machine learning techniques.
CO4: To develop skills of using recent machine learning software for solving practical problems.
CO5: To gain experience of doing independent study and research.

SYLLABUS:

Introduction to ML; Problems, data and tools. Learning systems, goals, challenges and applications of machine learning system. Aspects of developing system, training data, testing data, concept representation, classification errors, validation. Linear regression, SSE, gradient decent, bias and variance estimation, overfitting and underfitting, regularization.

Logistic regression, hypothesis representation, decision boundary, cost function, multi-class classification. Nearest neighbor methods. Decision Tree learning, representing concepts as decision trees, picking the best splitting attribute: entropy and information gain. Probability and

classification, Naïve Bayes classification, Non-linear predictions, EM algorithm, kernels, Kernel regression, kernels, Support vector machine (SVM) and kernels, kernel optimization.

Neural networks learning, non-linear hypothesis, model representation, perceptron, cost function, back propagation algorithm. Unsupervised learning, clustering, different clustering methodologies. Dimensionality Reduction, Data compression, PCA, LDA algorithm. Current problems on machine learning.

CO – PO Affinity Map

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2	PSO3
CO1	3	1	1	-	-	-	-	-	-	-	-	-	-	-	-
CO2	2	1	2	2	-	-	-	-	-	-	-	-	-	-	-
CO3	1	1	3	-	-	-	-	-	-	-	-	-	-	-	-
CO4	2	1	2	1	-	-	-	-	-	-	-	-	-	-	-
CO5	1	2	2	1	2	1	-	1	-	-	1	-	-	-	-

TEXTBOOKS / REFERENCES:

1. Machine Learning, Tom Mitchell, McGraw Hill, 1997
2. Christopher, M. Bishop. Pattern Recognition and Machine Learning, Springer-Verlag New York, 2016.
3. Duda, Richard, Peter Hart, and David Stork, "Pattern Classification" Second Edition, New York, NY: Wiley-Interscience, 2000.
4. Hastie, T., R. Tibshirani, and J. H. Friedman, "The Elements of Statistical Learning: DataMining, Inference and Prediction", New York, Springer, 2001.

20CSA602 SOFTWARE ENGINEERING AND DESIGN PATTERNS 3 0 0 3

COURSE OUTCOMES

CO1: Deliver quality software products by possessing the leadership skills as an individual or contributing to the team development and demonstrating effective and modern working strategies by applying both communication and negotiation management skill.

CO2: Understands the concept of pattern based analysis and design and the pattern based design principle. Learn that design patterns are solutions, and they can solve many problems that can be encountered in the future.

CO3: Understands how to apply the pattern based analysis and design to the software to be developed. Understands the structure of design patterns and the logic of design patterns. Understands the importance of design patterns in software development.
CO4: Understands the details of object oriented programming by comparing the object-oriented programming model with the standard structured programming.
CO5: Uses the basic design principles in solving real life problems

SYLLABUS

Software Engineering – Introduction - Software Classification - Layered Technology – Software Process –Practice - Generic Process Model , Process Assessment and Improvement – CMMI framework - Perspective Models - Specialized Models - Agile Process Models Requirements Engineering – SRS - Requirement Analysis- Unified Modelling Language –Approaches - Scenario based Modelling - UML Models that supplement Use Cases –

Activity and Swim lane Diagrams - Design Engineering - Architectural Design – Modelling Component level design - Performing User Interface Design.
Introduction: What Is a Design Pattern?, Design Patterns in Smalltalk MVC, Describing Design Patterns, The Catalog of Design Patterns, Organizing the Catalog, How Design Patterns Solve Design Problems, How to Select a Design Pattern, How to Use a Design Pattern.
A Case Study: Designing a Document Editor : Design Problems, Document Structure, Formatting, Embellishing the User Interface.

Creational Patterns: Abstract Factory, Builder, Factory Method, Prototype, Singleton, Discussion of Creational Patterns. Structural Pattern Part-I : Adapter, Bridge, Composite. Structural Pattern Part-II: Decorator, açade, Flyweight, Proxy.Behavioral Patterns Part-I : Chain of Responsibility, Command, Interpreter, Iterator. Behavioral Patterns Part-II : Mediator, Memento, Observer, State, Strategy, Template Method ,Visitor, Discussion of Behavioral Patterns.

TEXT BOOKS/ REFERENCES:

1. Roger S. Pressman, “Software Engineering-A Practitioner’s Approach”, Seventh Edition, Tata McGraw-Hill, 2010.
2. Ian Sommerville “Software Engineering”, Ninth Edition, 2011
3. Richard Fairley , “Software Engineering concepts”, Tata McGraw-Hill Publishing Company Pvt. Ltd., Ninth Edition
4. Pattern’s in JAVA Vol-I By Mark Grand ,WileyDreamTech.
5. JAVA Enterprise Design Patterns Vol-III By Mark Grand ,WileyDreamTech.
6. Head First Design Patterns By Eric Freeman-Oreilly-spd

CO – PO Affinity Map

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2	PSO3
CO1	1	1	1	1	-	1	1	1	1	-	-	1	-	-	-
CO2	1	1	1	1	-	-		1	1	-	-	1	-	-	-
CO3	1	1	1	1	-	1	1	1	-	-	-	-	-	-	-
CO4	1	1	1	1	-	-	1	1	-	-	-	-	-	-	-
CO5	1	1	1	1	-	-	1	1	-	-	-	-	-	-	-

20CSA681 IOT AND CLOUD LAB 0 0 1 1

COURSE OUTCOMES

CO1: Understand different types of cloud services – Delivery models, Deployment models using promient cloud platforms
CO2: Implement different solution approaches in Cloud – VM, containers , setting up and monitoring applications in cloud
CO3: Understand general concepts of IoT and recognize different devices –IoT Architecture, Microcontroller basics (Arduino/NodeMCU), Different Sensors, Communication Protocols, Networking
CO4: Create IoT solutions using sensors, actuators and devices and evaluate the design/security issues in it – Home automation, Industry applications, Surveillance applications and other IoT applications

SYLLABUS

Cloud Computing:- Familiarize various cloud platforms AWS, Google cloud etc, Create and configure VMs, Working with Containers and docker, Application development and deployment in cloud, Containerizing and orchestrating apps with Kubernetes Engine, Different storage options, Monitoring and load-balancing
Internet of Things:- Introduction to IoT, Reference Architecture, Microcontroller basics (Arduino/NodeMCU), Sensing, Actuation, Networking basics, Communication Protocols, Sensor Networks, IoT with Cloud Platforms, Domain specific applications of IoT (Home automation, Industry applications, Surveillance applications, Other IoT applications), Privacy and Security issues in IoT.

TEXT BOOKS/ REFERENCES:

1. https://www.qwiklabs.com/
2. https://sites.google.com/google.com/gcp-teachingresources/home?pli=1&authuser=1
3. Vijay Madisetti and ArshdeepBahga, “Internet of Things (A Hands-on-Approach)”, 1st Edition, VPT, 2014

4. https://www.arduino.cc/en/Tutorial
5. https://randomnerdtutorials.com/esp8266-web-server/

CO – PO Affinity Map												
PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO												
CO1	1	1	-	-	3	-	-	-	-	-	-	-
CO2	1	2	3	2	3	-	-	-	-	-	-	-
CO3	2	1	-	-	1	-	-	-	-	-	-	-
CO4	1	1	3	-	3	-	-	-	-	1	1	-

20CSA698 Dissertation – Phase I 4 Credits

The goal of Dissertation-Phase I is to help the student apply the theories and important tools they studied in this MCA program to solve real world problems and mobilize the students for the next semester course Dissertation-Phase II.

Course Objectives:

CO-01**:** Provide opportunities to identify real world problems.
CO-02**:** Conduct thorough literature review on the problem domain.
CO-03: Specialize in problem specific methods, applications and tools.
CO-04: Demonstrate independence and originality in thought and application.
CO-05: Provide opportunity to work as a team and evaluate the developed product/algorithm both from individuals' and teams' perspective.

CO – PO Affinity Map

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	2	-	3	-	2	3	1	3
CO2	3	3	3	3	2	2	2	-	2	-	-	2

CO3	3	2	3	3	3	1	-		-	-	-	2
CO4	2	1	1	1	1	3	-	-	3	-	3	3
CO5	2	2	1	1	1	3	-	-	3	-	3	2

Semester 4

20CSA699 Dissertation – Phase II 12 credits

The goal of Dissertation Phase II is to help the student experienced in industrial/research projects by applying the skills they acquired by the different courses in MCA program, to solve real world problems.

Course Objectives:

CO-01: Apply the skills a student acquired through the different courses in this program to design software solutions for real world problems.
CO-02: To expose the student to the industry-standard project practices, under time and deliverable constraints.
CO-03: Provide opportunity to work as a team and evaluate the developed product/algorithm both from individual's and team's perspective.
CO-04: Train the student to write and publish research papers.
CO-05: Demonstrate independence and originality in thought and application and communicate among software professionals to demonstrate the knowledge and principles.

CO – PO Affinity Map

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	3	3	2	2	1	1	2	3	2	3
CO2	3	3	3	3	2	3	1	3	2	-	2	2
CO3	3	2	3	3	3	2	2	2	-	-	3	2
CO4	2	1	1	1	1	3	3	-	-	2	2	3
CO5	2	2	1	1	1	3	3	-	-	2	2	3

ELECTIVES

20CSA531Artificial Intelligence 3 0 0 3

OBJECTIVE- The course aims to offer a view of the conventional approach to Artificial Intelligence and serves as a basis for more in depth treatment of specific theories and principles for understanding complete A.I. systems integrating different approaches and methods. The course also helps to familiarize the students with how to represent knowledge, including incomplete and uncertain knowledge of the real world; how to reason logically with that knowledge using probabilities; and so on. The course also incorporates some state-of-the-art topics, such as the logical representation of different types of knowledge and reasoning under uncertainty.

COURSE OUTCOMES

CO1	To be aware of the basics of AI and its need along with the issues in designing search problems
CO2	Understand various AI search algorithms (uninformed, informed, heuristic, constraint satisfaction, genetic algorithms)
CO3	To get a thorough idea about the fundamentals of knowledge representation (logic-based, frame-based, semantic nets), inference and theorem proving
CO4	Express and comprehend the working knowledge of reasoning in the presence of incomplete and/or uncertain information
CO5	To gain the aptitude to apply knowledge representation and reasoning to real-world problems, to develop expert systems.

SYLLABUS

Artificial Intelligence – Basics, The AI Problems – The Underlying Assumption – What is an AI technique – Criteria for Success. Problems, Problem Spaces and Search – Defining Problem as a State Space Search – Production Systems – Problem Characteristics – Production System Characteristics – Issues in the design of Search Programs.

Heuristic Search Techniques - Generate – and – Test – Hill Climbing – Best-First Search – Problem Reduction – Constraint Satisfaction - Means - Ends Analysis. Knowledge Representation issues – Representations and Mapping - Approaches to knowledge Representation – Issues in knowledge Representation – The Frame Problem. Using Predicate Logic – Representing simple facts in Logic – Representing Instance and Isa Relationship – Computable Functions and Predicates – Resolution – Natural Deduction. Representing Knowledge Using Rules – Procedural versus Declarative knowledge – Logic Programming – Forward versus Backward Reasoning – Matching – Control Knowledge. Symbolic

Reasoning under Uncertainty – Introduction to Non-monotonic Reasoning – Augmenting a Problem Solver – Implementation: Depth - First Search. Statistical Reasoning – Probability and Baye's Theorem – Bayesian Networks – Fuzzy Logic.
Game Playing - The Minimax Search Procedure – Adding Alpha-Beta Cutoffs. Understanding – What is Understanding? What makes Understanding hard? Common Sense – Qualitative Physics – Commonsense ontology – Memory Organization - Expert Systems – Representing and Using Domain knowledge – Expert System Shells – knowledge Acquisition - Components of an AI program.

TEXTBOOKS:

1. *Artificial Intelligence (Second Edition) – Elaine Rich, Kevin knight (Tata McGraw-Hill)*
2. *A Guide to Expert Systems – Donald A. Waterman (Addison-Wesley)*

REFERENCES:

1. *Principles of Artificial Intelligence – Nils J. Nilsson (Narosa Publishing House)*
2. *Introduction to Artificial Intelligence – Eugene Charnaik, Drew McDermott (Pearson Education Asia)*

CO – PO AFFINITY MAP

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	1	-	-	-	-	-	-	-	-
CO2	2	1	1	-	-	1	-	-	-	-	-	-
CO3	3	2	1	1	-	-	-	-	-	-	-	-
CO4	1	2	1	1	-	1	1	-	-	-	-	-
CO5	2	1	1	1	-	-	1	-	-	-	-	-

20CSA532 Mobile Application and Development 3 0 0 3

Course Outcome

1. This Course provides a comprehensive overview of how to integrate mobile technology. This course focuses on developing multiplatform mobile applications using the Web skills.
2. Learn to setup Android application development environment
3. Create, test and debug Android application by setting up Android development environment
4. Illustrate user interfaces for interacting with apps and triggering actions
5. Analyze performance of android applications and understand the role of permissions and security

Module: 1

Introduction-Mobile vs. Desktop devices -App Store, Google Play, Windows Store –Development environments-Phone GAP- Native vs. web applications – Mobile Connectivity Evolution. Characteristics and advantages of mobile communication, types of mobile applications – development approaches, overview of mobile strategy and designing mobile solutions.

Module:2

Introduction to the Android Platform(Android Studio), Android Platform and Development Environment, Application Fundamentals, The Activity Class. Get started, Build your first app, Install Tools, Create HelloWorld App, Activities, Testing, debugging and using support Libraries.

Module: 3

User Interaction Application Development, Testing UI, Background Tasks, Triggering, scheduling and optimizing tasks.

Module: 4

Data Storage and accessing the mobile data with different databases, Preferences and Settings, Storing data using SQLite, Sharing data with content providers, Loading data using Loaders. Google APIs for Android - Maps, Cloud Messaging, Authentication, Storage, Hosting and Google Play services.

Module: 5

Different level of security in mobile application, Solution of attacks, malware, permission, Firebase and Recent Trends.

TEXTBOOKS

1. Google Developer Training, "Android Developer Fundamentals Course – Concept Reference", Google Developer Training Team, 2017.
2. Brian Fling, "Mobile Design and Development" O'Reilly Media,2009.
3. Maximiliano Firtman "Programming the Mobile Web", O'Reilly Media, 2010.
4. Erik Hellman, "Android Programming – Pushing the Limits", 1st Edition, Wiley India Pvt Ltd, 2014.
5. Valentino Lee, Heather Schneider, and Robbie Schell, "Mobile Applications: Architecture, Design and Development", PrenticeHall , 2004.

CO – PO Affinity Map

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2	PSO3
CO1	3	3	2	2	-	-	-	-	3	-	-	-	-	-	-
CO2	2	2	2	1	3	-	-	-	-	-	-	-	-	-	-
CO3	2	2	3	1	3	1	-	-	2	1	1	-	-	-	-
CO4	2	2	3	-	3	-	-	-	-	-	2	-	-	-	-
CO5	1	2	2	1	2	1	2	1	-	-	3	3	-	-	-

20CSA533 CRYPTOGRAPHY 3003

Course Objectives: The course provides the inner workings of cryptographic systems and how to correctly use them in real-world applications. It describes various cryptographic algorithms

COURSE OUTCOMES

CO1: To understand the mathematical fundamentals of Cryptography.
CO2: To acquire knowledge on standard algorithms used to provide confidentiality, integrity and authenticity.
CO3: To acquaint with Discrete logarithm and the Public Key Cryptographic methods.
CO4: To understand message authentication and hash functions.
CO5: To be familiar with the significance of digital signatures and digital signature algorithms.

SYLLABUS

Mathematical Background for Cryptography-integer arithmetic, modular arithmetic, matrices, linear congruence, algebraic structures,GF(2n) fields.

Symmetric key ciphers – Kerckhoff's principle, substitution ciphers, transposition ciphers, stream and block ciphers,modern block ciphers, modern streamciphers, DES structure and analysis, multiple DES, security, AES- transformations, key expansion, ciphers, analysis.

Discrete Logarithm and its Applications - Introduction, Diffie-Hellman Key Exchange, Other Applications. Asymmetric key cryptography – RSA cryptosystem, RABIN cryptosystem, ELGAMAL cryptosystem, elliptic curve cryptosystem.

Message integrity- hash functions,Random oracle model, message authentication, MAC (Message Authentication Codes) and other applications, digital signature.

TEXT BOOKS/ REFERENCES:

1. Behrouz A. Forouzan, "Cryptography and Network Security", Tata McGraw-Hill Publishing.
2. Cryptography and Network Security- William Stallings, Pearson Education, 7th Edition.
3. Wenbo Mao, "Modern Cryptography, Theory & Practice", Pearson Education.
4. Manuel Mogollon, "Cryptography and Security Services – Mechanisms and Applications", Cybertech Publishing.

CO – PO Affinity Map

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2	PSO3
CO1	3	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO2	2	2	3	-	1	-	-	-	-	-	-	-	-	-	-
CO3	1	1	3	-	1	-	-	-	-	-	-	-	-	-	-
CO4	1	1	3	-	1	-	-	-	-	-	-	-	-	-	-
CO5	1	1	3	-	1	-	-	-	-	-	-	-	-	-	-

Course Objectives: The main objective of this course is to introduce the major concept areas of language translation and compiler design and to develop an awareness of the function and complexity of modern compilers. This course is a study of the theory and practice required for the design and implementation of interpreters and compilers for programming languages.

COURSE OUTCOMES

CO1: To understand the theory and practice of compiler implementation.

CO2: To learn finite state machines and lexical scanning.

CO3: To learn context free grammars, compiler parsing techniques, construction of abstract syntax trees, symbol tables, intermediate machine representations and actual code generation

CO4: Identify the similarities and differences among various parsing techniques and grammar transformation techniques.

CO5: To provide practical, hands on experience in compiler design

SYLLABUS

Automata and Language: Chomsky hierarchy of languages, Introduction to Finite Automata –Non-Deterministic Finite Automata- equivalence of NFAs and DFAs- minimization of DFA-Regular Expressions. Context-free Grammar - Parse tree derivations (Top-down, Bottom-up), Context-free languages – Chomsky normal form, GNF.

Introduction to Compilers: Compiler structure – Overview of Translation. Lexical Analysis: From regular expression to Scanner. Implementation of scanner: Lex - Parsers: Expressing syntax – Top-down parsing: Recursive descent parsing, Non-recursive predictive parsing. Bottom-up parsing: LR(0), LR(1) and LALR(1) – Implementation of Parser - YACC

Context-Sensitive Analysis: Type Systems – Attribute – Grammar – Syntax Directed Translation. Intermediate Representations: Graphical and Linear Intermediate Representations – Symbol tables. Procedure Abstraction: Procedure calls – Name Spaces – Communicating Values between Procedures.

Iterative Data Flow Analysis – Instruction selection via Tree Pattern Matching – Register allocation: Local and Global – Introduction to Optimization.

TEXT BOOKS/ REFERENCES:

1. *Peter Linz*, "*An Introduction to Formal Languages and Automata*", Fifth Edition, 2012.

2. *Keith Cooper and Linda Torczon*, "*Engineering a Compiler*", Second Edition, Morgan Kauffmann, 2011.
3. *Alfred V.Aho, Monica S. Lam, Ravi Sethi and Jeffrey D. Ullman*, "*Compilers: Principles, Techniques and Tools*", Prentice Hall, Second Edition, 2006.
4. *Andrew W. Appel and Jens Palsberg*, "*Modern Compiler Implementation in Java*", Cambridge University Press, Second Edition, 2002.

CO – PO Affinity Map

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2	PSO3
CO1	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-
CO2	2	2	2	-	1	-	-	-	-	-	-	-	-	-	-
CO3	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-
CO4	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-
CO5	1	1	2	-	1	-	-	-	-	-	-	-	-	-	-

20CSA535BIG DATA ANALYTICS AND VISUALIZATION 3 0 0 3

COURSE OUTCOMES

CO1: Gain the ability to choose the right solution for a commercial task involving big data, including databases, architectures and cloud services.
CO2: Gain an understanding of the analysis of big data including methods to visualise and automatically learn from vast quantities of data.
CO3: Develop the programming skills to build solutions using big data technologies such as Map Reduce, scripting for No-SQL, Apache Mahout, Hive and the ability to write parallel algorithms for multi-processor execution.
CO4: Understanding of the issues of scalability of databases, data analysis, search and optimization.
CO5: Get insights into different data visualization techniques. Understanding of real life issues faced by different organizations and its effective solutions

Introduction of big data – Big data characteristics - Volume, Veracity, Velocity, and Variety – Data Appliance Challenges and Issues, Case for Big data, Big data sources, Features of data. - Evolution of Big data – Best Practices for Big data Analytics - and Integration tools Introduction to Data Modeling, Data Models Used in Practice: Conceptual data models, Logical data models, Physical data models, Common Data Modeling Notations , How to Model Data : Identify entity types, Identify attributes, Apply naming conventions, Identify relationships,

Apply data model patterns, Assign keys, Normalize to reduce data redundancy, Introduction to elementary data analysis: Measures of center: Mean, Median, Mode, Variance, Standard deviation, Range. Normal Distribution: Center, Spread, Skewed Left, Skewed Right, outlier. Correlations: Correlation Patterns: Direction relationship, Magnitude Relationship. Introduction to Bayesian Modeling: Bayes Rule, Probabilistic Modeling Introduction to Predictive Analytics: Simple Linear regression, Multiple Linear regression, Logistic Linear Regression. History of Visualization, Goals of Visualization, Types of Data Visualization: Scientific Visualization, Information Visualization, Visual Analytics, Impact of visualization Introduction to Data Processing , Map Reduce Framework , Hadoop ,HDFS , S3 Hadoop Distributed file systems, Apache Mahout, Hive,Sharding, Hbase , Impala , Case studies : Analyzing big data with twitter ,Big data for Ecommerce , Big data for blogs.

TEXT BOOKS/ REFERENCES:

1. Frank J Ohlhorst, "Big Data Analytics: Turning Big Data into Big Money", Wiley andSAS Businessm.Series, 2012.
2. The Data Modeling Handbook: A Best-Practice Approach to Building Quality DataModels 1st Edition by Michael C. Reingruber (Author), William W. Gregory(Author) A Wiley QED publications
3. Colleen Mccue, "Data Mining and Predictive Analysis: Intelligence Gathering andCrime Analysis",Elsevier, 2007
4. Correlation and Regression: Applications for Industrial Organizational Psychologyand Management (Organizational Research Methods) 1st Edition, by Philip BobkoMultiple Regression and Beyond 1st Edition by Timothy Z. Keith.

CO – PO Affinity Map

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO 2	PSO 3
CO1	2	1	1	1	1	-	-	-	-	-	-	-	-	-	-
CO2	3	2	1	3	1	-	-	-	-	-	-	-	-	-	-
CO3	1	1	2	2	3	-	-	1	-	-	-	-	-	-	-
CO4	2	2	3	2	1	-	-	-	-	-	-	-	-	-	-
CO5	1	2	3	1	2	1	-	2	-	1	1	-	-	-	-

20CSA536 C# AND .NET FRAMEWORK 3 0 0 3

Objectives: Using a syntax that is deliberately from Java, C++ and C, C#.NET achieves a natural trade-off of terseness and clarity, enabling programmers to express concepts in a clear and maintainable form. The recent enhancements to the language allowing students to work with C#.NET in both an Object-Oriented and partially functional style.

Course Outcomes

CO1	**Learn to use .NET frame work and basic programming concepts in C#**
CO2	**Students will be able to develop programs to solve real world problems using C# in .Net framework.**
CO3	**Understand the Window Programming and event driven programming. Must be able to develop interactive programs for real time aaplications.**
CO4	**Understanding the Role of Managed Provider and ADO.NET Objects.**
CO5	**Must be able to understand the concepts of serialization/deserialization used with binary data.**

SYLLABUS

Unit 1

.Net Framework Overview- Architecture-.Net Framework class Libraries-CLR-Metadata-Interoperability-Assemblies-the .net Packaging system-CLR-MSIL , Introduction to Visual Studio.Net-C# Programming Concepts-Predefined Types- Value types and reference type, Classes and Objects, Constructors and methods , Conditional statements, loops, arrays, Collection classes: ArrayList, HashTable, Stack ,Queue, indexers and properties. Generic Collection Classes: parametric polymorphism-working

Unit 2

String class: methods and properties of string class, enumerations, boxing and unboxing, OOPS concepts: Encapsulation, data hiding, inheritance, interfaces, polymorphism, operator overloading, overriding Methods, Static Class members, Delegates and events. Exception Handling, garbage collector, DLLs, Assemblies, Reflection and Class Libraries.

Unit 3

Basics of Windows Programming- Event Driven Programming, Windows Forms, Using common controls-Labels, textboxes, buttons, check boxes, radio button, progress bar, combo box, list box. Components-timer, Imagelist, Menus, Modal and Modeless Dialog Boxes, MDI, Mouse

and keyboard event handling.Components: Timer, FileSystemWatcher, Process, BackgroundWorker. Drag and Drop , Advanced Controls : TreeView and ListView

Unit 4

Introduction to ADO.Net-Object Model- System. Data Namespace- Data Bound controls- Connected Mechanism-Disconnected mechanism- .Net Data Providers.

Unit 5:

Files: System.IO, directory and file types, Stream readers and stream writers, dealing with Binary files: Serialization / Deserialization.

Textbook/Reference:

1. C# 4.0 the Complete Reference by Herbert Schildt
2. Latest version of Andrew Trolsens C# text from Apress(Pro C# 5.0 and the .NET Framework 4.5)
3. Robert Powel, Richard Weeks, C# and the .NET Framework, Techmedia

CO – PO Affinity Map

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2	PSO3
CO1	3	2	3	-	-	-	-	-	-	-	-	-	-	-	-
CO2	2	1	1	1	-	-	-	-	-	-	-	-	-	-	-
CO3	3	1	1	1	-	-	-	1	-	-	-	-	-	-	-
CO4	2	1	1	2		-	-	2	2	-	-	1	-	-	-
CO5	3	2	2	2	1	1	-	2	2	-	-	1	-	-	-

20CSA537 Parallel and Distributed Computing 3 0 0 3

COURSE OUTCOMES

CO1. Understand the requirements for programming parallel systems and how they can be used to facilitate the programming of concurrent systems.

CO2. To learn and apply knowledge of parallel and distributed computing techniques and methodologies

CO3. To learn the architecture and parallel programming in graphics processing units (GPUs)

CO4. Understand the memory hierarchy and cost-performance tradeoffs.

CO5. To gain experience in the design, development, and performance analysis of parallel and distributed applications

SYLLABUS

Introduction-Asynchronous/synchronous computation/communication, concurrency control, fault tolerance, GPU architecture and programming, heterogeneity, interconnection topologies, load balancing, memory consistency model, memory hierarchies, Message passing interface (MPI), MIMD/SIMD examples.

Multithreaded programming, parallel algorithms & architectures, parallel I/O, performance analysis and tuning, power, programming models (data parallel, task parallel, process-centric, shared/distributed memory), scalability and performance studies, scheduling, storage systems, synchronization, and tools

TEXTBOOKS/REFERENCES

1. Kai Hwang, Jack Dongarra& Geoffrey C. Fox, "Distributed and Cloud Computing: Clusters, Grids, Clouds, and the Future Internet (DCC)", 2012.
2. Andrew S. Tanenbaum& Maarten van Steen, "Distributed Systems: Principles and Paradigms", Prentice Hall, 2017.

CO – PO Affinity Map

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2	PSO3
CO1	3	2	1	-	-	-	-	-	-	-	-	-	-	-	-
CO2	2	2	2	3	1	-	-	1	-	-	-	-	-	-	-
CO3	1	1	2	1	-	-	-	-	-	-	-	-	-	-	-

CO4	2	2	2	-	1	-	-	-	-	-	-	-	-	-	-
CO5	3	2	1	1	1	-	-	-	-	-	-	-	-	-	-

Elective

20CSA538 Advanced Algorithms 3-0-0-3

Course objectives

This course introducesstudents to advanced techniques for the design and analysis of algorithms and explores a variety of applications. It gives a sound theoretical understanding of algorithms and improves the scientific problem solving skills.

Course outcomes

CO 1. Understand advanced algorithmic methods to solve problems
CO 2. Learn various graph algorithms and solve computational problems using graph models
CO 3. Learn Network flow algorithms with applications
CO 4. Understand NP completeness and methods to tackle Hard problems.

Syllabus

Unit 1. Basics of algorithms– Asymptotic analysis, amortised analysis, Recurrences, Greedy, Dynamic programming and backtracking methods
Unit 2. Graph algorithms, BFS and DFS, applications, topological sort, strongly connected component, bi-connected component, articulation points, graph colouring, bipartite graph, Network flow, residual network, applications
Unit 3. P, NP and NP complete problems, polynomial time reduction, Approximation algorithms, approximation ratio, vertex cover, tsp, Parameterized Algorithms

References

1. Cormen, Leiserson, Rivest, Stein: "Introduction to Algorithms", 3/E, the MIT Press, 2009.
2. Vijay V. Vazirani. Approximation Algorithm, Springer; 2003
3. Parameterized Algorithms, Cygan et al.Springer 2015

CO-PO mapping

PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	-	-	-	-	-	-	-	-	-
CO2	1	2	3	2	1	-	-	-	-	-	-	-
CO3	2	3	2	2	1	-	-	-	-	-	-	-
CO4	2	3	3	2	2	-	-	-	-	-	-	-

20CSA539DEEP LEARNING 3 0 03

COURSE OUTCOMES

CO1:To know the main techniques in deep learning and the main research in this field.

CO2: Be able to design and implement deep neural network systems.

CO3: Be able to identify new application requirements in the field of computer vision.

CO4: Applying knowledge and understanding

CO5: To learn how to develop algorithms for resolving huge data processing problems.

SYLLABUS

Image Classification: Data driven approach – k- Nearest Neighbor - Linear Classification: Support Vector Machine – softmax – Optimization: Stochastic Gradient Descent – Backpropagation – Neural Network Architecture: model of a biological neuron – activation functions – neural net architecture – preprocessing – weight initialization - batch normalization – regularization – loss functions- Learning and Evaluation – Convolutional Neural Networks: Architectures – Convolution / pooling layers – Understanding and Visualizing Convolutional Neural Networks . Lenet, Alexnet, Googlenet for visual perception tasks.

TEXT BOOKS/ REFERENCES:

1. Domingos, Pedro. "A few useful things to know about machine learning." *Communications of the ACM* 55.10 (2012): 78-87.
2. Li Fei-Fei (Stanford), Rob Fergus (NYU), Antonio Torralba (MIT), "Recognizing and Learning Object Categories" (Awarded the Best Short Course Prize at ICCV 2005).
3. Baydin, AtilimGunes, Barak A. Pearlmutter, and Alexey AndreyevichRadul. "Automatic differentiation in machine learning: a survey." *arXiv preprint arXiv:1502.05767* (2015).
4. Bengio, Yoshua. "Practical recommendations for gradient-based training of deep architectures." *Neural Networks: Tricks of the Trade*. Springer Berlin Heidelberg, 2012. 437-478.
5. LeCun, Yann A., et al. "Efficient backprop." *Neural networks: Tricks of the trade*. Springer Berlin Heidelberg, 2012. 9-48.
6. Simonyan, Karen, Andrea Vedaldi, and Andrew Zisserman. "Deep inside convolutional networks: Visualising image classification models and saliency maps." *arXiv preprint arXiv:1312.6034* (2013).
7. Zeiler, Matthew D., and Rob Fergus. "Visualizing and understanding convolutional networks." *Computer vision–ECCV 2014*. Springer International Publishing, 2014. 818-833.
8. Springenberg, Jost Tobias, et al. "Striving for simplicity: The all convolutional net." *arXiv preprint arXiv:1412.6806* (2014).
9. Russakovsky, Olga, et al. "Imagenet large scale visual recognition challenge." *International Journal of Computer Vision* 115.3 (2015): 211-252.

CO – PO Affinity Map

PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2	PSO3

CO															
CO1	3	1	1	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	1	3	-	-	-	-	-	-	-	-	-	-	-
CO3	2	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	1	3	1	1	-	-	-	-	-	-	-	-	-	-
CO5	2	2	2	1	3	1	-	1	-	-	1	-	-	-	-

20CSA540 **SOFTWARE TESTING** **3 0 0 3**

COURSE OUTCOMES

CO1) Introduction to different software testing techniques, process and errors handled in software projects.

CO2) Distinguish black box and white box testing techniques for functional and structural testing and testcase designing.

CO3) To understand the different testing activities and levels of testing which aims to uncover the defects in all the stages of project.

CO4) Discuss about the non-functional testing and debugging methods.

CO5) Demonstrate various issues for object-oriented testing and tools for testing.

SYLLABUS

Introduction: Introduction to software testing and analysis, Error, Fault, Failure, Incident, Test Cases, Testing Process, Limitations of Testing, No absolute proof of correctness.

Specification-based testing techniques, code-based testing techniques, Model-based testing,
Blackbox box testing- Functional Testing: Boundary Value Analysis, Equivalence Class Testing, Decision Table Based Testing, Cause Effect Graphing Technique.
Whitebox testing- Structural Testing: Path testing, DD-Paths, Cyclomatic Complexity, Graph Metrics, Data Flow Testing, Mutation testing, Static Analysis, Dynamic Analysis
Reducing the number of test cases: Prioritization guidelines, Priority category, Scheme, Risk Analysis, Regression Testing, Slice-based testing
Testing Activities: Unit Testing, Levels of Testing, Integration Testing, System Testing, Debugging, Domain Testing, Regression Testing, Acceptance testing
Object Oriented Testing: Issues in Object Oriented Testing, Class Testing, GUI Testing, Object Oriented Integration and System Testing, Methods of test data generation and validation.
Program slicing and its application, Reliability analysis, Formal methods; verification methods; oracles.
Testing Tools: Static Testing Tools, Dynamic Testing Tools, and Characteristics of Modern Tools

TEXT BOOKS/REFERENCES:

1. William Perry, “Effective Methods for Software Testing”, John Wiley & Sons, New York, 2007.
2. CemKaner, Jack Falk, Nguyen Quoc, “Testing Computer Software”, Second Edition, Van Nostrand Reinhold, New York, 2000.
3. Boris Beizer, “Software Testing Techniques”, Second Volume, Second Edition, Van Nostrand Reinhold, New York, 1990.
4. Louise Tamres, “Software Testing”, Pearson Education Asia, 2002
5. "Software Testing: A Craftsman's Approach, Second Edition," by Paul C Jorgensen, CRC Press, June 26, 2002. (required)
6. "The Art of Software Testing," 2nd ed., Glenford J. Myers, John Wiley & Sons, Inc., Hoboken, New Jersey, 2004. (optional)
7. "Lessons Learned in Software Testing: a Context-Driven Approach," CemKaner, James Bach, and Bret Pettichord, John Wiley & Sons, Inc., New York, 2002. (optional)

CO – PO Affinity Map

PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2	PSO3
CO															
CO1	2	1			-	-	-	-	-	-		-	-	-	-
CO2	2	3	2	1		-	-	-	-	-	-	-	-	-	-

CO3		2	3			-	-	-	-	-	2	-	-	-	-
CO4		2	2	1		-	-	-	-	-	2	-	-	-	-
CO5		1	1	2	2	-	-	-	-	-	2	-	-	-	-

20CSA541 Natural Language Processing 3 0 0 3

Objectives: To explore fundamental concepts of NLP and its role in current and emerging technologies. Gain a thorough understanding of modern neural network algorithms for the processing of linguistic information.

Course Outcomes

CO1: Provides an overview of Natural Language Processing

CO2: Understand global vectors for word representations

CO3: Will be able to recognize named entity using neural networks.

CO4: Able to model languages and perform sentimental analysis.

CO5: Understand dynamic memeory networks for NLP

Syllabus

Introduction to NLP, Simple Word Vector representations: word2vec-GloVe: Global Vectors for Word Representation

Advanced word vector representations: language models, softmax, single layer networks-Neural Networks and back propagation for named entity recognition

Introduction to Tensorflow-Recurrent neural networks -- for language modelling and other tasks-RUs and LSTMs -- for machine translation-Recursive neural networks -- for parsing-Parsing with Compositional Vector Grammars-Recursive neural networks -- for different tasks (e.g. sentiment analysis)

Convolutional neural networks -- for sentence classification-The future of Deep Learning for NLP: Dynamic Memory Networks

TEXT BOOKS/ REFERENCES:

1. Jurafsky and James H. Martin. Speech and Language Processing (3rd ed.)
2. Yoav Goldberg. A Primer on Neural Network Models for Natural Language Processing
3. Ian Goodfellow, YoshuaBengio, and Aaron Courville. Deep Learning. MIT Press.

CO – PO Affinity Map

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2	PSO3
CO1	3	2	2	1	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO3	2	3	3	2	-	-	-	-	-	-	-	-	-	-	-
CO4	2	2	3	3	1	-	-	-	-	-	-	-	-	-	-
CO5	2	2	3	2	1		-	-	-	-	-	-	-	-	-

20CSA542 WIRELESS NETWORKS 300 3

COURSE OUTCOMES

CO1: Explain the concepts and features of wireless communication and transmission technologies.
CO2: Describe the design and working of different wireless communication methods, its signalling and channel access mechanism.
CO3: Describe the architecture and working of wireless communication networks and protocols.
CO4: To explore the characteristics of different types of Wireless LAN networks.
CO5: Explain the working of wireless routing protocols.

Syllabus

UNIT 1
Introduction to Wireless Systems: Brief History of Wireless Communication. Transmission Fundamentals: Time Domain, Frequency Domain, Bandwidth vs. Data Rate –Channel Capacity -Transmission Media –Protocols and TCP/IP Suite: TCP/IP Protocol Architecture -OSI Model.

UNIT 2

Antennas and Wave Propagation: Antennas, Propagation Modes, Fading in the Mobile Environment -Free Space Propagation.Modulation Techniques: Signal Encoding, Digital Data -Analog Signal, Analog Data -Analog Signal, Analog Data -Digital Signal, Frequency Hopping Spread Spectrum (FHSS), Direct Sequence Spread Spectrum (DSSS), Code Division Multiple Access (CDMA).

UNIT 3

Wireless Networking: Satellite Communications-Capacity Allocation –Frequency Division, Time Division, WiMax and IEEE 802.16 Broadband Wireless Access Standards, Cellular Wireless Networks .

UNIT 4

Wireless LAN Technology: Infrared, Spread Spectrum, Narrowband LANS-Wi-Fi and IEEE 802.11 Standard, Bluetooth and IEEE 802.15 Standard.

UNIT 5

Wireless Routing Protocols: Infrastructure, AdHoc Networks, ProActivevs. ReActive, Dynamic Source Routing(DSR), AdHoc On Demand Distance Vector (AODV),Temporarily Ordered Routing Algorithm(TORA), Destination Sequenced Distance Vector(DSDV). Case Study using NS2 / NS3.

TEXTBOOK / REFERENCES:

1. William Stallings,"Wireless Communication and Networks", Pearson Education, Third Edition, 2002.
2. Wireless Communications: Principles and Practice by Rappaport, Pearson, Second Edition.

CO – PO Affinity Map

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2	PSO3
CO1	3	1	2	-	-	-	-	-	-	-	-	-	-	-	-
CO2	2	2	1	3	-	-	-	-	-	-	-	-	-	-	-
CO3	1	1	1	3	2	-	-	-	-	-	-	-	-	-	-
CO4	1	2	3	-	1	-	-	-	-	-	-	-	-	-	-
CO5	2	2	3	1	2	-	2	1	-	-	1	1	-	-	-

20CSA543 **BIO INFORMATICS** **3-0-0-3**

Course Outcomes:

CO1	Perform DNA sequence analysis using biological sequence data from online repositories.
CO2	Perform Protein structural analysis and do protein structure prediction.
CO3	Do computer aided drug design, docking, screening, QSAR.

CO – PO Affinity Map

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2
CO1	3	2	2	2	2									
CO2	3	2	2	2	2									
CO3	3	2	2	2	2									
CO4														
CO5														

Unit I

Introduction to genes and proteins, organization of DNA, RNA and protein, Motifs, Restriction maps and Restriction enzymes, DNA sequence analysis, DNA Databases, Searching scientific information using search engines, Protein structure and function, protein sequence databases, sequence alignment, PAM matrix, Global and local alignment, BLAST: features and scores, Multiple sequence alignment, Conservation score, phylogenetic trees.

Unit II

Protein sequence analysis, hydrophobicity profiles, non-redundant datasets, Protein secondary structures, Ramachandran plot, propensity, secondary structure prediction, Protein tertiary structure, Protein Data Bank, visualization tools, structural classification, contact maps, Protein structural analysis, protein structure prediction.

Unit III

Protein stability, energetic contributions, database, stabilizing residues, stability upon mutations, Protein folding rates, proteins interactions, binding site residues, Computer aided drug design, docking, screening, QSAR.

References

1. M. Michael Gromiha, Protein Bioinformatics: From Sequence to Function, Academic Press, 2010
2 D.E. Krane and M.L. Raymer, Fundamental concepts of bioinformatics, Pearson Education Inc. 2006

20CSA544 Network Management and System Administration 3 0 0 3

COURSE OUTCOMES

CO1: Acquire the knowledge about network fundamentals and network management standards (OSI and TCP/IP).
CO2: Acquire the knowledge about network infrastructure and network security.
CO3: Acquire the knowledge about windows server fundamentals and popular windows Network services and Applications.
CO4: Understanding the concepts of Linux fundamentals and Linux installation and package management.
CO5: Understanding the concepts of User management and file management in Linux.

SYLLABUS

Basic Hardware: Network Fundamentals: Local Area Networking - Defining Networks with the OSI Model - Wired and Wireless Networks - Internet Protocol - Implementing TCP/IP in the Command Line- Working with Networking Services - Understanding Wide Area Networks - Defining Network Infrastructures and Network Security.

27 Security Fundamentals: Security Layers – Authentication – Authorization - Accounting - Security Policies - Network Security - Server and Client Protection.

Windows Server Fundamentals: Server Overview - Managing Windows Server 2008 R2 - Managing Storage - Monitoring and Troubleshooting Servers - Essential Services - File and Print Services - Popular Windows Network Services and Applications.

Linux Fundamentals: System ArchitectureDetermine and Configure Hardware Settings- Boot the System - Change Run Levels and Shut Down or Reboot System -Linux Installation and Package Management - File Systems- Create Partitions and File systems - Maintain the Integrity of File Systems - Control Mounting and Unmounting of File Systems. Manage Disk Quotas - File Permissions and Ownership - Create and Change Hard and Symbolic Links. Network Management Lab: Windows Network Configurations and Linux Network Configurations.

TEXT BOOKS/ REFERENCES:

1. 98-366: “Networking Fundamentals, Microsoft Official Academic Course (MicrosoftCorporation)”, Wiley, 2011.
2. 98-367: “MTA Security Fundamentals, Microsoft Official Academic Course(MicrosoftCorporation)”, Wiley, 2011.
3. 98-365: “Windows Server Administration Fundamentals, Microsoft Official AcademicCourse (Microsoft Corporation)”, Wiley, 2011.
4. Adam Header, Stephen Addison Schneiter, James Stanger and Bruno Gomes Pessanha,LPI “Linux certification in Nut shell”, Third edition, O’Reilly, 2010

CO POAffinity Map

PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2	PSO3
CO															
CO1	2	1	1	-	1	-	-	-	-	-	-	-	-	-	-
CO2	2	1	1	2	3	-	-	-	-	-	-	-	-	-	-

CO3	1	1	1	2	2	-	-	-	-	-	-	-	-	-	-
CO4	2	-	3	2	1	-	-	-	-	-	-	-	-	-	-
CO5	1	2	3	1	2	1	-	1	-	-	1	-	-	-	-

20CSA545 DIGITAL IMAGE PROCESSING 3 0 0 3

COURSE OUTCOMES

CO1: To enable students to learn the fundamental concepts of a digital image processing and its working protocols.
CO2: To understand image enhancement techniques in spatial and frequency domain so as to devise algorithms or mathematical models for real time image enhancement problems.
CO3: To enable students implement algorithms for handling intensive image restoration problems.
CO4: Development of segmentation algorithms used to detect and extract the region of interest from images.
CO5: Interpretation and use of feature extraction and image representation techniques to carry out image labeling and automatic image understanding.

UNIT-1
Introduction and Fundamentals of Image Processing: Origins of Digital Image Processing – Examples - Fundamental Steps in Digital Image Processing - Elements of Visual Perception - A Simple Image Formation Model - Basic Concepts in Sampling and Quantization.

UNIT-2
Representing Digital Images- Zooming and Shrinking Digital Images - Some Basic Relationships between Pixels - Linear and Nonlinear Operations - Connectivity and Relations between Pixels- Simple Operations- Arithmetic, Logical, Geometric Operations.

UNIT-3
Image Enhancement in the Spatial Domain and Frequency Domain: Some Basic Gray Level Transformations - Histogram Processing – Basics of Spatial Filtering - Smoothing Filters-Mean, Median, Mode Filters - Edge Enhancement Filters – Sobel, Laplacian, Robert, Prewitt filter, Contrast Based Edge Enhancement Techniques.

UNIT-4

Design of Low Pass Filters - High Pass Filters- Edge Enhancement - Smoothening Filters in Frequency Domain. Butter Worth Filter, Homomorphic Filters in Frequency Domain-Comparative Study of Filters in Frequency Domain and Spatial Domain.

UNIT-5

Edge Detection - Line Detection - Curve Detection - Edge Linking and Boundary Extraction -Thresholding Algorithms- Region Based Segmentation - Region Growing – Connected Components Labeling - Region Growing and Region Adjacency Graph (RAG), Split and Merge Algorithms - Morphology - Dilation, Erosion, Opening and Closing.

TEXTBOOKS:

1. Rafael C. Gonzalez and Richard E. Woods, "*Digital Image Processing*", Third Edition, Addison Wesley, 2007.

REFERENCES

2. Arthur R. Weeks, Jr., "*Fundamentals of Electronic Image Processing*", First Edition, PHI,1996.
3. Milan Sonka, Vaclav Hlavac and Roger Boyle, "*Image processing, Analysis, and Machine Vision*", Third Edition, Vikas Publishing House, 2007.

CO – PO Affinity Map

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2	PSO3
CO1	3	1	1	-	-	-	-	-	-	-	-	-	-	-	-
CO2	2	1	1	3	-	-	-	-	-	-	-	-	-	-	-
CO3	1	1	3	-	-	-	-	-	-	-	-	-	-	-	-
CO4	2	1	3	-	-	-	-	-	-	-	-	-	-	-	-
CO5	1	2	3	1	2	1	-	1	-	-	1	-	-	-	-

20CSA546 INFORMATION RETRIEVAL 3 0 0 3

COURSE OUTCOMES

CO1: Be familiar with the basic methods for information extraction and retrieval of textual data

CO2:Understand the concept of apply text processing techniques to prepare documents for statistical modelling
CO3: Must be able to evaluate the performance of machine learning models for textual data
CO4:Master the concept of machine learning models for analyzing textual data and correctly
Interpreting the results

SYLLABUS

Boolean Expression Based Retrieval: Vocabulary and Postings – Lists – Dictionaries andTolerant Retrieval – Index Construction and Compression - Scoring and Vector Space Model– Score Computation – Evaluating Information Retrieval Systems.
Relevance Feedback andQuery Expansion – XML Based Retrieval– Probabilistic Models – Language Models –Text Classification – Vector Space Classification – SVM Based Document .
–Latent Semantic Indexing – Web Search – Web Crawlers – Link Analysis – UnstructuredData Retrieval Semantic Web – Ontology - Implementations using Natural Language Toolkit.

TEXT BOOKS/ REFERENCES:

1. C. Manning, P. Raghavan and H. Schütze, "*Introduction to Information Retrieval*",Cambridge University Press, 2008.
2. R. Baeza-Yates and B. RibeiroNeto, "*Modern Information Retrieval: The Conceptsand Technology Behind Search*", Second Edition, Addison Wesley, 2011.
3. David A. Grossman and OphirFrieder "*Information Retrieval: Algorithms andHeuristics*", Second Edition, Springer 2004.

CO – PO Affinity Map

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2	PSO3
CO1	3	2	1	-	-	-	-	-	-	-	-	-	-	-	-
CO2	2	2	2	3	1	-	-	1	-	-	-	-	-	-	-
CO3	1	1	2	1	-	-	-	-	-	-	-	-	-	-	-
CO4	2	2	2	-	1	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

20CSA547 SEMANTIC WEB TECHNOLOGIES 3003

Introduction to Semantic Web: Semantic Web Concepts- Need for the Semantic Web- Information Overload - Stovepipe Systems - Poor Content Aggregation - XML and the Semantic Web - Web Services and the Semantic Web -Current Applications of the Semantic Web - Business Case for the Semantic Web Decision Support Business Development - Information Sharing and Knowledge. Understanding the Resource Description Framework: What Is RDF - Capturing Knowledge with RDF - Other RDF Features - RDF Schema – Non-Contextual Modelling. Web Ontology Language:

Motivation and Overview – The OWL Language- Defining the Ontology Spectrum - Thesaurus, Logical Theory - Ontology - Topic Maps Standards and Concepts – Occurrence – Association – Subject Descriptor – Scope.
Ontologies: Overview of Ontologies - Ontology Example – Definitions – Syntax – Structure – Semantics - and Pragmatics - Expressing Ontologies Logically - Ontology and Semantic Mapping Problem. Knowledge Representation**:** Languages - Formalisms, Logics - Description Logics - Ontology Design and Management using the Protege Editor - Ontology Reasoning with Pellet/FACT++, Ontology Querying with SPARQL.

Course Outcome

CO1: Understand the rationale behind Semantic Web.
CO2: Model ontologies using Resource Description Framework (RDF).
CO3: Design RDF Schemas for ontologies.
CO4: Model and design ontologies using Web Ontology Language (OWL).
CO5: Query ontologies using SPARQL.
CO6: Understand and reflect on the principles of Ontology Engineering.
CO7: Apply Semantic web technologies to real world applications.

PO1: Engineering Knowledge
PO2: Problem Analysis
PO3: Design/Development of Solutions
PO4: Conduct Investigations of complex problems
PO5: Modern tools usage
PO6: Engineer and Society
PO7: Environment and Sustainability
PO8: Ethics
PO9: Individual & Team work

PO10: Communication
PO11: Project management & Finance
PO12: Lifelong learning

CO – PO Affinity Map

	PO1	PO2	PO3	PO4	PO5	PO6	Po7	PO8	PO9	PO10	PO11	PO12			
CO1	1	3	3									1			
CO2		3	2	2											
CO3	1	2	2												
CO4		2	3		3										
CO5	1	2	3												
CO6	1	2	3												
CO7		2	3												

TEXT BOOKS / REFERENCES:

1. Michael C. Daconta, Leo J. Obrst and Kevin T. Smith, "*The Semantic Web: A Guide to the Future of XML, Web Services, and Knowledge Management*", Fourth Edition, Wiley Publishing, June 2003.
2. Jeffrey T. Pollock, "*Semantic Web FOR DUMMIES*", Wiley Publishing, 2009.
3. John Davies, Rudi Studer and Paul Warren John, "*Semantic Web Technologies: Trends and Research in Ontology-based Systems*", John Wiley and Sons, 2006.
4. John Davies, Dieter Fensel and Frank Van Harmelen, "*Towards the Semantic Web: Ontology-Driven Knowledge Management"*, John Wiley and Sons, 2003

20CSA548 Software Defined Network 3 0 0 3

Course Outcomes:

1. Differentiate between traditional networks and software defined networks and learn the fundamentals of software defined networks.
2. Understand advanced and emerging networking technologies, separation of the data plane and control plane.
3. Improves the advanced networking research skills.
4. Study of the SDN Programming and analyse the performance of varying and complex networking tasks.
5. Expand the knowledge learned about SDN concepts and apply it to solve real time world problems.

Module: 1

Basic Packet Switching Terminology, Historical Background, The Modern Data Center, Traditional Switch Architecture, Autonomous and Dynamic Forwarding Tables, Open Source and Technological Shifts. Why SDN?, Genesis of SDN-

Module: 2

Working of SDN- Fundamental Characteristics of SDN, SDN Operation, SDN Devices, SDN Controller, SDN Applications, Alternate SDN Methods. Introduction to OpenFlow Specification, Improving OpenFlow Interoperability, OpenFlow Limitations, Optical Transport Protocol Extensions.

Module: 3

Introduction to Open SDN and its limitations, SDN via APIs, SDN via Hypervisor Based Overlays, SDN via Opening up the Device, Introduction of SDN Controllers and its general concepts, Layer 3 Centric, Plexxi, Cisco OnePK.
Introduction of Network Programmability, Management Interface, Application-Network Divide, Modern Programmatic Interfaces, I2RS, Modern Orchestration

Module: 4

SDN in the Data Center- Introduction of Data Center and its demands, Tunneling Technologies for the Data Center, Path Technologies in the Data Center, Ethernet Fabrics in the Data Center, SDN Use Cases in the Data Center, Comparison of Open SDN, Overlays and APIs, Real-World Data Center Implementations

Module: 5

Introduction SDN application and its usages, SDN in the Data Center - SDN in Other Environments - SDN Applications - SDN Use Cases - The Open Network Operating System.

Text Books

1. Paul Goransson and Chuck Black, Software Defined Networks: A Comprehensive Approach, Second Edition, Morgan Kaufmann, 2014.
2. SDN: Software Defined Networks, An Authoritative Review of Network Programmability Technologies, By Thomas Nadeau, Ken Gray, Publisher: O'Reilly Media.
3. Foundations of Modern Networking: SDN, NFV, QoE, IoT, and Cloud 1st Edition, Kindle Edition, by William Stallings.

4. SDN and NFV Simplified: A Visual Guide to Understanding Software Defined Networks and Network Function Virtualization 1st Edition, Kindle Edition, by Jim Doherty.

CO – PO Affinity Map

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2	PSO3
CO1	3	2	2	-	-	-	-	-	-	-	-	-	-	-	-
CO2	2	3	2	3	-	1	1	-	-	-	-	-	-	-	-
CO3	1	1	3	2	2	2	-	-	1	1	-	-	-	-	-
CO4	1	1	2	2	-	-	-	-	-	-	-	-	-	-	-
CO5	1	2	3	1	1	1	-	1	-	1	1	1	-	-	-

20CSA549 OPEN SOURCE SYSTEMS 30 0 3

COURSE OUTCOMES

CO1: Understand the difference between open source software and commercial software.
CO2: Exposed to the context and operation of Open Source Communities and associated software projects.
CO3: Get familiar with participating in an open source project using Git and GitHub.
CO4: Get insights into different development models and frameworks used in open source community.
CO5: Learn open source programming using Python.

SYLLABUS

Overview of Open Source System: Definition – The FOSS Philosophy – The Free Software Foundation – Taboos and Norms in OSS Development – Open Source Software Development Models – Licensing – BSD – Linux – Apache – Mozilla.

Open Source Development: Infrastructure needed for an open-source project – Software Development Life Cycle – Building a Community – Joining an Existing Open Source Project – Ending an Open-Source Project – Open Source within a Company – Using Git and GitHub for Open Source Development - FOSS Programming in Python

Deriving a Framework for Analyzing OSS: Zachman's Framework for IS Architecture – CATWOE and Soft System Method – Deriving the Analytical Framework for OSS Environment – Classifying OSS Motivations – Technological Micro-level Motivation – Economic Micro level and Macro-level Motivation – Socio-Political Micro-level and Macro-level Motivation.

Open Source Server Applications: Infrastructure Services – Web Servers – Database Servers – Mail Servers – Open Source Desktop Applications**:** Graphical Desktops – Web Browsers – The Office Suite – Mail Clients – Personal Software – Case Studies on OSS.

TEXT BOOKS/ REFERENCES:

Joseph Feller, Brian Fitzgerald and Eric S. Raymond, "*Understanding Open Source Software Development*", Addison Wesley Professional, 2000.

E-Book "Producing Open Source Software" which is available at: https://producingoss.com/

CO – PO Affinity Map

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2	PSO3
CO1	1	1	-	-	3	-	-	-	-	-	-	-	-	-	-
CO2	1	2	3	2	3	-	-	-	-	-	-	-	-	-	-
CO3	2	1	-	-	1				-	-	-	-	-	-	-
CO4	1	1	3	-	3				-	1	1	-	-	-	-
CO5									-	-	1	-	-	-	-

20CSA550 NETWORK SECURITY 3 0 0 3

COURSE OUTCOMES

CO1: Understand network security models and analyze authentication mechanisms for challenge response scenarios.
CO2: Understand e-mail architecture and standards for securing mail communication.
CO3: Understand Internet Security Protocol and explore common solutions for security issues
CO4: Apply and analyze Web security protocols for E-Commerce applications.

SYLLABUS

Digital Signature and Authentication Schemes: Digital signature-Digital Signature Schemes and their Variants- Digital Signature Standards-Authentication: Overview- Requirements Protocols -Applications - Kerberos -X.509 Directory Services.Electronic mail security: Email Architecture -PGP – Operational Descriptions- Key management- Trust Model- S/MIME.IP Security: Overview- Architecture - ESP, AH Protocols IPSec Modes – Security association - Key management.Web Security: Requirements- Secure Sockets Layer- Objectives-Layers -SSL secure communication-Protocols - Transport Level Security. Secure Electronic Transaction- Entities DS Verification-SET processing.

TEXT BOOKS

1. Padmanabhan T R, Shyamala C K and Harini N, “Cryptography and Security”, First Edition, Wiley India Publications, 2011.
2. Stallings W, “Cryptography and Network Security”, Third Edition, Pearson Education Asia. Prentice Hall, 2000.
3. Forouzan B A, “Cryptography and Network Security”, Special Indian Edition, Tata McGraw Hill, 2007.

CO – PO Affinity Map												
PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO												
CO1	3	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-
CO3	3	3	2	-	3	-	-	-	-	-	-	-
CO4	2	2	3	2	3	-	2	-	-	2	-	1

20CSA551 DATABASE ADMINISTRATION 3003

COURSE OUTCOME

CO1:Establish and in-depth understanding of Database Administration using the Oracle DBMS interfaces.

CO2:Analyze and model requirements and constraints for the purposes of installing, configuring, and tuning a DBMS

CO3:To develop methods for implementing security, back-up and recovery measures.

CO4:To develop methods for creating and Managing Database Storage Structures and understand network responsibilities for DBA.

CO5: Acquire and apply the knowledge and skills required to Monitoring the Performance of the Database

SYLLABUS

Introduction: DBMS Architecture and Data Independence - DBA Roles and Responsibilities. SQL * PLUS Overview: SQL plus Fundamentals, Producing more readable outputs, Accepting values at Runtime, Using iSQL *Plus. Modifying Data**:** Using DML, TCL- Managing Constraints -Managing Views. User Access and Security**:** Creating and Modifying User Accounts, Managing User Groups with Profiles. Oracle Overview and Architecture**:** Overview of Logical and Physical Storage Structures. Managing Oracle Instances. Control and Redo Log Files: Managing the Control Files. Managing Tables, Indexes and Constraints. Managing Users and Security. Introduction to Network Administration: Network Design Considerations, Network Responsibilities for the DBA, Network Configuration, Overview of Oracle Net Features, Oracle Net Stack Architecture. Backup and Recovery Overview: Defining a Backup and Recovery Strategy, Disaster Recovery, Replication Strategies Testing-The Backup and Recovery Plan. Introduction to Performance Tuning**:** Brief Overview of Tuning methodology, General Tuning Concepts.

TEXT BOOKS/REFERENCES:

1. Craig S. Mullins, "*Database Administration: The Complete Guide to DBA Practices andProcedures*", Second Edition, Addison Wesley, 2012.
2. C.J. Date, "*Introduction to Database Systems*", Eighth Edition, Addison Wesley, 2003.
3. Chip Dawes, Biju Thomas, "*Introduction to Oracle 9i SQL*", BPB, 2002.
4. Bob Bryla, Biju Thomas, "*Oracle 9i DBA Fundamental I*", BPB, 2002.

CO – PO Affinity Map												
PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	1	-	-	-	-	-	-	-	-	-	-
CO2	1	3	2	1	-	-	-	-	-	-	-	-
CO3	1	1	3	-	-	-	-	-	-	-	-	-
CO4	1	1	3	-	-	-	-	-	-	-	-	-
CO5	1	2	3	1	-	-	-	-	-	-	-	-

20CSA552 **PATTERN RECOGNITION 3 0 03**

OBJECTIVE

The objective of this course is to equip students with mathematical and statistical techniques used in pattern recognition and enable students to develop machine learning algorithms for real life problems.

COURSE OUTCOMES

CO1: Understand the concept of a pattern and the basic approach to the development of pattern recognition and machine intelligence algorithms and applications of PR system

CO2: Understand the basic methods of feature extraction, feature evaluation, analyseand relate research in the pattern recognition area.

CO3: Understand and apply both supervised and unsupervised classification methods to develop PR system in real-world data

CO4: Apply pattern recognition techniques to real-world problems such as object detection and recognition

CO5: Implement simple pattern classifiers, classifier combinations, and structural pattern recognizers

CO6: Summarize, analyze, and relate research in the pattern recognition area verbally and in writing

Introduction to Pattern Recognition- Tree Classifiers Getting our feet wet with real classifiers-Decision Trees: CART, C4.5, ID3- Random Forests-Bayesian Decision Theory Grounding our inquiry- Linear Discriminants Discriminative Classifiers: the Decision Boundary,Separability, Perceptrons, support Vector Machines, Parametric Techniques Generative Methods grounded in Bayesian Decision Theory, Maximum Likelihood Estimation- Bayesian Parameter Estimation. Non-Parametric Techniques- Kernel Density Estimators- Nearest Neighbor Methods - Unsupervised Methods Exploring the Data for Latent Structure - Component Analysis and Dimension Reduction- The Curse of Dimensionality, Principal Component Analysis, Fisher Linear Discriminant, Locally Linear Embedding, Clustering, K-Means,. Expectation Maximization, Mean Shift, Classifier Ensembles, Bagging, Boosting / AdaBoost.

Text Books

1. Duda, Hart and Stork, Pattern Classification, Second Edition, Wiley, 2001.
2. T.M. Mitchell, Machine learning, McGraw-Hill, New York, 1997.
3. S. Theodoridis, K. Koutroumbas, Pattern recognition, Academic Press, 1999.

CO – PO Affinity Map

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	2	1	1	-	-	-	-	-	-	-	-	-	-	-
CO3	1	1	3	3	1	-	-	-	-	-	-	-	-	-	-
CO4	2	1	3	2	-	-	1	-	-	-	-	-	-	-	-
CO5	1	2	3	1	2	1	-	1	-	-	1	-	-	-	-
CO6	1	-	2	1	1	-	1	-	2	1	1	1			

20CSA553BLOCKCHAIN TECHNOLOGIES 3-0-0-3

COURSE OBJECTIVES

By the end of the course, students will be able to understand

1. Basic Cryptographic primitives used in Blockchain – Secure, Collison-resistant hash functions, digital signature, public key cryptosystems, zero-knowledge proof systems
2. Basic Distributed System concepts – distributed consensus and atomic broadcast, Byzantine fault-tolerant consensus methods
3. Basic Blockchain (Blockchain 1.0) – concepts germane to Bitcoin and contemporary proof-of-work based consensus mechanisms, operations of Bitcoinblockchain, crypto-currency as application of blockchain technology
4. Blockchain 2.0 – Blockchains with smart contracts and Turing complete blockchain scripting – issues of correctness and verifiability, Ethereum platform and its smart contract mechanism
5. Blockchain 3.0 – Plug-and-play mechanisms for consensus and smart contract evaluation engines, Hyperledger fabric platform
6. Beyond Cryptocurrency – applications of blockchain in cyber security, integrity of information, E-Governance and other contract enforcement mechanisms
7. Limitations of blockchain as a technology, and myths vs. reality of blockchain technology

8. Research directions in Blockchain technology

COURSE OUTCOMES

- Explain design principles of Bitcoin and Ethereum.
- Explain Nakamoto consensus.
- Explain the Simplified Payment Verification protocol.
- List and describe differences between proof-of-work and proof-of-stake consensus.
- Interact with a blockchain system by sending and reading transactions.
- Design, build, and deploy a distributed application.
- Evaluate security, privacy, and efficiency of a given blockchain system

SYLLABUS

Introduction: Need for Distributed Record Keeping, Modeling faults and adversaries, Byzantine Generals problem, Consensus algorithms and their scalability problems, Why Nakamoto Came up with Block chain based crypto currency? Technologies Borrowed in Block chain – hash pointers, consensus, byzantine fault-tolerant distributed computing, digital cash etc.

Basic Distributed Computing: Atomic Broadcast, Consensus, Byzantine Models of fault tolerance

Basic Crypto primitives: Hash functions, Puzzle friendly Hash, Collison resistant hash, digital signatures, public key crypto, verifiable random functions, Zero-knowledge systems

Blockchain1.0 : Bitcoinblockchain, the challenges, and solutions, proof of work, Proof of stake, alternatives to Bitcoin consensus, Bitcoin scripting language and their use

Blockchain 2.0: Ethereum and Smart Contracts, The Turing Completeness of Smart Contract Languages and verification challenges, Using smart contracts to enforce legal contracts, comparing Bitcoin scripting vs. Ethereum Smart Contracts

Blockchain 3.0: Hyperledger fabric, the plug and play platform and mechanisms in permissioned blockchain

Privacy, Security issues in Blockchain: Pseudo-anonymity vs. anonymity, Zcash and Zk-SNARKS for anonymity preservation, attacks on Blockchains – such as Sybil attacks, selfish mining, 51% attacks - -advent of algorand, and Sharding based consensus algorithms to prevent these.

Text Books:

[1]. Imran Bashir, Mastering Blockchain, Packt Publishing, 2018.
[2]. Drescher, Daniel. "Blockchain basics", Apress, 2017.

Reference Book:

[1]. Josh Thompson, 'Blockchain: The Blockchain for Beginnings, Guild to Blockchain Technology and Blockchain Programming', Create Space Independent Publishing Platform, 2017.

20CSA554 OPERATIONS RESEARCH AND OPTIMIZATION TECHNIQUES 3 0 0 3

Course Objective: This Course deals with the optimization techniques and tools used for operations research. Students would be able to acquire skill and knowledge for various optimization techniques .

Course Outcome: Getting Familiarise the concept of operations research. Gives an overview of the various manual techniques used for solving the different types of problems in operations research.

Formulation Of LPP-Graphical Solution Of LPP – Canonical And Standard Form Of LPP-Simplex Method-Big M Method- Two Phase Method-Principle Of duality-Dual Simplex Method.Transportation Problem-Initial Basic Feasible Solution-North West Corner Rule-Vogel's.Approximation Method –Tests For Optimality-Unbalanced Transportation Problem-Assignment Problem-Travelling Salesman Problem. Decision Theory-Decision making under risk-EMV-EOL-EVPI criteria-decision tree analysis,Game Theory, Queuing Theory.

TEXT BOOKS/ REFERENCES:

1. Sastry S.S., Numerical Analysis, Prentice-Hall India , 4th edition
2. KanthiSwarup, P.K.Gupta,Man Mohan, Operations research, Sultan Chand & Sons, 5th edition.
3. R Panneerselvam – Operations research, 2nd edition, PHI

4. Froberg, Introduction to Numerical Analysis-Second Edition, Addition Wesley
5. Gerald and Wheatley, Applied Numerical Analysis, Pearson Education Asia, Sixth Edition
6. S.S Rao, Optimization Theory and Applications, Wiley Eastern
7. Grawin W. W, Introduction of Linear Programming, McGraw Hill.

ManagementElective IV

20HU531 PRINCIPLES OF ECONOMICS AND MANAGEMENT 3003

CO 1: Define and explain how basic concepts of microeconomics (such as elasticity, scarcity or choice) can be used to explain the behaviour of individuals, household or firms.
CO 2: Represent supply and demand, in graphical form, including the downward/upward slope of the curves and what shifts/moves along the curves.
CO 3: To understand the importance of market structures, on the question of the stability and failure of markets.
CO 4: Describe and explain how basic macroeconomic policies (such as fiscal or monetary) can be used to analyse the economy as a whole.
CO 5: Explain basic management, business and marketing principles to be able to continue studies on a higher level.
CO 6: To understand the role of PESTLE factors on the SWOT of corporations, in the domestic and the international business environment.

SYLLABUS:

Introduction to Management: Managers and Management - History Module - The Historical Roots of Contemporary Management Practices, The Management Environment.
Planning: Foundations of Planning - Foundations of Decision Making - Quantitative Module Quantitative Decision-Making Aids. Organizing: Basic Organization Designs - Staffing and Human Resource Management - Career Module Building Your Career - Managing Change, Stress, and Innovation .Leading-Foundations of Individual and Group Behavior - Understanding Work Teams – Motivating and Rewarding Employees - Leadership and Trust - Communication and Interpersonal Skills.

Introduction to Economics: The Firm and Its Goals - Review of Mathematical Concepts usedin Managerial Economics, Supply and Demand - The Mathematics of Supply and Demand,Demand Elasticity - Applications of Supply and Demand, Demand Estimation andForecasting, The Theory and Estimation of Production - The Multiple-Input Case -Expressing the Production Function with the Use of Calculus, The Theory and Estimation of cost - A Mathematical Restatement of the Short-Run Cost Function - The Estimation of Cost.

Pricing and Output Decisions: Perfect Competition and Monopoly - The Use of Calculus in Pricing and Output Decisions - Break-Even Analysis (Volume-Cost-Profit), MonopolisticCompetition and Oligopoly - Special Pricing Practices.

TEXT BOOKS/REFERENCES

1. Stephen P, Robbins David A. De Cenzo, “Fundamentals of Management”, Prentice Hall, Sixth Edition, 2008.
2. Philip K. Y. Young, Steve Erfle and Paul G. Keat, “Managerial Economics: Economic Tools for Today's Decision Makers”, Pearson, Seventh Edition, 2013.

CO – PO Affinity Map

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO 2	PSO 3
CO1	3	2	2	2	-		1	-	-	-	-	-	-	-	-
CO2	2	2	1	2	1	1	2	-	-	-	-	-	-	-	-
CO3	1	2	1	2	1	-	-	1	-	-	-	-	-	-	-
CO4	2	1	1	3	1	2	1	1	1	1	1	-	-	-	-
CO5	2	3	2	1	2	1	1	1	-	2	1	1	-	-	-

20HU532 SOFTWARE PROJECT MANAGEMENT 3 0 0 3

COURSE OUTCOMES

CO1: To understand the basics of software project management activities for the success of project

CO2: Project Evaluation and programme management techniques

CO3: Understand the basic steps that need to be carried out by a manager in project planning and the right selection of process development models.

CO4: Focus on effort and duration estimation techniques.

CO5: Understand project activity planning based on estimations

CO6: To study various risk management approaches and its simulations

CO7: Resource allocations and issues

CO8: Project monitoring and control issues and techniques for configuration management.

CO9: To understand software quality management and team management

SYLLABUS

Introduction to Software Project Management: Software Projects-Other Types of Projects -Problems with Software Projects. Project Evaluation and Programme Management: Evaluation of Individual Projects – Cost Benefit Evaluation Techniques – Risk Evaluation. Step Wise: An Overview of Project Planning. Selection of an Appropriate Project Approach: Build or Buy? - Waterfall Model – Spiral Model – Prototyping – Incremental Delivery –RAD – Agile Methods – XP - Scrum. Software Effort Estimation**:** Bottom up Estimating – Top down Estimating – FP Analysis –COCOMO II – Cost Estimation**.** Activity Planning**:** Project Schedules - Sequencing and Scheduling Projects - Network Planning Models – AOA – AON - CPM - Shortening Project Duration – Crashing - Identifying Critical Activities. Risk Management: A Framework for Dealing with Risk – Risk Management **–** PERT. Resource Allocation**:** Identifying Resource Requirements – Scheduling Resources –Publishing Resource Schedule – Cost Schedule. Monitoring and Control: Visualizing Progress - Earned Value Analysis. Managing People in SW Environments: Organizational Behavior – Motivation. Working in Teams: Organizing Teams. Software Quality Management: Defining Software Quality – Metrics – Process Capability Models – Software Reliability. Case Study: PMBOK - MS Project.

TEXTBOOK / REFERENCES:

1. Mike Cotterell and Bob Hughes, "*Software Project Management*", Fifth Edition, Tata McGraw-Hill, 2010.
2. Roger S. Pressman, "*Software Engineering a Practitioner's Approach*", Seventh Edition, Tata McGraw-Hill, 2010.
3.Jalote P, "*Software Project Management in Practice",* Addison Wesley, 2002

CO – PO Affinity Map

PO	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2	PSO3
CO															
CO1		3	2	3	-	-	-	-	-	-	2	-	-	-	-
CO2	1	3	3	2		-	-	-	-	-	-	-	-	-	-
CO3		3		2		-	-	-	-	-	2	-	-	-	-
CO4	1	3		3		-	-	-	-	-	2	-	-	-	-
CO5		3	3	3		-	-	-	-	-	2	-	-	-	-

CO6		3		3		-	-	-	-	-	2	-	-	-	-
CO7		3	2								2				
CO8	1	3	3												
CO9	1	3	3												

20HU533MANAGEMENT INFORMATION SYSTEMS 3 0 0 3

COURSE OUTCOMES

CO1: To educate the role, advantages and components of an Information System
CO2: Provide knowledge about new methodologies and strategies to improve efficiency and efficacy of business models.
CO3: To learn different types of systems that supports in managing different levels of organization.
CO4: Acquire knowledge in integrating methodologies with functional areas and decision-making process in an organization
CO5: To learn role of Information System techniques in achieving competitive advantage of an organization.

Introduction to Information System Concepts -Definition to MIS, Role and Impact-Role of Computers in MIS, Management Practices. Strategic Management of Business -The Concept of Corporate Planning -Essentiality of Strategic Planning -Development of Business Strategies and Types of Strategies. Decision Making -Information Concepts -Systems –Concepts –Controls –Types of System - Role and advantages of Transaction Processing System, Management Information System, Expert Systems and Artificial Intelligence, Executive Support Systems and Strategic Information Systems. Business Process Re-engineering –Introduction –Business Process –Process Model of the Organization. Decision Support System –Concepts and Philosophy –DSS Deterministic System –MIS and Role of DSS. Introduction to Enterprise Management technologies - Total Quality Management and Enterprise Management System viz. ERP, SCM, CRM and Ecommerce.

TEXTBOOK / REFERENCES:

1.W.S. Jawadekar, Management Information System Second Edition: Tata McGraw-Hill 5th Edition.

2.Ashok Arora, AkshayaBhatiya, Management Information System, Excel Books.

3. Management Information Systems, James A. O'Brein, Tata McGraw-Hill

CO – PO Affinity Map												
P1O	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2		1		1				1		1
CO2	3	2	3	2	2		-	1	1	-	2	1
CO3	2	1	1	1	-	-	-	2	-	-	1	1
CO4	1	2	1	1	2	1	2	1	-	1	1	-
CO5	2	1	2	1	-	1	1	2	-	1	1	2

20HU534 Management & Organizational Behaviour 3 0 0 3

CO1: Understand the concepts related to Business and demonstrate the roles, skills and functions of management.
CO2: Demonstrate the applicability of the concept of organizational behaviour to understand the behaviour of people in the organization.
CO3: Analyse the complexities associated with management of the group behaviour in the organization.
CO4: Demonstrate how the organizational behavior can integrate in understanding the motivation (why) behind behavior of people in the organization.

Unit – 1 Introduction to Management

Management: Introduction, Definition of management, Nature, Purpose and Functions, Levels and types of managers, managerial roles, skills for managers, evolution of management thought, Fayol's fourteen principles of management, Recent trends in management.

Unit-2 Managerial Functions

Planning : Nature of Planning, Planning Process, Objectives, MBO, Strategies, level of strategies, **Organizing**: Formal and informal organizations, Principles of organizations-chain of command, span of control, delegation, decentralization, and empowerment, **Staffing**: definition – importance of staffing – recruitment & selection – training & development, **Controlling**: definition – importance – characteristics & limitations.

Unit- 3 Introduction to OB

Introduction: Organizational Behaviour: Introduction, definition, historical development, fundamental principles of OB, contributing disciplines, challenges and opportunities. Foundations of Individual Behaviour: Individual behaviour:Foundations of individual behaviour.. Ability: Intellectual abilities, Physical ability, the role of disabilities. Personality: Meaning, formation, determinants, traits of personality, big five and MBTI, personality attributes influencing OB.

Unit - 4 GroupBehaviour

Organization structure – Formation – Groups in organizations – Influence – Group dynamics – Emergence of informal leaders and working norms - Leadership styles – Group decision making techniques – **Team building -** Organizational behaviour modification - Interpersonal relations – Communication – Control.

Unit - 5 Dynamics of organizational behaviour

Organizational culture and climate – Factors affecting organizational climate – Importance - Job satisfaction – Determinants – Measurements – Influence on behaviour, Organizational change – Importance – Stability Vs Change – Proactive Vs Reaction change – the change process – Resistance to change – Managing change, Stress – Work Stressors – Prevention and Management of stress – Balancing work and Life, Organizational development – Characteristics – objectives –. Organizational effectiveness

TEXT BOOKS

1. Stephen P. Robins, Organisational Behavior, PHI Learning / Pearson Education, 11th edition, 2008.
2. Fred Luthans, Organisational Behavior, McGraw Hill, 11th Edition, 2001

REFERENCES

1. Schermerhorn, Hunt and Osborn, Organisational behavior, John Wiley, 9th Edition, 2008.
2. UdaiPareek, Understanding OrganisationalBehaviour, 2nd Edition, Oxford Higher Education, 2004.
3. Mc Shane & Von Glinov, OrganisationalBehaviour, 4th Edition, Tata McGraw Hill, 2007.
4. Hellrigal, Slocum and Woodman, Organisational Behavior, Cengage Learning, 11th Edition 2007.
5. Ivancevich, Konopaske&Maheson, OranisationalBehaviour& Management, 7th edition, Tata McGraw Hill, 2008.

CO – PO Affinity Map

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2	PSO3
CO1	3	1	1	-	-	3	2	-	-	1	-	1	-	-	-
CO2	3	1	1	3	-	1	-	-	2	1	-	2	-	-	-
CO3	2	3	1	-	-	2	2	-	-	2	3	-	-	-	-
CO4	2	1	3	-	-	1	-	-	-	1	-	2	-	-	-
CO5	1	2	3	3	-	2	-	1	-	3	3	-	-	-	-

20HU535 BUSINESS INTELLIGENCE 3 0 03

CO1: Understand the Business Intelligence Framework and its applications
CO2: Learn Data Modeling, Representation and Transformation of data for BI
CO3: Understand Multidimensional Modeling, ETL and Transformations in SSIS with a knowledge of SSIS architecture and its parts
CO4: Understand the OLAP operations of a data warehouse, its schemas and implementation
CO5: Learn business metrics, frameworks, enterprise reporting and dashboards using SSAS and SSRS

Introduction to Business Intelligence: Introduction to OLTP and OLAP, BI Definitions & Concepts, Business Applications of BI, BI Framework, Role of Data Warehousing in BI, BI Infrastructure Components – BI Process, BI Technology, BI Roles & Responsibilities

3-tier data warehouse architecture, Data Marts Data integration: Basics of Data Integration (Extraction Transformation Loading)- Concepts of data integration need and advantages of using data integration. Introduction to common data integration approaches, Introduction to ETL using SSIS, Introduction to data quality, data profiling concepts and applications. Introduction to Multi-Dimensional Data Modeling-Introduction to data and dimension modeling, multidimensional data model, ER Modeling vs. multi-dimensional modeling, OLAP operations, concepts of dimensions, facts,

cubes, attribute, hierarchies, star and snowflake schema, OLAP Servers – MOLAP, ROLAP, OLAP query model and query processing, indexing OLAP Data, Data Warehouse Implementation

Introduction to business metrics and KPIs, creating cubes using SSAS. Basics of Enterprise Reporting- Introduction to enterprise reporting, concepts of dashboards, balanced scorecards, introduction to SSRS Architecture, enterprise reporting using SSRS.

TEXT BOOKS/ REFERENCES:

1. Loshin D, "Business Intelligence", First Edition, Elsevier Science (USA), 2003.
2. Jiawei Han, MichelineKamber and Jian Pei, "Data mining concepts and Techniques",Third Edition, Elsevier Publisher, 2006.
3. Biere M, " Business intelligence for the enterprise", Second Edition, IBM Press,2003.
4. Moss L T, Atre S, "Business intelligence roadmap", First Edition, Addison-WesleyLongman Publishing Co., Inc. 2003.

CO – PO
Affinity Map

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2	PSO3
CO1	2	-	3	-	3	-	-	-	-	-	-	-	-	-	-
CO2	-	2	3	3	-	-	-	-	-	-	-	-	-	-	-
CO3	-	2	3	3	-	-	-	-	-	-	-	-	-	-	-
CO4	1	1	3	-	3	-	2	-	1	-	-	-	-	-	-
CO5	2	2	3	1	3	1	2	1	-	1	1	1	-	-	-

OPEN LAB

20CSA682 R Programming Lab 0 0 11

Course Outcomes

CO1: Learn the basic syntax of R programming language in RStudio environment

CO2: Pre-process raw data in R for further analysis.
CO3: Conduct exploratory data analysis and create insightful visualizations to identify patterns.
CO4: Introduce machine learning algorithms for supervised and unsupervised learning.
CO5: Evaluate the performance of models and degree of certainty of predictions

Syllabus

Unit 1

Introduction to Data Science Process – Loading Data in R – Exploring Data – Managing Data

Unit 2

Modeling Methods – Choosing and evaluating models – Data Driven Models – Supervised Learning techniques – Unsupervised Learning – Ensemble Models

Unit 3

Delivering Results – Documentation and Deployment – Producing Effective Reports and Visualizations

TEXTBOOKS

1. "R for Data Science", Hadley Wickham and Garett Grolemund, , O'Reilly, 2017
2. "Data Mining for Business Analytics: Concepts, Techniques and Applications in R", GalitShmueli, et al, Wiley India, 2018.
3. "Practical Data Science with R", Nina Zumel and John Mount, Dreamtech/Manning, 2014

CO – PO Affinity Map															
PO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS01**	**PS O2**	**PS O3**
CO															
CO1	2	2	2	1	3	-	-	-	2	-	-	-	-	-	-
CO2	2	3	2	2	3	-	-	-	3	-	-	-	-	-	-
CO3	2	3	3	3	3	-	-	-	3	3	-	-	-	-	-
CO4	3	3	3	3	3	-	-	-	3	-	-	-	-	-	-
CO5	3	3	3	3	3	-	-	2	3	2	-	-	-	-	-

20CSA683 MATLAB PROGRAMMING 0 0 1 1

Introduction to MATLAB, Installation, basic features, MATLAB Desktop, command window, workspace, current directory, data types, matrices, control flow and operators, strings, graphics, basic plotting, mathematical functions, programmers toolbox, array operations and linear equations, M-file scripts, debugging, solving linear systems, polynomials, Eigen values, Eigen vectore, interpolation, least square regression, root finding methods.

20CSA684 HIGH PERFORMANCE COMPUTING LAB 0 0 1 1

Introduction to parallel computing, introduction to OPENMP, OPENMP paradigms, parallel regions, multi-threading, data sharing attribute clauses, worksharing, OPENMP reduction, runtime functions, OPENMP exercises to illustrate for loop, sections, critical section, synchronization. Divide and conquer strategies using OPENMP. Introduction to MPI, basics of MPI, MPI function call, example programs on MPI and OPENMP+MPI.

20CSA685 Natural Language Processing Lab 0 0 1 1

Objectives: To acquire practical knowledge about the fundamental concepts of NLP and its role in current and emerging technologies. Gain practical understanding of modern neural network algorithms for the processing of linguistic information.

Course Outcomes

CO1: Basic practical understanding of Natural Language Processing
CO2: Understand global vectors for word representations
CO3: Will be able to recognize named entity using neural networks.
CO4: Able to model languages and perform sentimental analysis.
CO5: Able to use CNN for sentence classification

Syllabus

1. Understand and implement word2vec
2. Understand the skip-gram method in word2vec
3. Understand and implement GloVe using gradient descent and alternating least squares
4. Use recurrent neural networks for named entity recognition
5. Understand and implement recursive neural tensor networks for sentiment analysis
6. CNN for sentence classification

CO – PO Affinity Map

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2	PSO3
CO1	3	2	2	2	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	3	3	2	-	-	-	-	-	-	-	-	-	-
CO3	3	3	3	3	2	-	-	-	-	-	-	-	-	-	-
CO4	2	3	3	3	2	-	-	-	-	-	-	-	-	-	-
CO5	3	3	3	3	3		-	-	-	-	-	-	-	-	-

20CSA686 CYBER SECURITY LAB 0 0 1 1

COURSE OUTCOMES

CO1: Understand the causes of basic security vulnerabilities and how they are exploited
CO2: Understand the basic security issues in web and its countermeasures
CO3: Develop skills in using security-oriented development
CO4: Develop the skill to test the security vulnerabilities in a system

SYLLABUS

Security Issues in C Language: String Handling, Avoiding Integer Overflows and Underflows and Type Conversion Issues- Memory Management Issues, Code Injection Attacks, Canary based countermeasures using StackGuard and Propolice. Buffer Overrun- Stack overrun, Heap Overrun,

Array Indexing Errors, Format String Bugs. Socket Security, Avoiding Server Hijacking, Securing RPC, ActiveX and DCOM Database and Web-specific issues: SQL Injection Techniques and Remedies, Race conditions, Time of Check Versus Time of Use and its protection mechanisms. Validating Input and Inter-process Communication, Securing Signal Handlers and File Operations. XSS scripting attack and its types – Persistent and Non persistent attack XSS Countermeasures and Bypassing the XSS Filters.Defence in Depth and Principle of Least Privilege. Secure Coding Techniques: Protection against DoS attacks, Application Failure Attacks, CPU Starvation Attacks, ARP Spoofing and its countermeasures. Buffer Overrun- Stack overrun, Heap Overrun, Array Indexing Errors, Format String Bugs

TEXT BOOKS

1. Michael Howard , David LeBlanc, "Writing Secure Code", Microsoft Press, 2nd Edition, 2003
2. Robert C.Seacord, " Secure Coding in C and C++", Pearson Education, 2nd edition, 2013
3. Julia H. Allen, Sean J. Barnum, Robert J. Ellison, Gary McGraw, Nancy R. Mead, " Software Security Engineering : A guide for Project Managers", Addison-Wesley Professional, 2008
4. Buffer Overflow Attacks: Detect, Exploit, Prevent by Jason Deckar,Syngress,1st Edition, 2005
5. Threat Modeling, Frank Swiderski and Window Snyder,Microsoft Professional, 1st Edition, 2004

CO – PO Affinity Map												
PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO												
CO1	3	1	-	-	3	1	-	-	-	-	-	-
CO2	3	1	-	-	3	1	-	-	-	-	-	-
CO3	1	3	3	1	3	2	2	-	-	3	-	-
CO4	1	3	3	2	3	3	2	-	-	3	1	-

20CSA687 DEEP LEARNING LAB 0011

COURSE OUTCOMES

CO1:To know the main techniques in deep learning and the main research in this field.

CO2: Be able to design and implement deep neural network systems.

CO3: Engineering and training neural networks for various application domains.

CO4: Use deep Learning technologies throughout most of machine learning pipeline.

CO5: To learn how to develop algorithms for resolving huge data processing problems.

SYLLABUS

1. CNNs for Hand-written digit recognition using Tensor flow.
2. CNNs for Hand-written digit recognition using Keras.
3. Simple image classification with Inception Model.
4. Demonstrate use of GoogleNet and Hyper-parameter Optimization..
5. Demonstrate use of AlexNet and Hyper-parameter Optimization.
6. Create CONV layer of a CNN.
7. Display details of CONV layer of a CNN.
8. Demonstrate use of Stride and Pad for CONV layers of a CNN.
9. Neuron view of the convolution layer.
10. RELU in CNNs.
11. Pooling and fully connected layers in CNNs
12. Classify movie reviews — binary classification using Keras.
13. Python Code: RNNs for Hand-written digit recognition using Tensorflow
14. Python Code: Bi-directional RNNs for Hand-written digit recognition using Tensorflow
15. Python Code: Next word prediction using RNNs

TEXT BOOKS/ REFERENCES:

1. Domingos, Pedro. "A few useful things to know about machine learning." *Communications of the ACM* 55.10 (2012): 78-87.
2. Li Fei-Fei (Stanford), Rob Fergus (NYU), Antonio Torralba (MIT), “Recognizing and Learning Object Categories” (Awarded the Best Short Course Prize at ICCV 2005).
3. Baydin, AtilimGunes, Barak A. Pearlmutter, and Alexey AndreyevichRadul. "Automatic differentiation in machine learning: a survey." *arXiv preprint arXiv:1502.05767* (2015).
4. Bengio, Yoshua. "Practical recommendations for gradient-based training of deep architectures." *Neural Networks: Tricks of the Trade*. Springer Berlin Heidelberg, 2012. 437-478.
5. LeCun, Yann A., et al. "Efficient backprop." *Neural networks: Tricks of the trade*. Springer Berlin Heidelberg, 2012. 9-48.

6. Simonyan, Karen, Andrea Vedaldi, and Andrew Zisserman. "Deep inside convolutional networks: Visualising image classification models and saliency maps." *arXiv preprint arXiv:1312.6034* (2013).
7. Zeiler, Matthew D., and Rob Fergus. "Visualizing and understanding convolutional networks." *Computer vision–ECCV 2014*. Springer International Publishing, 2014. 818-833.
8. Springenberg, Jost Tobias, et al. "Striving for simplicity: The all convolutional net." *arXiv preprint arXiv:1412.6806* (2014).
9. Russakovsky, Olga, et al. "Imagenet large scale visual recognition challenge." *International Journal of Computer Vision* 115.3 (2015): 211-252.

CO – PO Affinity Map

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2	PSO3
CO1	3	1	1	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	1	3	-	-	-	-	-	-	-	-	-	-	-
CO3	2	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	1	3	1	1	-	-	-	-	-	-	-	-	-	-
CO5	2	2	2	1	3	1	-	1	-	-	1	-	-	-	-